AmbujaNeotia

THE NEOTIA UNIVERSITY

ज्ञानम् आत्म प्रदीपाय

AmbujaNeotia

NEOTIA INSTITUTE OF TECHNOLOGY MANAGEMENT AND SCIENCE (Formerly ITME. Since 2002.)

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ANURANAN

An e-Magazine of Science, Engineering & Technology

School of Science & Technology

and

School of Maritime Studies

Diamond Harbour Road, Sarisha, West Bengal 743368

www.tnu.in www.nitmas.edu.in

FOREWORDS

I personally happy to learn that the School of Science and Technology and School of Maritime Studies of our University is going to publish its first e-magazine '**Anuranan**' on this month i.e. September-2021. In fact, the word **'Anuranan'** represent the resonance and to me it is the resonance of ideas and dreams.

I like to start my writing with a quote of a famous Scientist and Philosopher of all ages, who quoted;

"We owe a lot to the ancient Indians, teaching us how to count. Without which most modern scientific discoveries would have been impossible." ***– Albert Einstein***

It is well established that the Indian civilization is one of the oldest civilizations of the world due to its strong tradition of science & technology. The ancient India had contributed **sixteen original ideas** those have enriched the thinking processes. These are; ***'Zero', 'Decimal System', 'Numeral Notations', 'Fibbonacci Numbers', 'Binary Numbers', 'Chakravala method of Algorithms', 'Ruler Measurements', 'Theory of Atom', 'Heliocentric Theory', 'Wootz Steel', 'Smelting of Zinc', 'Seamless Metal Globe', 'Iron-Cased Rockets' 'Plastic Surgery', 'Cataract Surgery'*** and ***'Ayurveda***'.

The pursuits of knowledge on science and technology started from 'Fact and Principle', 'Inquiry and Discovery', 'Experiments and Speculation'. Integration of these is the father of modern science and technology.

After independence pursuits of knowledge on science and technology was initiated by our first Prime Minister, Late Jawaharlal Nehru who promoted higher education in science and technology though high ranking institutions during 1950-60. One of such reformation was setting up the five 'Indian Institute of Technology' in various parts of the country for promoting technical education. In addition to these several 'Regional Engineering Colleges', (now National Institutes of Technology) emerged to trained the young generations for economic restructuration of the country. Various scientific programs like space program, nuclear programs etc. also initiated to take the country in the global technological forum.

In our University we have introduced several modern science and technological program to train our future citizen such that they can contribute for the benefit of humanity and society. The COVID-19, pandemic situation teaches us lots and accustomed us in using the virtual systems. In reality we are now controlled by the technologies. The days are coming when every aspect will be controlled under the 'Artificial Intelligence'.

The e-magazine **'Anuranan'** will represent a resonance of thought process of the entire community of our University which will;

- Provide a media for resonance of thinking on modern science and technology for translating knowledge.
- Increase connectivity among the teachers, students in enriching thought process.
- Welcome new ideas to visualize 'Extra Personal World'

The publication of such a e-magazine will not the possible without the strong support from the entire academic community of our University in general and Director, faculty members and the students of the Science and Technology School and School of Maritime Studies in particular. Thus, I would like to express my gratefulness to all our colleague and students for this publication. I personally hope that this e-magazine will publish regularly containing new ideas and thoughts and will establish a strong connectivity among students, teachers in pursuing knowledge from physics to philosophy, chemistry to chemical technology, mathematics to data science, mechanical to mechatronics, integration of these will represent a modern knowledge based civilization.

Prof. B. Ghosh, D.Sc.(Engg.)
Vice Chancellor
The Neotia University

CHIEF-EDITOR'S MESSAGE

PROF. (DR.) SUSANTA MITRA
Pro- Vice Chancellor and Director
School of Science & Technology
The Neotia University

It was a different feeling of happiness altogether for me when we could finally decide upon to start an e-magazine jointly by the School of Science and Technology and School of Maritime Studies. Now, I am extremely delighted to know that the Faculty members and students of the academic units of these two schools are going to bring out the coveted first e-magazine issue on the **Engineers' Day, 15th September 2021**.

Development is required in every individual to every nation in all aspects and for development to happen, science and technology go hand in hand. Merging **S**cience, **T**echnology, **E**ngineering, and **M**athematics, **STEM** education can help us to solve the challenges that the world faces today. Science gives learners an in-depth understanding of the world around us. It helps them to become better at research and critical thinking. Technology prepares young people to work in an environment full of high-tech innovations. Engineering allows students to enhance problem-solving skills and apply knowledge in new projects. Mathematics enables people to analyse information, eliminate errors, and make conscious decisions when designing solutions. **STEM** education links these disciplines including Biotechnology, Physics and Chemistry into a cohesive system. The **STEM** approach to education fosters creativity and divergent thinking alongside fundamental disciplines. Project-based learning and problem-solving equips learners to respond to real-world challenges. The courses covered under the two schools well fit into the **STEM** or its variation like **STREM** (**S**cience, **T**echnology, **R**obotics, **E**ngineering and **M**athematics). The industries including the Shipping industries are of the opinion that a focus on the diverse skills needed for a greener and more digitally connected industry.

Today's world is passing through a critical time with lot of challenges like pandemic, economic, energy crisis, global warming, natural calamities and few others. This challenge is much more in India where the poverty rate has increased significantly specially after the post-Covid period. This is mainly due to negligible economic growth leading to massive unemployment. However, we should be optimistic and utilize scientific and technological innovations properly to create more and more job opportunities for the masses for a sustainable economic growth in near future. The fourth industrial revolution or Industry 4.0 (IR4) have brought forward emerging technologies like Artificial Intelligence (AI), Robotics, Nanotechnology, IOT / Industrial IOT, Biotechnology, Autonomous Vehicles, 3D Printing for mitigating the challenges and betterment of human life. However, these technologies should be made available in easier and simpler ways for more use by the common people across different walks of life and generate large employment and entrepreneurship opportunities for them. At the same time, we need to be cautious about the dark side of too much digitization in daily human lives. With the advent of Artificial Intelligence (AI) and Robotics more and more repetitive and hazardous tasks will be taken from the people by the machines that can think and learn autonomously without human interventions. We need to keep in mind that humans created machines and it will always be humans who shall control the machines, and not vice versa. Thanks to fifth Industrial Revolution (5IR) which is trying to focus on humanity. This 5IR asks the question: How can you make the world 'better' rather than just 'more efficient' or 'more productive'? The fourth and fifth industrial revolutions should co-exist and work in parallel for a better world tomorrow.

It has been planned that the e-magazine will have both academic and non-academic sections and will be quarterly in nature. The objective is to provide all, specially the students to express their clarity of thoughts on the subjects in their own ways and also to ventilate their inherent talents beyond curriculum. Moreover, it will foster team spirit and enable them to enjoy their regular academic activities. I strongly believe that this e-magazine can be a good platform for sharing multidisciplinary ideas and knowledge between students, researchers, teachers and industry professionals. My heartfelt thanks to the entire academic community of our University in general and all the faculty members and students of the two schools in particular for their whole hearted support. I like to express my sincere gratitude to the all the members of the magazine committee for their untiring efforts without which the publication of this first issue will not be possible. Finally, I wish for a grand success of this e-magazine to my all beloved students and faculty members.

EDITOR'S MESSAGE

"A magazine or a newspaper is a shop. Each is an experiment and represents a new focus, a new ratio between commerce and intellect."

-John Jay Chapman

In recent times people related to academia are experiencing a lot of challenges in teaching-learning procedure because of a huge threat in the existing practice due to the COVID-19 pandemic followed by introduction of a new normal. Nevertheless, the online mode of teaching-learning is in continuation wisely so as to deliver whatever is possible after thorough modification of curriculum than to stop delivering. In this regard, information-communication-technology (ICT) based tools are being vastly used to reach the students in order to cope up with the new normal. Demolishing the orthodox method of teaching & learning we are in a search of new tools to exchange information in the virtual platforms to provide a stable learning adventure to the students. As a part of this venture, the School of Science and Technology, The Neotia University is coming up with its first E-magazine '**Anuranan**' to celebrate the exchange of knowledge and information.

From the inception, The Neotia University is motivated to impart holistic education to the students. Also the implementation of CBCS (choice based credit system) in the new education policy has explored the avenue to nourish the inclination of students towards a subject which is partially or totally different from his/her course curriculum. Though this magazine '**Anuranan**' we are trying to provide with a platform to the students to cultivate their inquisitive minds and hobbies.

It was a wonderful journey to work as the Joint Editor of '**Anuranan**' in its first version. I wish all the success of the aims and motives behind this magazine.

Editor

Dr. Amit Sarkar

Assistant Professor and HOD
Department of Biotechnology

Joint Editor

Dr. Manashi Chakraborty

Assistant Professor
Department of Chemistry

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In Memorium

Dr. Basudev Halder

1971-2021

I inform you with profound sadness that the NITMAS and TNU community suffered an irreparable loss on Thursday, April 29th, 2021, when Dr. Basudev Halder, of the Neotia Institute of Technology Management and Science, passed away. He was 49 years old.

He was the Head of the Department of Computer Science and Engineering. He was born on 12th November 1971 in the city of Bongaon, West Bengal. He grew up in his hometown and completed his high school education in the year 1991. He then obtained a B. Sc degree from Calcutta University and a B.E degree in Computer Science and Engineering from the Jadavpur University in 1994 and 1999. After completing his graduation in Computer Science and Engineering, he joined Scriptron Pvt. Ltd. as a software developer in 1999. He served there for a year and then returned to Jadavpur University and completed his M.E in Computer Science and Engineering in 2002. He started his academic career in 2001 as a part-time lecturer at the Women's Polytechnic College. After completing his M.E, he joined as a full-time lecturer in the IT department of the Birbhum Institute of Engineering & Technology in 2002. After one year, he joined as a lecturer in the Department of Computer Science and Engineering of the Neotia Institute of Technology Management and Science on 20th January 2003. We then knew the NITMAS as the Institute of Technology and Marine Engineering or, more often, abbreviated as ITME. In December 2013, he took charge as the Head of the IT department of the Institute. He served as the HOD of the IT department until 2017. Soon after this, he took charge as the head of the CSE Department from 2018. He has also served as visiting faculty at the Jadavpur University and the University of Calcutta.

Apart from being a dedicated teacher, he was a passionate researcher. His current research interests dealt with biomedical signal analysis, its classification, signal compression, and watermarking. His publications in reputed journals and conferences reflect his extensive research work and highlight his significant contribution. Among his major contribution in recent times, the development of cloud-based telemonitoring of cardiac signals, its analysis, and classification are worth mentioning. In 2020, the University of Calcutta awarded him a Ph.D. degree for his thesis on soft computing techniques for compression, analysis, and classification of cardiac signals.

I have known Dr. Basudev Halder for a long time since my days at ITME. He was a modest person with a kind heart. The most noticeable thing about him is that he would always greet one with a cheerful smile. I have always observed in him strong leadership skills with a caring temperament towards his subordinates. Through my interactions with him over the years, I could see in him the reflections of a committed family man with a strong love for his daughter and wife. He would work tirelessly at his office and still find time to carry out all his duties towards his family to ensure that they are taken care of and fostered. His colleagues, junior faculty members, and staff members in the Institute were also no less than his family. His love and support for them were unparalleled. These turned out to be instrumental in lifting the morale of his subordinates and building team cohesiveness. As an educator, his engaging teaching methods and immeasurable care for his students made him immensely popular. His ability to ignite the minds of the young students and inspire them to uplift their performance was exceptional. One of his many good traits that were unmatched is his tremendous energy level and ability to work tirelessly to achieve his goals. In him, the NITMAS and TNU community has lost a most vibrant personality. It is exceedingly difficult for us to accept the shocking fact that he has passed away. The anguish and pain of losing an old friend and a colleague are amongst the greatest sorrow that we must bear. But I do believe that his students will carry forward his legacy. Dr. Basudev Halder will always continue to live in our hearts.

Dr. Basudev Halder is survived by his wife Mrs. Mini Halder and his daughter Ms. Anangsha Halder.

Reflections from Colleagues

Prof. Souvik Biswas

"Dr. Basudev Halder, was known to his inner circle as Basuda, worked for nearly twenty years in our institution Neotia Institute of Technology Management and Science in the department of computer science and engineering. He will be remembered as a colleague, a mentor, a leader, a visionary and above all, a good human being."

Prof. Debarata Nath

"He had taken good care of our department. We learnt a lot from him. We will be missing him."

Prof. Sunanda Sinha

"I found him to be a good administrator with exceptional managerial skills."

Prof. Bappaditya Mondal

"Basuda, I don't know where you are right now, but I hope you are happy wherever you are. I cannot for a moment forget that you are no longer with us. I still haven't been able to come to terms with this sad truth. All the time, your memories keep coming in my mind. And your last words: "বাপ্পা অক্সিজেন সিলিন্ডারটা তাড়াতাড়ি পাঠা কলেজ থেকে আমার খুব কষ্ট হচ্ছে" still rings in my ear. The incompleteness left by your demise shall never be filled. May God give strength to your family to bear this irreparable tragic loss. And I say one more time, may you remain happy and well wherever you are."

Prof. Soumendranath Mishra

"He was not only my HOD, he was the friend, philosopher and guide to me. Whenever I faced any kind of problem either official or personal I discussed with him and he advised nicely. He was a great person. He will remain in my heart forever. I will miss him very much."

Prof. Deep Suman Dev

"It is very unfortunate to all associated with Ambuja Neotia Education Vertical that Dr. Basudev Halder is not with us. His fighting with the virus effect in his body stopped on 29th April, 2021. I was not in a state on that date to believe that Basuda (I used to call him Basuda) is no more. The day before his death, he called me twice in the afternoon and I will never forget his voice. We have lost a dynamic academician like him.

I never thought that I have to write about him for obituary section. From the day on which I have joined this Institution, I have seen him as a very energetic person who carried out any responsibility sportingly. Listening his encouraging words, nobody can sit idle. He loved to listen to songs. I never seen him angry in different pressure situations and he always tried to coordinate the matter with smile on his face. Any colleague who asked for any type of help, he would always try to help them beyond his limit. I am still missing and shall miss his cheerful attitude and bright smile."

Prof. Kallol Bera

"In the last one and half years due to Corona virus pandemic situation we have spent some bad time in our life. In between that time, we have lost not only our HOD, our colleague, and friend "Lt. Basudeb Halder". When I have joined this Institution, he was already 9 years experienced in teaching. Yet he helped me in various way as a friend.

When a loved one passes away, we are never prepared for the changes that will come to our lives from this tragic accident. Receiving the call that Basu da had passed away was very shocking to me. It's something that no one in this world wants to go through the loss of a loved one. Managing the emotions and feelings is very important since we have to be strong minded and be able to move forward.

We will remember you, Basu da till the end of our life."

Dr. Basudev Halder with his colleagues and students of the CSE Department on Teachers Day

Dr. Basudev Halder addressing the audience during a workshop

Dr. Basudev Halder with his daughter and wife

by

Prof. Sujoy Biswas

Professor and Principal, NITMAS

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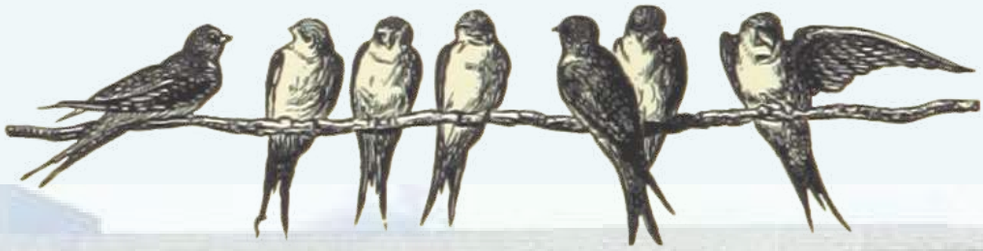

OUR ACADEMIC UNITS

ACADEMIC UNIT - BASIC SCIENCE

It is common knowledge that best scientific solutions originate from the knowledge of fundamental sciences. Hence maintaining a reasonable balance between basic and applied sciences is necessary. A sound knowledge of Basic Science helps students to understand and adapt to the new trends in education and industry that came to substitute the earlier approaches.

The Unit of Basic Science comprises of:

Department of Physics

Department of Chemistry

Department of Mathematics

Highlights of Department of Basic Science

- More than 100 International Publications in peer-reviewed Journals
- Two SERB/UGC sponsored Projects, One University Sponsored Project
- State-of the art infrastructure (experimental and computational)
- Potential research collaboration with research labs at IITs, IISERs, NITs, NISER and other supreme research institutes
- Workshops to uplift and upgrade students with recent research

COURSE OFFERED

M.Sc in Applied Physics

M.Sc in Mathematics & Computing

(2 years, 4 semesters)

PhD

FACULTY MEMBERS

Dr. Kalyanashis De
Assistant Professor

Dr. Manashi Chakraborty
Assistant Professor

Dr. Abhijit Samanta
Assistant Professor

Dr. Mostaid Ahmed
Assistant Professor

Dr. Ayan Chatterjee
Assistant Professor

Dr. Chandra Mukherjee
Assistant Professor

Dr. Debajyoti De
Assistant Professor (on lien)

ACADEMIC UNIT - BIOTECHNOLOGY

Biotechnology is the application of advances made in the biological sciences which affects almost every sphere of human life starting from the production of food to fighting against deadly infectious diseases. At this time when the global population is increasing at an alarming rate, environment becoming heavily polluted or encountering unprecedented challenges like the Covid-19 pandemic, the entire world looks to this discipline for solutions in terms of sustainable agriculture, production of green energy, development of vaccines etc.

COURSE OFFERED

B.Sc (Hons) Biotechnology (3 years, 6 semesters)

M.Sc Biotechnology (2 years, 4 semesters)

Ph.D in Biotechnology

Event organized in recent times

Internal webinar series on "Biotechnology: Sustenance of Life Through Cutting Edge Science" 20-24 July, 2021

FACULTY MEMBERS

Dr. Amit Sarkar
Assistant Professor and Head

Dr. Prosun Tribedi
Assistant Professor

Dr. Prashant Shukla
Assistant Professor

Dr. Diwakar Kumar Singh
Assistant Professor

Dr. Poulomi Chakraborty
Assistant Professor

Mr. Ranojit Kumar Sarker
Teaching Associate

Ms. Payel Paul
Teaching Assistant

Ms. Tamashi Das
Laboratory Attendant

ACADEMIC UNIT - BNS DEPARTMENT

BNS Department or BSc in Nautical Science is a 3 Years fully residential program.

It has Theory and Practical sessions.

After giving the requisite exams, it ultimately leads you to become Captain of a ship.

It has a magnificent Ship Manoeuvring Simulator.

We do not have any provisions for carrying out Research as yet.

COURSE OFFERED

B.Sc in Nautical Science
(3 years, 6 semesters)

FACULTY MEMBERS

Capt Diptesh Bhattacharya
HOD & Faculty

Capt Ranjit Roy
Faculty

Capt Shyamal Mandal
Visiting Faculty

Capt Subir Kr Chatterjee
Visiting Faculty

Mr Sailendra Nath Das
Visiting Faculty

Mr Motilal Shaw
Sr Technical Assistant

ACADEMIC UNIT – CSE DEPARTMENT

Computer Science & Engineering (CSE) department imparts teaching on general aspects of Computer Science along with specialized areas in cutting edge technologies like Data Science, Cyber Security, AI & ML and Embedded Systems & Industrial IOT to make the students industry ready as well as provides training for doing research in future.

COURSE OFFERED

B. Tech in CSE, Specialization in Cyber Security

B. Tech in CSE, Specialization in Data Science

B. Tech in CSE, Specialization in AI & ML

(4 years, 8 semesters)

M. Tech in CSE, Specialization in Cyber Security

M. Tech in CSE, Specialization in Data Science

M. Tech in CSE, Specialization in AI & ML

(2 years, 4 semesters)

FACULTY MEMBERS

Prof (Dr.) Partha Kumar Mukherjee
Head of the Department

Dr. Pranam Paul
Faculty Member

Dr. Ruchi Sharma
Faculty Member

Mr. Bilas Halder
Faculty Member

Mr. Jaydeb Mondal
Faculty Member

Industry Partnership

TNU has also collaborated with Batoi Systems Private Limited (BSPL), Bhubaneswar to provide better understanding of Computer Science and Engineering in general and specifically Cyber Security, Internet of Things (IoT), large Data Sciences, etc. other current strengths in CSE to its students. BSPL to provide assistance in drafting the syllabus for B.Tech & M.Tech programme along with help in establishing laboratory and CSE vertical with stress on modern areas including its applications.

Achievement of Pass Out Students

Anirdam Haldar, CSE (Cyber Security)

"An Approach of Solutions for a Vulnerable Website through Penetration Testing"; Paper ID: JETIR1812704; Registration ID: JETIR193699; Accepted and Publication in UGC Recognized Journal, "International Journal of Emerging Technologies and Innovative Research (JETIR)"; Impact Factor: 5.87; ISSN No. :2349-5162; Volume 5 ; Issue 12 ; Published on Dec 2018;pp: 18 – 29.

Affsan Abrrar, CSE (Cyber Security)

"Development of Application to Recognise Hand Written Digit at run time"; Accepted and Published in "International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)"; Impact Factor: 7.194; ISSN No: 2320-9801 (Online), 2320-9798 (Print); Vol. 6, Issue: 11, November

2018; pp: 9001 – 9008.

Arindam Haldar and Affsan Abrrar had started their own IT Development and Security Analytics company.

ACADEMIC UNIT - MARINE ENGINEERING

This unique 4 years course is one of the few course taught in TNU among various university/colleges in eastern India. Being a practical oriented course TNU's ship-in-campus is the best to devolve skill, knowledge and proficiency which is very much required post completion of this course.

State of art modern laboratory ,spacious classrooms with modern teaching aids, WIFI enable hostel rooms, indoor and outdoor game facility in TNU's huge greenery campus helps student for overall development.

DGS (GOI) approved course/curriculum being followed at TNU, which is on the basis of each subject vis-a -vis total hours of classroom/practical training for every semester. Very experienced faculty members imparts the training.

COURSE OFFERED

B. Tech in Marine Engineering

(4 years, 8 semesters)

Event organized in recent times

Internal webinar series on "Carrier Prospect in Marine Engineering" 22-24 July, 2021

FACULTY MEMBERS

Prof. Ashoke Kumar Barai
Head of the Department

Prof. Rajneesh Roy Choudhury
Faculty Member

Prof. Tamal Mukherjee
Faculty Member

Prof. A.K.Biswas
Faculty Member

Mr. T.K.Dey
Faculty Member

INDUSTRY PARTNERSHIP

K-Ship - RPSL 249 - Ship Management: TNU Signed MoU with K-Ship, who will be the interface between TNU and leading Marine Companies to help in placing Marine Engineering (MRE) and Bachelor of Nautical Science (BNS) Students.

Destan Ship Management Pvt. Ltd.: MoU is signed authorizes DSMPL to recruit and place students of Marine Engineering (MRE) and Bachelor of Nautical Science (BNS) in leading shipping companies as engine cadets and Deck cadets.

Blue Bird Shipping Management Private Limited: MoU signed authorizes BBSMPL to recruit and place students of MRE & BNS on shipping companies.

ACADEMIC UNIT - ROBOTICS AND AUTOMATION

Robotics is an interdisciplinary branch of engineering and science that includes mechanical engineering, electronic engineering, information engineering, computer science, and others. Robotics deals with the design, construction, operation, and use of robots, as well as computer systems for their control, sensory feedback, and information processing.

The robotics engineering sector is growing at a rapid pace, and promises to be one of the next biggest fields due to the rapid growth in the manufacturing sector. These engineers are engaged for design, construction, operation and application of robots that assemble the components to make the final product; thereby increasing productivity. Robotics engineers make work more efficient, faster, hazard free, and inexpensive.

The advanced curriculum structure of Robotics and Automation at The Neotia University, and the MoU signed with Phi Robotics Research Pvt. Ltd, expose the students to experiential learning that help them venture into myriad career pathways.

COURSE OFFERED

B.Tech in Robotics and Automation

Ph.D in Science and Technology

FACULTY MEMBERS

Dr. Ankush Ghosh
Associate Professor and Head

Md. Kamaruzzaman
Teaching Associate

Ms. Sangeeta Barua
Teaching Assistant

ACADEMIC UNIT - CSE DEPARTMENT (NITMAS)

The Computer Science and Engineering (CSE) department started imparting quality and value based education to the students by following the most modern curricula and syllabus of MAKAUT (formerly WBUT) since 2002 for raising satisfaction level of all stakeholders.

16 batches of students have graduated till 2021.

COURSE OFFERED

B.TECH with Honours in

Computer Science & Engineering

(4 Years, 8 Semesters)

Affiliated to MAKAUT and Approved by AICTE

Computer Science and Engineering, Lab Session, NITMAS

FACULTY MEMBERS

Prof. Debabrata Nath
Assistant Professor

Prof. Deep Suman Dev
Assistant Professor

Prof. Soumendranath Mishra
Assistant Professor

Dr. Bappaditya Mondal
Assistant Professor

Prof. Subrata Datta
Assistant Professor

Prof. Souvik Biswas
Assistant Professor

Prof. Sunanda Sinha
Assistant Professor

Prof. Kallol Bera
Assistant Professor

Achievement of Pass Out Students

Sayamindu Dasgupta was a Moore/Sloan & WRF Innovation in Data Science postdoctoral fellow at the University of Washington. He received his PhD from Massachusetts Institute of Technology (MIT) in 2016.

Sankha Basu is an Associate Professor of Marketing at Leeds University Business School. He obtained his PhD in Marketing from Nanyang Technological University.

Arijit Panigrahi, Beauty Bose, Joyeta Sardar "Fingerprint Matching using Graph Structure based Symmetric Ternary Pattern", International Journal of Computing and Digital Systems (IJCDS), Vol. 10, No. 1, August 2021.

Udit Ghosh "High occupancy itemset mining with consideration of transaction occupancy," Arabian Journal for Science and Engineering, Springer, 2021.

Udit Ghosh, Sourav Das, Sourav Ghosh "Rare correlated coherent association rule mining with CLS-MMS," The Computer Journal, 2020, Oxford University Press, 2021. (Accepted)

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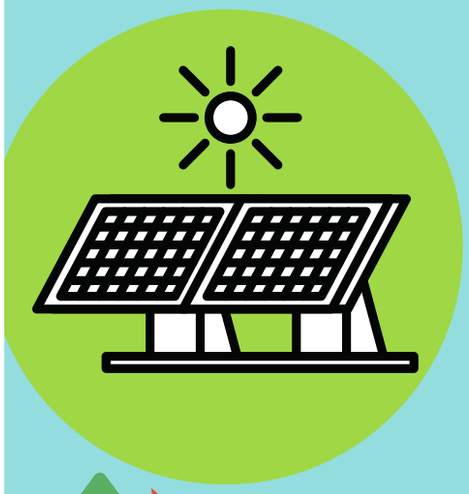

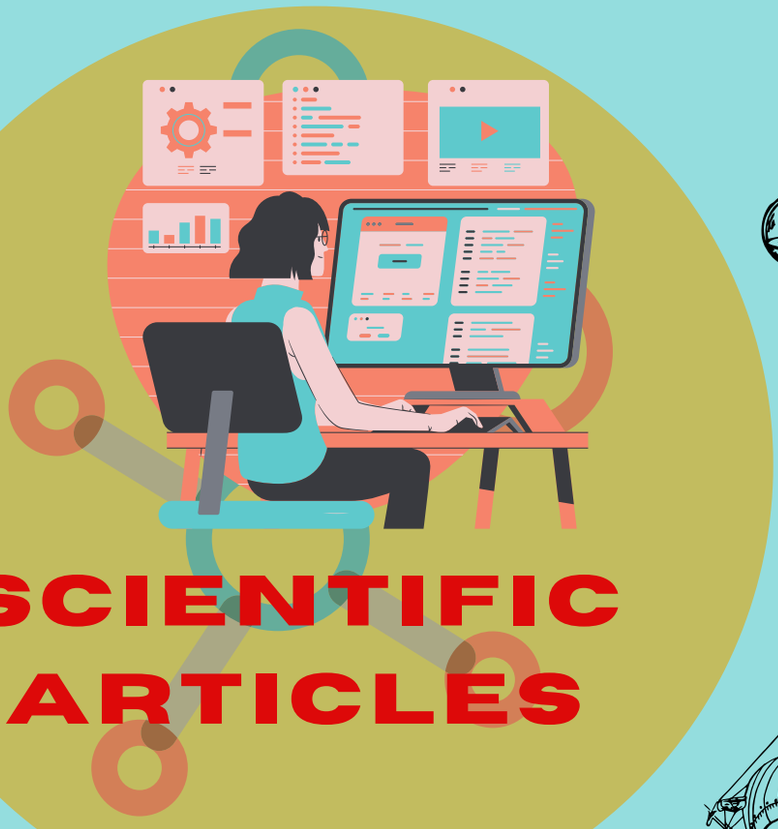

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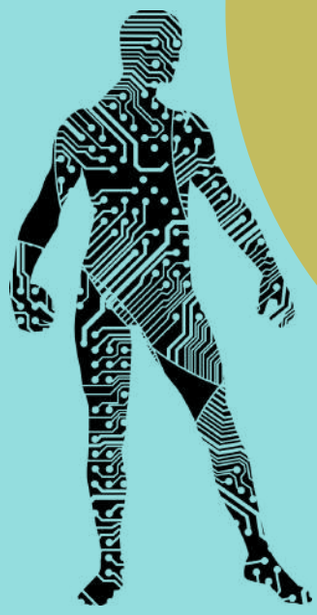
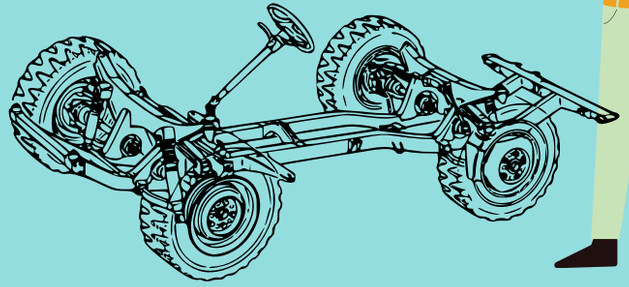




HOW TO ARCHIVE DATA FROM RELATIONAL DATABASES TO AMAZON GLACIER USING AWS DMS

Objective -

To move data (one time or continuous) securely and efficiently from the on premise environment into AWS cloud and save the storage cost. The stored data can be queried as needed and can be presented via dashboards/ reports using AWS QuickSight or Tableau visualization tool.

Problem Statement –

The client wants a solution to move their on premise archival data securely and efficiently into AWS cloud. That way, client can sunset their existing on premise server/s and reduce the overall cost (storage cost, licensing cost, etc.).

I implemented this process using the STAR method.

Situation- (**What was the situation you/ your previous employer faced?**)

Task – (**What tasks were involved in that situation?**)

Action – (**What actions did you take?**)

Results – (**What were the results of those actions?**)

Situation –

The client has a huge volume of archival data which is stored in their on premise environment and paying a huge storage cost. That's why client wants to move this data out of on premise environment into a data lake to minimize their storage cost.

Task –

Identified archived data which needs to be moved, data movement frequency, life cycle rules, data retention plan, identified analytic query tool, visualization tool

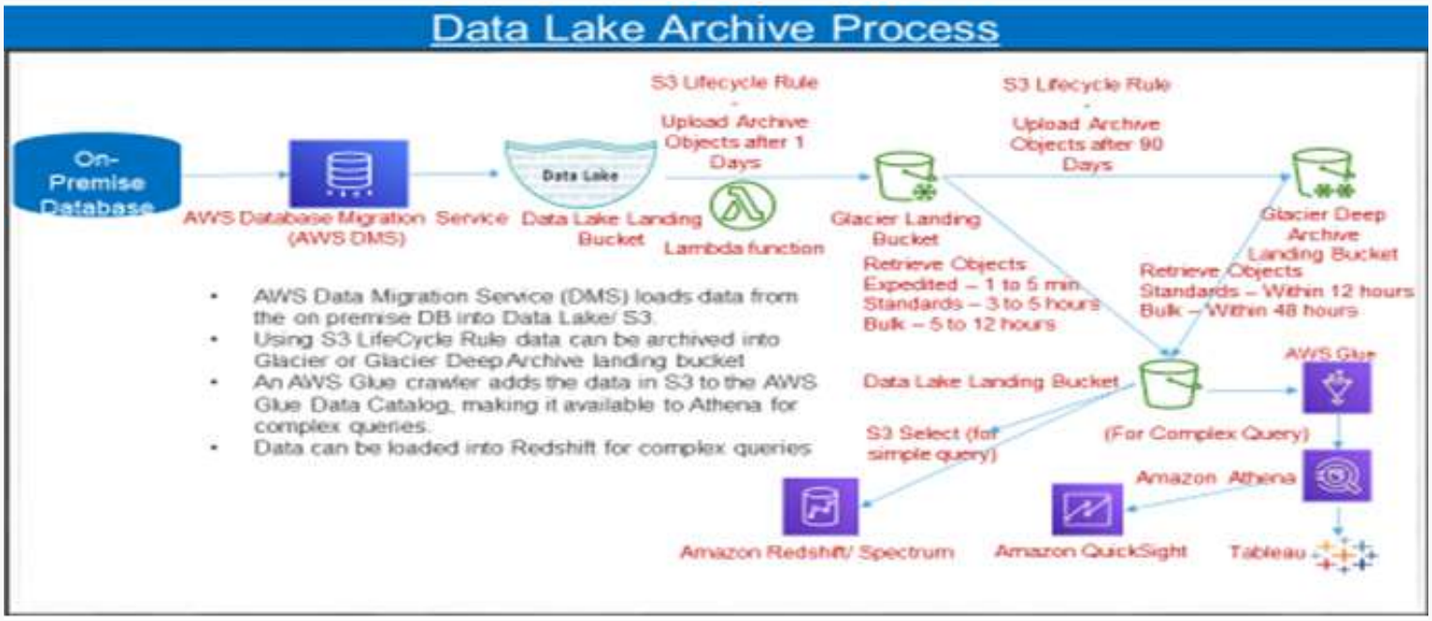
Action/ High level steps-

You can use AWS Database Migration Service (AWS DMS) to migrate data from various sources to most widely used commercial and open-source databases. AWS DMS also supports Amazon S3/ Data Lake as a source and as a target for migrations. When you use Amazon S3 as a target, you can use AWS DMS to extract information from any database that is supported by AWS DMS. You can then write it to Amazon S3 in CSV format, which can be used by almost any application.

Use S3 Lifecycle rule to move data from S3/ Data Lake to Glacier and from Glacier to Glacier Deep Archive.

Use Athena or Amazon Redshift/ Spectrum to query the data (complex query) and Tableau or QuickSight to create reports/ dashboards.

HOW TO ARCHIVE DATA FROM RELATIONAL DATABASES TO AMAZON GLACIER USING AWS DMS



Results –

The process helps client manages their data growth while balancing cost and performance.

Conclusion-

Managing ever-growing data is a major challenge for many enterprises. This article explained how you can use AWS DMS, Amazon Glacier, AWS Lambda, and Amazon S3 to handle infrequently accessed data that is stored in relational databases. This combination of services helps you manage your data growth while balancing cost and performance.

About the Author

Manas Mondal is a senior IT Solutions Architect at Unisys Corporation, USA. He works with customers to provide guidance and technical assistance on cloud technology, solution architect, hybrid architecture, and data migration into AWS cloud, data warehousing architecture, ETL / ETL design, and business intelligence solutions.

CYBERSECURITY ON BOARD SHIPS

A few months back there was a scarcity of oil , the gas stations in USA had nearly gone dry!

The reason was a Ransomware attack on Colonial Pipelines had taken place, in the valves accessing the pipelines. The effect was chaos and panic. Ultimately, an undisclosed value of crypto currency was paid to the Attacker (hacker) to normalize it.

What is Ransomware – it is a form of malware designed to attack the computer systems and make it unusable. Hackers attacked the pipeline software and asked for a ransom to make it operational.

Imagine this same scenario on board ships, attacking :- the Navigating bridge equipments, cargo handling system of a tanker, propulsion machinery and power control systems, passenger servicing system, Administrative system, Communication system.

Suddenly no positions on the ECDIS, suddenly the manifold valves automatically close during discharge of the oil!

It is a seafarers' nightmare!

But, there is a way to avoid this.

In June 2017 the International Maritime Organization (IMO) laid out its "Guidelines on Maritime Cyber Risk Management" produced by IMO, ICS, INTERTANKO etc.

From the 1st January 2021 onwards ship owners and managers are required to build cyber risk management into their ship safety initiatives – or risk having their ships detained.

These guidelines are there to improve safety and security of seafarers, the environment, cargo and the ship.

The steps leading to Cybersecurity in the Maritime Industry

Step 1. Cyber security and Risk Management

Cyber security characteristics of the maritime industry

- There are different kinds of incidents which can happen.
- Senior Management involvement is critical for this to work properly.
- Roles, responsibilities and tasks must be clearly allocated.
- "IT systems manage data and support business functions, OT is the hardware and software that processes and must function independent of the IT system on board.
- As per the IMO Resolution MSC 428(98) says that there is a growing need to raise awareness on cyber risk threats to shipping. Hence, the SMS of the Company has to include cyber security measures.
- Relationship between the Owner, Manager, Agent and vendors and external parties all have to be properly evaluated.

Step 2. Identify Threats

When identifying threats, companies should consider any specific aspects of potential threat actors 'capability, opportunity, and intent to attack. This can include using eg an external person or an insider as an unintentional middleman unknowingly carrying the threat eg on an infected USB stick.

In 2019, it took on average 279 days between the time a victim's network was breached and the containment of the

CYBERSECURITY ON BOARD SHIPS

breach. However, intrusion can go undetected for years.

Once identified, threats should be considered alongside identified vulnerabilities to evaluate the likelihood of an attack or incident taking place. Together with the impact of a given incident, the likelihood of the incident occurring produces the risk factor.

Step 3. Identifying Vulnerabilities

The following are common cyber vulnerabilities, which may be found onboard existing ships, and on some newbuild ships:

- Obsolete and unsupported operating systems.
- Unpatched system software.
- Outdated or missing antivirus software and protection from malware
- Inadequate security configurations and best practices, including ineffective network management and the use of default administrator accounts and passwords.
- Shipboard computer networks, which lack boundary protection measures and segmentation of networks
- Safety critical equipment or systems always connected with the shore side Inadequate access controls to cyber assets, networks etc. for third parties including contractors and service providers
- Staff inadequately trained and/or skilled to manage cyber risks
- Missing, inadequate or untested contingency plans and procedures.

INCIDENT: Crash of integrated navigation bridge system at sea

A ship with an integrated navigation bridge system suffered a failure of nearly all navigation systems at sea, in a high traffic area and reduced visibility. The ship had to navigate by one radar and backup paper charts for two days before arriving in port for repairs. The cause of the failure of all ECDIS computers was determined to be attributed to the outdated operating systems. During the previous port call, a manufacturer technical representative performed a navigation software update on the ship's navigation computers. However, the outdated operating systems were incapable of running the software and crashed. The ship was required to remain in port until new ECDIS computers could be installed, classification surveyors could attend, and a near-miss notification had been issued as required by the company. The costs of the delays were extensive and incurred by the shipowner.

This incident emphasizes that not all computer failures are a result of a deliberate attack and that outdated software is prone to failure. More robust testing and proactive software maintenance on the ship may have prevented this incident from occurring.

INCIDENT: Navigation computer crash during pilotage

A ship was under pilotage when the ECDIS and voyage performance computers crashed. A pilot was on the bridge. The computer failures briefly created a distraction to the watch officers; however, the pilot and the Master worked together to focus the bridge team on safe navigation by visual means and radar. When the computers were rebooted, it was apparent that the operating systems were outdated and unsupported. The Master reported that these computer problems were frequent and that repeated requests for servicing from the shipowner had been ignored.

CYBERSECURITY ON BOARD SHIPS

It is a clear case of how simple servicing and attention to the ship by management can prevent mishaps.

Step 4. Assessing the Likelihood

The likelihood of an incident occurring is assessed by seeing the two factors Threat and Vulnerability. Likelihood is the product of these two factors.

Step 5. Impact Assessment

Confidentiality, Integrity and Availability model provides the Impact assessment.

- Loss of Confidentiality of information, eg unauthorised access to and disclosure of information or data about the ship, crew, cargo and passengers.
- Loss of Integrity, which would modify information and data relating to the safe and efficient operation and management of the ship.
- Loss of Availability due to the destruction of the information to services/operation of ship systems.

Step 6. Risk Assessment

fter establishing the threats, vulnerabilities, impacts and likelihoods it is possible to do the Risk Assessment.

A Risk assessment is to be repeated at intervals to ensure that the findings are kept up to date and new threats mitigated.

Step 7. Develop Protection Measures

It is important to protect critical systems and data with multiple layers of protection measures, which consider the role of personnel, procedures and technology to:

- Increase the probability that a cyber incident is detected.
- Make the best use of resources required to protect confidentiality, integrity, and availability of data in IT and OT systems.

Training and Awareness are the key elements to an effective approach to cyber risk management.

INCIDENT: Bunker surveyor's access to a ship's administrative network

A dry bulk ship had just completed bunkering operations. The bunker surveyor boarded the ship and requested permission to access a computer in the engine control room to print documents for signature. The surveyor inserted a USB drive into the computer and unwittingly introduced malware onto the ship's administrative network. The malware went undetected until a cyber assessment was conducted on the ship later, and after the crew had reported a "computer issue" affecting the business networks.

This incident emphasises the need for procedures to prevent or restrict the use of USB devices onboard, including those belonging to visitors.

INCIDENT: Main application server infected by ransomware

A ransomware infection on the main application server of the ship caused complete disruption of the IT infrastructure. The ransomware encrypted every critical file on the server and as a result, sensitive data was lost, and applications needed for ship's administrative operations were unusable. The incident was reoccurring even after complete restoration of the application server.

CYBERSECURITY ON BOARD SHIPS

The root cause of the infection was poor password policy that allowed attackers to successfully brute force remote management services. The company's IT department deactivated the undocumented user and enforced a strong password policy on the ship's systems to remediate the incident

Step 8. Develop Detection Measures

Detecting intrusions and infections is a central part of cyber risk management. A baseline of network operations and expected data flows for users and systems should be established and managed, so that cyber incident alert thresholds can be established. Key to this will be the definition of roles and responsibilities for detection to help ensure accountability.

Antivirus and anti malware programs should be installed, updated and regularly used and updated.

Step 9. Establish Contingency Plans

The following Contingency Plans as per Ch 8 of the ISM Code are to be incorporated:-

- ***Loss of availability of electronic navigational equipment or loss of integrity of navigation related data.***
- ***Loss of availability or integrity of external data sources, including but not limited to GNSS.***
- ***Loss of essential connectivity with the shore, including but not limited to the availability of Global Maritime Distress and Safety System (GMDSS) communications.***
- ***Loss of availability of industrial control systems, including propulsion, auxiliary systems and other critical systems, as well as loss of integrity of data management and control.***
- ***The event of a ransomware or denial of service incident.***

Step 10. Respond to and Recover from a Cybersecurity Incidents

Response should be effective following the response plan.

Regular simulated drills and developing contingencies are recommended.

The 4 phases of a Response are :- Preparation, Detection and Analysis, Containment and Eradication and Post Incident recovery.

Following are the Vulnerable Areas on board a ship:-

Communication systems

- integrated communication systems
- satellite communication equipment
- Voice Over Internet Protocols (VOIP) equipment
- wireless networks (WLANs)
- public address and general alarm systems
- systems used for reporting mandatory information to public authorities.

Bridge systems

- Integrated navigation system
- positioning systems (GPS, etc.)
- Electronic Chart Display Information System (ECDIS)
- Dynamic Positioning (DP) systems
- Systems that interface with electronic navigation systems and propulsion/maneuvering systems
- Automatic Identification System (AIS)
- Global Maritime Distress and Safety System (GMDSS)
- Radar equipment
- Voyage Data Recorders (VDRs)

CYBERSECURITY ON BOARD SHIPS

- Bridge Navigational Watch Alarm System (BNWAS)
- Shipboard Security Alarm Systems (SSAS).

Propulsion, machinery management and power control systems

- Engine governor
- Power management
- Integrated control system
- Alarm system
- bilge water control system
- water treatment system
- emissions monitoring
- heating, ventilation and air-conditioning monitoring
- damage control systems
- other monitoring and data collection systems eg fire alarms.

Access control systems

- surveillance systems such as CCTV network
- electronic "personnel-on-board" systems.

Cargo management systems

- Cargo Control Room (CCR) and its equipment
- Onboard loading computers and computers used for exchange of loading information and load
- plan updates with the marine terminal and stevedoring company
- remote cargo and container tracking and sensing systems
- level indication system
- valve remote control system
- ballast water systems
- reefer monitoring systems
- water ingress alarm system.

Passenger or visitor servicing and management systems

- Property Management System (PMS)
- ship management systems (often including electronic health records)
- financial related systems
- ship passenger/visitor/ seafarer boarding access systems
- authorisation systems.
- incident management systems.
- infrastructure support systems like domain naming system (DNS) and user authentication.

Passenger-facing networks

- passenger Wi-Fi or Local Area Network (LAN) internet
- personnel can connect their own devices
- guest entertainment systems.

Core infrastructure systems

- security gateways
- routers
- switches
- firewalls
- Virtual Private Network(s) (VPN)
- Virtual LAN(s) (VLAN)
- intrusion prevention systems
- security event logging systems.

Administrative and crew welfare systems

- administrative systems
- crew Wi-Fi or LAN internet access, for example where onboard personnel can connect their own devices.

As per the Resolution MSC428(98) of the International Maritime Organization adopted on 16th June 2017 says that the "Guidelines on Cyber Security Onboard ships" and all the Procedures should be in place from 1st Jan 2021.

So, once the above steps are followed we should not have any incident on board regarding Cybersecurity or in case it happens we can adopt the Contingency procedures and come out of the situation safely.

The article has been summarised from "The Guidelines on Cyber Security on board ships" Ver.4 produced by BIMCO,ICS etc.

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THE PHYSICIST BEHIND MODERN BIOLOGY: REMEMBER WITH REVERENCE

Erwin Rudolf Josef Alexander Schrödinger, a well known name to each and every student of Physics, Chemistry and Mathematics, is the pioneer of wave mechanics in Quantum theory. He is recognized as the father of Quantum Mechanics and also credited as one of the founders of modern physics. This Nobel laureate theoretical physicist was born on August 12, 1887 in Vienna, Austria. His primary education was in Vienna. From 1896 to 1905 he attended the Akademisches Gymnasium in Vienna. Schrödinger later enrolled at the University of Vienna for higher education (1906-1910). At that time he came in contact with Friedrich Hasenöhrl, the successor to the famous physicist Ludwig Boltzman. Schrödinger received his doctorate in 1910 under the tutelage of Friedrich Hasenöhrl and Franz Exner. His doctoral research was based on the conduction of electricity on the surface of an electrical insulator under humid condition.

Then in 1911, Schrödinger was appointed as assistant to Franz Exner at the University of Vienna. During the First World War, he was appointed as artillery officer (1914-1918). In the post-war period (1921-1926), he was a professor at the University of Zurich and concentrated his research on the theoretical quantum theory. In 1926, he was invited to work as a professor at University of Berlin and he continued his work there until 1933. When Hitler came to power in Germany, he left Berlin for England, disgusted by the anti-Semitic hatred of the Nazi party.

In the meantime, Niels Bohr's model of the hydrogen atom was already able to explain the atomic spectrum of hydrogen, but it was not entirely flawless. Moreover, this model could not explain the spectrum of multi-electron atoms. So Schrödinger realized the need for further progress in the world of quantum physics. He came up with the idea of **wave function** in quantum mechanics. Schrödinger developed his famous equation using the concept of wave particle duality of matter (such as electrons). This was published in 1928 in the ***Annalen der Physik***, a scientific journal on physics. Schrödinger brings up the topic of wave function to explain the position and nature of waves to electrons. **Wave function, Ψ** is actually a complex number, which can tell the probability of getting electrons in a particular place. His wave equation of a one electron system like hydrogen atom, can give an accurate explanation of ions and Eigen values of energy. This equation even explained many more complex models of quantum mechanical systems (e.g. Simple harmonic oscillator, diatomic molecule, rigid rotor, stark effect). This wave equation is later known as **Schrödinger equation (HΨ = EΨ)**. Schrödinger was awarded the Nobel Prize in Physics in 1933(along with the physicist Paul AM Dirac) for his groundbreaking "***discovery of new productive forms of atomic theory***" [1]. In his discussion of the ***Einstein-Podolsky-Rosen (E.P.R)*** article with Einstein, Schrödinger introduced the Copenhagen Interpretation (designed by Niels Bohr and Heisenberg) in 1935 to explain the theory of **fictional cat experiments,** which later gave rise to the concept of '**quantum entanglement**'. According to his famous cat theory, one must have heard about **Quantum Mechanics** and **Parallel Universe**.... There is a funny thing about opening the box. "***Your curiosity may be the cause of Schrödinger's cat's death***!" This means that the cat was "**alive and dead**" until the moment you opened the box. If the cat is found dead after opening the box, the responsibility falls on you. If he hadn't opened the box, he would have been alive and dead!

There is one nicer thing here...Quantum mechanics speaks of a parallel universe. As much as an event can happen, every one of them is happening in some or the other universe. This is called "Many World Theory". According to this formula, as soon as the box is opened, two parallel universes will be created, one in which the cat is alive and the other is dead.

Isn't that great? In one world you are reading this article, in another world you are playing with Lionel Messi. Teleportation technology has arrived in one world and dinosaurs are still roaming in another world.

THE PHYSICIST BEHIND MODERN BIOLOGY: REMEMBER WITH REVERENCE

The world of quantum mechanics is the world of all possibilities. Here is its beauty!!! Well!!! Though all of these are related to the world of physics, chemistry and mathematics, he was also very much interested in biology and philosophy of science as well. It is said that he was the author of the first important book on bio-physics, the name of the book – ***"What is Life? The Physical Aspect of the Living Cell"***. In this famous book, he is the first to combine genetics with physics

Erwin Schrödinger. This Swedish photograph is in the public domain in Sweden. Copyright **©The Nobel Foundation 1933**

"The scientist only imposes two things, namely truth and sincerity, imposes them upon himself and upon other scientists." — Schrödinger

From 1939, he began to study in various branches of philosophy and biology. Nine years after receiving the Nobel Prize, he was invited to deliver three consecutive public lectures at Trinity College, Dublin, the first of which was on 5 February 1943. Naturally, it was quite unusual to a Nobel Prize-winning theoretical physicist, if lecture was "**What is life?**" Though it seemed curious!! The lectures attracted the attention of an audience of about 400, who were warned "that the subject-matter was a difficult one and that the lectures could not be termed popular, even though the physicist's most dreaded weapon, mathematical deduction, would hardly be utilized." His lecture focused on one important question: "How can the events in space and time which take place within the spatial boundary of a living organism are accounted for by physics and chemistry?"[2] The following year the lecture was published as a book "**What is life?**"

After the publication of the book, there was a huge response in the world of science. Some of the foremost researchers in modern biology, including JBS Holden, Francis Creek, Maurice Wilkins, Kurt Stern, Seymour Benzer, and several other talented biologists have recommended this book as their inspiration to enter into the field of biological research. **In the history of science, this book is considered to be the most influential book till date. In this book,** Ervin says that life is a fancy idea in ***'A Chemical Structure in Living cells'***. When biology researchers were trying to find the answer to the mystery of life, just then this book aroused the thoughts of many of them. After reading this book, they have become inspired by modern research in biology.

In fact, Schrödinger's book is the starting point for the Department of Molecular Biology. In this book he wrote about negative entropy and the genetic code of the organism. It should be noted that almost ten years after the publication of this book, on April 25, 1953, a research article on the formation of the double helix of the DNA molecule of Watson and Crick was published in the famous journal **Nature**. Discovering the molecular structure of DNA is a milestone discovery...Which is considered to be one of the first three discoveries in the world. Watson, Creek and Wilkins jointly won the Nobel Prize in 1962 for that discovery, nine years after the paper was published in Nature.

In a congratulatory letter to Schrödinger on his 66th birthday on August 12, 1953, Creek said that Watson and he were both excited and impressed to read his book and learn about the structure of DNA. Creek wrote to him, thanking the legendary physicist for this: "Watson and I were once discussing how we came to enter the field of Molecular Biology, and we discovered that we had both been influenced by your little book 'What is Life?'...Your term 'aperiodic crystal' is going to be avery apt one."

THE PHYSICIST BEHIND MODERN BIOLOGY: REMEMBER WITH REVERENCE

Erwin wrote several other books of philosophical value. These include **Mind and Matter (1958)**, **Science and Humanism (1952)**, **Space-Time-Structure (1950)**. Schrödinger was deeply interested in **Vedanta**. His views can be found in a book called "**My View of the World**" (actually comprises two essays) published in 1961 in Hamburg. The English translation came out in 1964.

Erwin returned to an honoured position in Vienna after his retirement. He died on **January 4, 1961** at the age of 73, after a long suffering from tuberculosis, survived by his faithful companion, Annemarie Bertel, whom he married in 19201. After his death, the **Erwin Schrödinger International Institute for Mathematical Physics** was established in Vienna in 1993. In 1969, **Walter J. Moch** (**Walter J. Moore**) wrote a book on Schrodinger's biography: **Schrödinger: 'Life and Thought'** [3].

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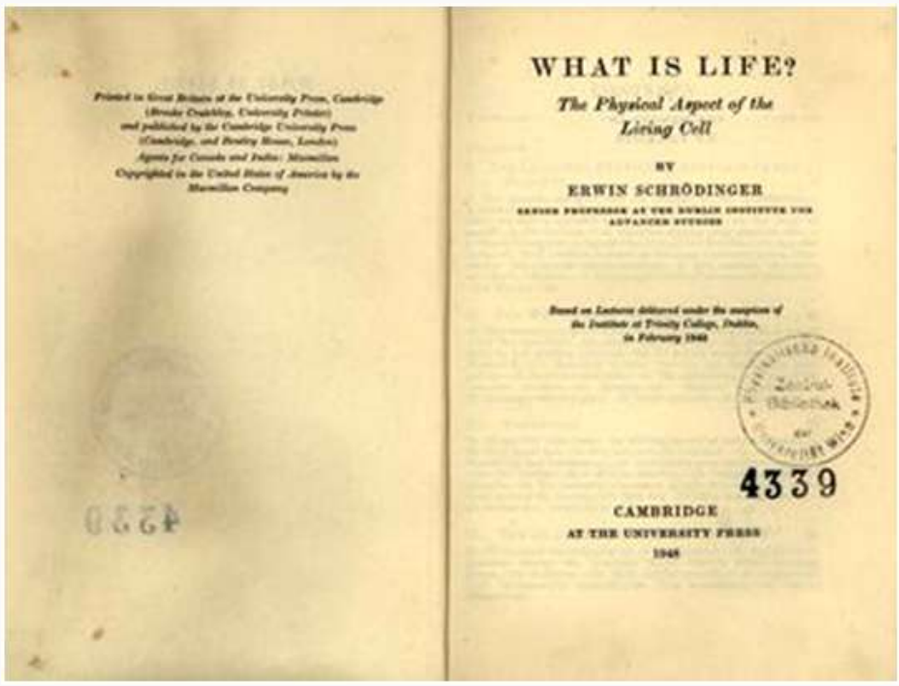
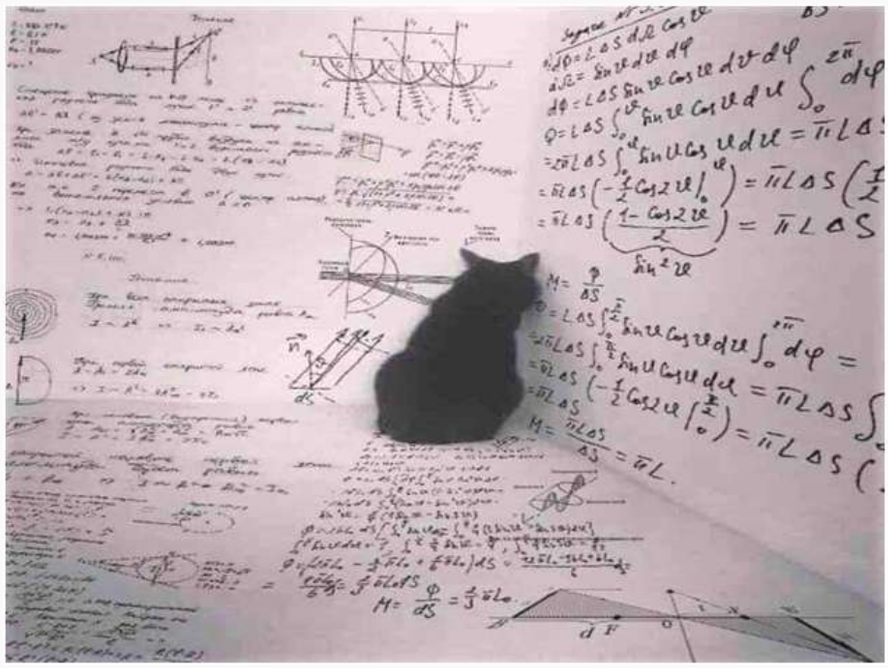


Title pages of **"What Is Life?" of 1948 edition** (This picture is available in public domain, collected from Wikipedia)



Meanwhile, Schrödinger's cat's plans its revenge inside the box!!!

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WHEN PIECES OF OLD SAREES ARE LIFE SAVER

We all know that South Asia is one of the most densely populated region of our planet and one of the major reason of this population burst is high infant (less than 5 years old) mortality rate. How high infant mortality rate could be linked with over population? Well, that's a different story.

***Vibrio cholerae* bacterium**

In this article let's focus on reason of high infant mortality rate and how some brilliant scientific minds invented a simple solution to combat this menace. Developing countries like India and its neighboring country Bangladesh scores very high in terms of infant mortality rate as compared to the global index. The major cause of this tragedy is not anything complicated but diarrheal diseases which we often consider as very simple and self-healing. But, diarrheal diseases could be caused due to different kinds of bacterial, viral infections or due to several other reasons and their severity are not always the same with respect to little children who are yet to develop a robust immune system. May be we all have read about the disease Cholera in several Bengali literatures where devastating effect of this deadly disease has been described in details. Cholera is caused by a type of Gram negative bacteria known as ***Vibrio cholerae*** which has several different variants (serovars). The toxin producing variant of these bacteria is actually capable of causing the most severe form of diarrhea in infants (as well as in adults) in the form of cholera leading to significant number of deaths per year.

Infant suffering from acute dehydration due to Cholera

The question is where these bacteria live and how they are entering our system? Fresh water is the natural habitat of such Vibrio cholerae and they get easily transmitted to humans through contaminated drinking water. Villagers of these regions are often found to be kind of reluctant to use tube wells due to high incidence of arsenic contamination in underground water. Therefore, in most cases, surface water sources like pond and river water is still used for house hold purposes including drinking. A section of villagers is still compelled to defecate in open areas and therefore Vibrio choelerae get easy chance to contaminate surface water which is known as 'oral-fecal route'. As a consequence, cholera is found to be prevalent throughout the year especially in rural areas where availability of safe drinking water and arrangement of proper sanitation both are generally not adequate. However, that is not the end of the misery as cholera takes a devastating epidemic form especially in rural low land areas of Bangladesh during the past few decades during monsoon season followed by flood as both availability of drinking water and proper sanitation is a sort luxury during that time of the year.

After it was known that cholera is water borne disease, quite naturally, improving drinking water quality was the main solution prescribed to combat this deadly problem. That should not be big deal as we know that drinking water quality could be improved in terms of making it germ free easily by using proper standard chemical and physical treatment which is in practice for quite sometime now. Let's take the example of one of the simplest physical water treatment method

WHEN PIECES OF OLD SAREES ARE LIFE SAVER

which is in practice for may be centuries, that is boiling of water before drinking. But this also could not be used routinely by the poor villagers because of the fact that it would require additional amount of fuel either in the form of fuel wood or kerosene etc. Secondly, during monsoon or flood, procuring enough fuel to boil water for drinking purposes could be a huge challenge too. So it seems that a very simple solution for somebody may not be feasible at all to others.

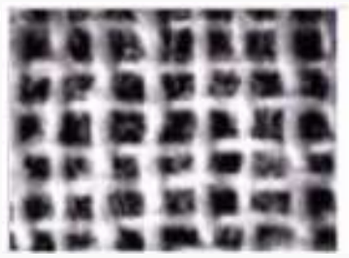
Thus, unfortunately, none of the standard method for producing clean drinking water was acceptable for a majority of village population. The major reason for this was as described above, cost of clean drinking water production, the insufficient amount of production to meet the daily needs and the ease of use apart from some of the social acceptability issues. Moreover, using any of the standard treatment method at the end user level for the production of safe drinking water during natural calamities such as flood is beyond imagination.

Now coming back to ***Vibrio choleare***, which is definitely an aquatic organism but not always free living. Rather it is found to be greatly associated with a particular type of zooplanktons known as 'copepods' as part of their natural gut microflora. Copepods are small crustaceans found in freshwater sources like pond and river in great abundance and single copepods have been found to be carrying up to 103 to 104 numbers of ***Vibrio choleare*** bacteria depending upon and size and species. The question may come into our mind here whether a few ***Vibrio choleare*** is good enough to cause the disease or not? The answer is no, cholera is a dose dependent disease and clinical symptoms of cholera develop only when this bacterium is ingested in 10^3 to 10^6 numbers and thus considered as infective dose for the disease. So it is pretty clear that even a single copepod is able to provide infective doses of the bacteria. It has also been demonstrated conclusively through laboratory studies that planktonic copepods play a major role in the survival, multiplication and transmission of cholera bacteria.

copepod

Interestingly, these copepods are found to be blooming in Bangladesh region during the period of October-November and an outbreak of cholera is followed immediately after that. Therefore, it has been hypothesized that a copepod bloom may lead to the presence of infective doses of ***Vibrio cholerae*** in per ml of surface water used for the purpose of drinking.

Traditionally it was observed that villagers often use cloth, mostly a flat, unfolded piece of an old saree to filter different kinds of drink prepared in their homes. Now scientist became interested about this traditional method and studied the old saree cloths under electron microscope and they found that old saree cloth which has almost no economic or commercial value could provide a filter of 20 mm size if folded 4-8 tim



Electron micrographs of a single layer of sari cloth filters. Pore size is 100–150 mm in old (laundered) sari cloth, but 20 mm if folded four to eight times.

Now, any filter of this size is actually sufficient to remove all copepods and Vibrio choelare attached with it from drinking water collected from surface water sources. Later it was found that

WHEN PIECES OF OLD SAREES ARE LIFE SAVER

this filtration method has the capability of retaining 99% of ***Vibrio choleare*** if used after folding them at least 4 times.

Based on the above mentioned observation, a group of scientists developed a simple filtration method between the year 1999-2000 using cloths like old saree or gamchaa to remove Vibrio cholerae attached to planktonic copepods from environmental water. This was done based on their hypothesis that if copepods could be removed by this method to a significant extent from surface water used for drinking purposes then incidence of cholera could be reduced to a great extent. The hypothesis was then tested through a 3 long years of study in Matlab, Bangladesh in collaboration with the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B).

Villagers from cholera affected areas including females and children under the age of 5 who do not have access to treated drinking water were selected for this study and grouped into three categories: one who will be using nylon mesh (another affordable material may be obtained from mosquito net, mesh size 150 mm) second saree cloth and the last group will be using none (will be treated as negative control). Villagers participating in this study were also trained to place the filter (nylon or saree) over the neck of the collecting vessel commonly known as "kalshi" so that when the kalshi is dipped into a pond, canal or river, the water can enter into the vessel only after passing through the filter. Participants were

Villager filtering pond water with a piece of saree

also trained to clean the filter by simply rinsing the filter at first with same contaminated pond/river water followed by filtered water and then to dry it under sunlight before use it for subsequent times. Approximately, 44,000 people participated in this study under each group.

Data collected over a period of three years showed that both the group who were using nylon filtration ($P<0.005$) or saree filtration ($P<00.2$) experienced significantly lower incidence of cholera in comparison to no filtration group, although saree filtration groups had little edge over nylon filtration group in terms of success. Based on linear model it was deduced that incidence of cholera reduced to almost half (~52%) for saree filtration users in comparison to no filtration group which was a highly encouraging data. Interestingly, most of the villagers were found to be quite interested in using this affordable filtration method as this was directly affecting health of their little child and it was so easy to use.

Thus, this study demonstrated that a simple household thing like an old saree could be used successfully to filter drinking water when other means are not easily available or affordable and thereby could save millions of lives. This filtration method holds the promise to be improved and tested for other waterborne diseases as well especially in those developing nations where access to safe drinking water is a big hurdle.

This story definitely teaches us that sometimes a simple idea could provide a sustainable and affordable solution to a global problem with respect to public health point of view in the less economically viable population who can barely afford to have sophisticated and expensive systems.

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CARBON CAPTURE ON SHIPS – SAILING ENROUTE TO DECARBONISATION

INTRODUCTION

We are surviving in the times when the Earth is at a critical point for us humans. Human existence is predictably threatened on our only home in the Universe.

For us the rapid climate change of the earth is of grave concern. According to many studies by the environment scientists the cause of the changes to the climate patterns is primarily due to global warming which in turn is caused by emission of greenhouse gases emitted largely by human actions.

The greenhouse gas making the largest contribution from human activities is carbon dioxide (CO2). It is released by burning fossil fuels and biomass as a fuel. Emissions of CO2 due to fossil fuel burning are virtually certain to be the dominant influence on the trends in atmospheric CO2 concentration during the 21st century. Global average temperatures and sea level are projected to rise jeopardizing large populations.

The latest scientific assessment from the United Nations Intergovernmental Panel on Climate Change generated plenty of grim headlines very recently, but at least one of its most important findings went largely unremarked upon. Cutting emissions is paramount, they say—but in order to keep warming below catastrophic levels, we now must also find a way to take billions of tons of the carbon dioxide we've poured into the atmosphere back out. That process is known as carbon dioxide removal, or negative emissions.

The IPCC mentioned negative emissions in a special report in 2018. But this time, in the official assessment, they've put real urgency behind the finding. The IPCC has told that we all have failed in reducing CO2 and conventional mitigation alone will not suffice. Anthropogenic CO_2 removal is what you have left when you have failed at everything else.

Shipping and GHG emissions

International trade is one singular human action which is a cause of large GHG emissions.

Shipping is carrying out about eighty per cent of the international trade and the global shipping industry produces around 1 billion tons GHG emission, annually, which consists more than 2.5% of the global GHG emission. According to the

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According to the International Maritime Organization (IMO), if no actions being taken, the portion of shipping emission may increase to 17% of the world in 2050.

The United Nations Framework Convention on Climate Change adopted the Paris Agreement in 2015 with the intent to sharply reduce greenhouse gas (GHG) emissions in order to keep the average global temperature rise below 2 degrees Celsius and preferably limited to 1.5 degrees above pre-industrial levels. In response to the U.N. initiative, the International Maritime Organization (IMO) recently set ambitious targets for de carbonization of the global fleet, aiming to reduce carbon dioxide (CO2) emissions from shipping by at least 50 percent by 2050 compared to 2008.

Carbon capture and storage (CCS) is seen as a potential bridge technology, offering the possibility to extract carbon from emissions until carbon-neutral fuels become more viable. In a full CCS solution, carbon removed from a vessel's exhaust gas would be stored away to prevent it from ever entering the atmosphere.

The commitments made by the IMO for radical reductions in shipping emissions by 2050 will require major changes to fuels and vessel design. The current favoured option is for the use of zero carbon ammonia as fuel. However the global investment required for fuel production and changes to ship design has been estimated to exceed $1 trillion. Adoption of technologies to capture engine emissions with delivery of the captured carbon dioxide to ports would avoid the huge cost of new fuel production and delivery systems. It would also allow retention of existing vessel and high performance engine designs, potentially offering a much lower cost of marine decarbonisation.

GHG emissions reduction can be achieved in several ways, including carbon capture and storage(CCS). This is not a new process for the Industry ashore but it has been recently adopted onboard ships and is still in an experimental stage This is the process of capturing waste CO2, usually from large point sources such as power plants or cement factories, and transporting it in liquid or vapor form to a storage site. The Intergovernmental Panel on Climate Change considers CCS . an important method of reducing global CO2 emissions.

Most studies concerning carbon capture focus on onshore power plants that use fossil fuels, but it is also a potential supplemental solution for reducing the overall carbon footprint of a vessel or offshore unit. Unless the vessel or unit is using a zero-carbon fuel such as ammonia or hydrogen, other fuels — including liquefied natural gas, liquefied petroleum gas, methanol, biodiesel and renewable diesel — will release CO2 as a byproduct of combustion. CCS for shipboard application refers to a set of technologies that can be used to capture CO2 from the exhaust gas of a vessel or offshore unit and store it for subsequent disposal or use.

Carbon capture methods

Carbon capture is an old technology onshore being recently adopted onboard ships. Over the past 20 years, many research groups around the world have explored carbon capture technologies to increase efficiency and reduce the size and cost of the systems, which are typically designed for electric power plants. CO2 has been safely transported and used in many industries for decades and can be moved by ship, truck or pipeline. Maritime deployment of CCS is now being researched and piloted by multiple firms.

There are three major types of CO2 capture systems: post-combustion, pre-combustion and oxyfuel combustion. Pre-combustion and

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oxy-fuel combustion remove carbon from the fuel prior to use and produce hydrogen and oxygen, respectively, for combustion. Consequently, the pre combustion and oxy-fuel combustion systems require integration into the fuel supply and power generation systems and call for a total redesign. The post-combustion method captures CO2 from flue gas and therefore can be added to a conventional design with minimal alteration to the engine. Retrofitting vessels or offshore units as a standalone system is relatively straightforward.

In the most conventional process, there are two steps to separate CO2 from emissions: capture(sorption) followed by thermal or pressure-swing desorption, also termed regeneration. In capture, the CO2 is absorbed into a liquid or solid by contacting the CO2 source with the absorber. In the desorption/regeneration step, CO2 is selectively desorbed from the absorber, resulting in a flow of pure CO2 gas with the original amine sorbent regenerated for further use.

Rules and Standards for Carbon capture

Regulations and policies for carbon capture are mostly still in development, with Europe being a notable early adopter. The European Union's directive on geological storage of carbon dioxide came into force in 2009, providing requirements for this stage of the process. In 2005, the Intergovernmental Panel on Climate Change released a special report on CCS that covers maritime considerations, including the design, construction, operation, risk, safety and cost of systems.

In addition to these initiatives, the United Kingdom's Department of Energy and Climate Change has projects in motion to support the relatively new technologies. In the United States, the Environmental Protection Agency is working on developing regulations to track national carbon capture activity and ensure safe practices.

Considerations Onboard Ships

The challenge in the offshore environment is the handling and storage of captured CO2. The process requires significant power to liquefy or solidify the captured byproduct, and storing it in gaseous form on board is not a viable option due to space requirements.

CO2 transforms from gas to solid directly when cooled at ambient pressure and solidifies at minus 78 degrees Celsius. It also can be solidified by interaction with other chemicals.

To transport CO2 in a liquid state, it needs to be contained at a pressure of 0.7 Megapascals and minus 50 degrees Celsius. If the liquefied CO2 is to be stored on board, the storage space should be determined based on the expected capture during the voyage. One ton of liquefied CO2 occupies about 1 cubic meter of volume.

It is encouraging to note that CO2 carrying ships are already being buil for storage and reuse of CO2.

Ultragas and Evergas two Companies set-up the first shipping company to transport CO2. The captured CO2 will be transported by vessels for storage (CCS) and reuse (CCU) and thereby enabling large-scale emission reductions. The shipping company will transport CO2 on specially designed ships that run on low carbon fuels. The carbon footprint from the shipping will be only about 3-6% of the CO2 that will be disposed of.

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Figure : CO2 Carrying Ship

Current research and application

Offshore CCS initiatives present CO2 storage opportunities through the use of existing or abandoned wells. Research projects in partnership with the U.S. Bureau of Ocean Energy Management are collecting data on offshore storage complexes along the mid-Atlantic, Southeast and Gulf coasts.

These projects use 3D flow and geo mechanical modeling to assess sites with the potential to store millions of metric tons of CO2.

Mitsubishi Heavy Industries (MHI) recently conducted a concept study focused on installing a carbon capture and storage unit on a very large crude carrier. The system was comprised of four towers for cooling the exhaust, absorbing CO2, treating the exhaust and regenerating the CO2, in addition to the required liquefaction and storage facilities. The objective of the project was to investigate onboard production of methane or methanol by combining hydrogen from water electrolysis with the captured CO2. MHI reported a CO2 capture rate of about 86 percent and a 20-year rate of return due to the high capital and operating expenses involved.

What's happening in the UK ?

The United Kingdom's Department for Transport recently funded a project by a Company called PMW Technology, the process specialists which has partnered with the marine design naval architechts' company Houlder Ltd. to study the potential of using the Advanced Cryogenic Carbon Capture process (A3C) carbon

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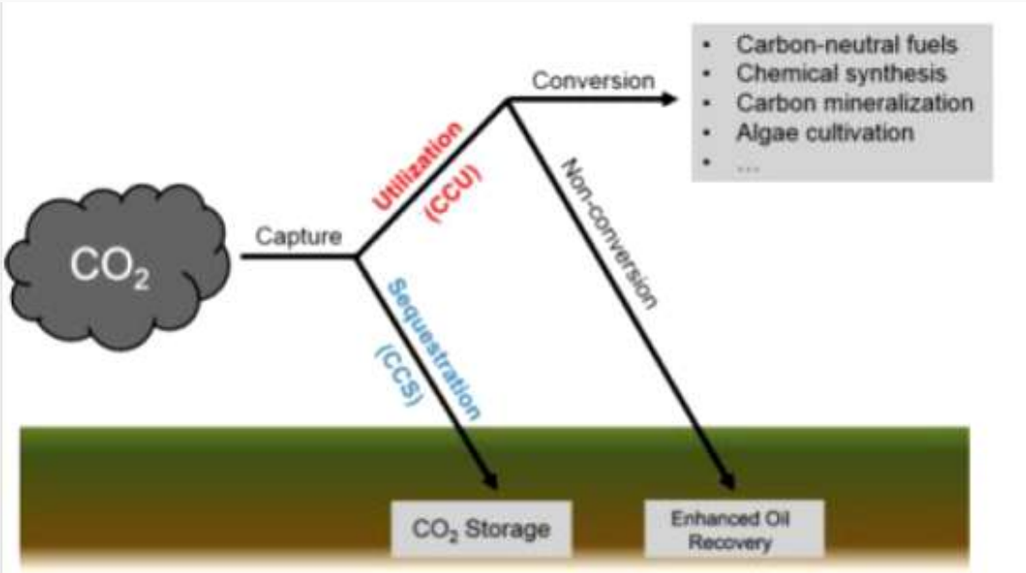

Figure : CO2 Utilization

capture process in shipping. The process involves extracting CO2 from exhaust gases by freezing and subliming it. The CO2 then would be liquefied and stored in tanks onboard the ship.

The Company PMW technology believe that their new A3C carbon capture process will be a major disruptive development to enhance industrial decarbonisation and can be easily installed on ships.

A study by the UK transport department showed that the adoption of alternative fuels necessitate substantial changes to ship / engine design and extensive new infrastructure for fuel manufacture and bunkering. It suggested that these will incur estimated costs of carbon abatement substantially higher than comparable costs estimated for carbon capture onboard and storage. Recent developments in carbon capture technology offer an alternative marine decarbonisation option that does not appear to have been considered to date. This disruptive technology uses a compact physical freezing process for carbon capture, avoiding the use of conventional large, energy intensive chemical processes. The liquid carbon dioxide captured at sea proposed to be unloaded to shore storage to be transferred directly, or via further ship transport, to geological carbon storage facilities. The impact of the additional flows of carbon dioxide and the costs of operation of such facilities had also been estimated.

The Advanced Cryogenic Carbon Capture process (A3C) uses low temperatures to separate the carbon dioxide physically from a gas stream without process chemicals. The equipment is compact, with an advanced heat exchange and refrigeration design which minimizes energy consumption, making it more suitable for marine application.

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The A3C process has been developed primarily for exhaust gas carbon abatement and its application to gas streams containing 1.5% to 40% mol carbon dioxide has already been evaluated. Marine diesel engine exhaust gases typically contain 3.5-6% carbon dioxide. Integration with the exhaust gases and ship systems is therefore the primary aim.

The A3C cryogenic carbon dioxide separation process has two stages, each with a circulating packed bed of metallic beads, as shown in Figure below. The first step cools and removes all traces of water from the gases, while the second cools the gases further to separate the carbon dioxide as a coating of frost on the moving bed material.

In this process the heat transfer within the moving beds of fine metal beads is very intense, enabling a very compact separation to be achieved, delivering a comparable separation to that in an absorber column 15m high in a bed only 50-100mm deep. The advanced recuperative refrigeration cycle exploits the heating required to

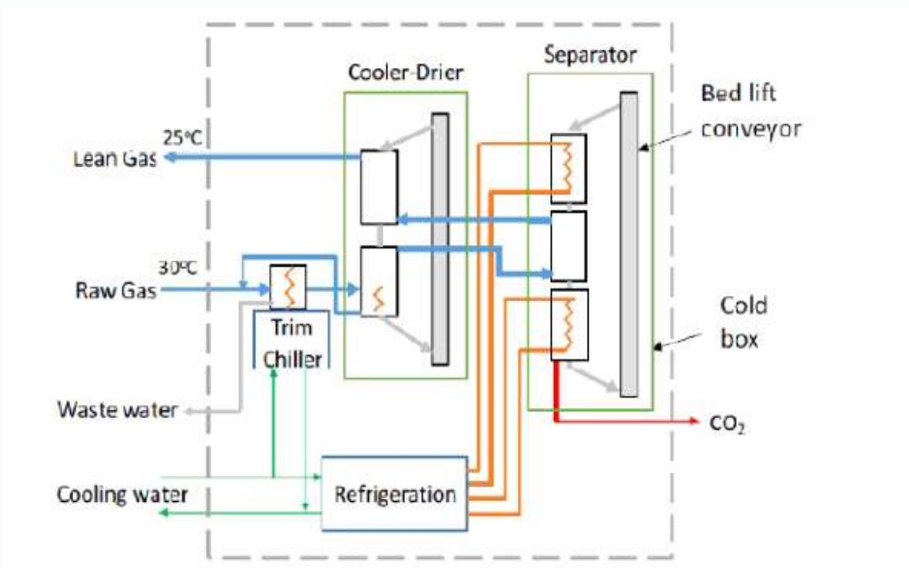

Figure : Outline of the Advanced Cryogenic Carbon Capture process

recover the carbon dioxide from the frosted bed to offer a very low refrigeration energy consumption for a cryogenic system.

The integration of the A3C process with ship systems is illustrated in the Figure below. The stages of the process comprise an inlet cooler which chills and cleans the engine exhaust gases, followed by A3C gas drying with cryogenic separation of the carbon dioxide.

The inlet cooler removes the sulphur and nitrogen dioxide contaminants in the exhaust gas and washes out any particulate matter. The resulting wash water is treated to remove particulate and other contaminants before discharge to sea. The raw gases from the inlet cooler flow into the A3C separation process described above, returning cold lean gases and a separated stream of gaseous carbon dioxide.

The separated carbon dioxide is liquefied using a simple process of low pressure CO2 liquefaction as shown in Figure below. This compresses the gas to around 30 bar, condenses it by cooling and then flashes the liquid to a lower pressure, typically 10 bar, causing a small part of the flow to flash off, cooling the remainder, while the cold gas is recompressed. The liquid carbon dioxide is stored in insulated tanks at about -40°C.

The liquid carbon dioxide would be unloaded at arrival ports to be transferred directly or by onward shipping to industrial cluster systems for sequestration.

The vessel main engines may be fuelled by fuel oil, distillate (MGO, MDO), a biofuel blend, or LNG. Any biofuel

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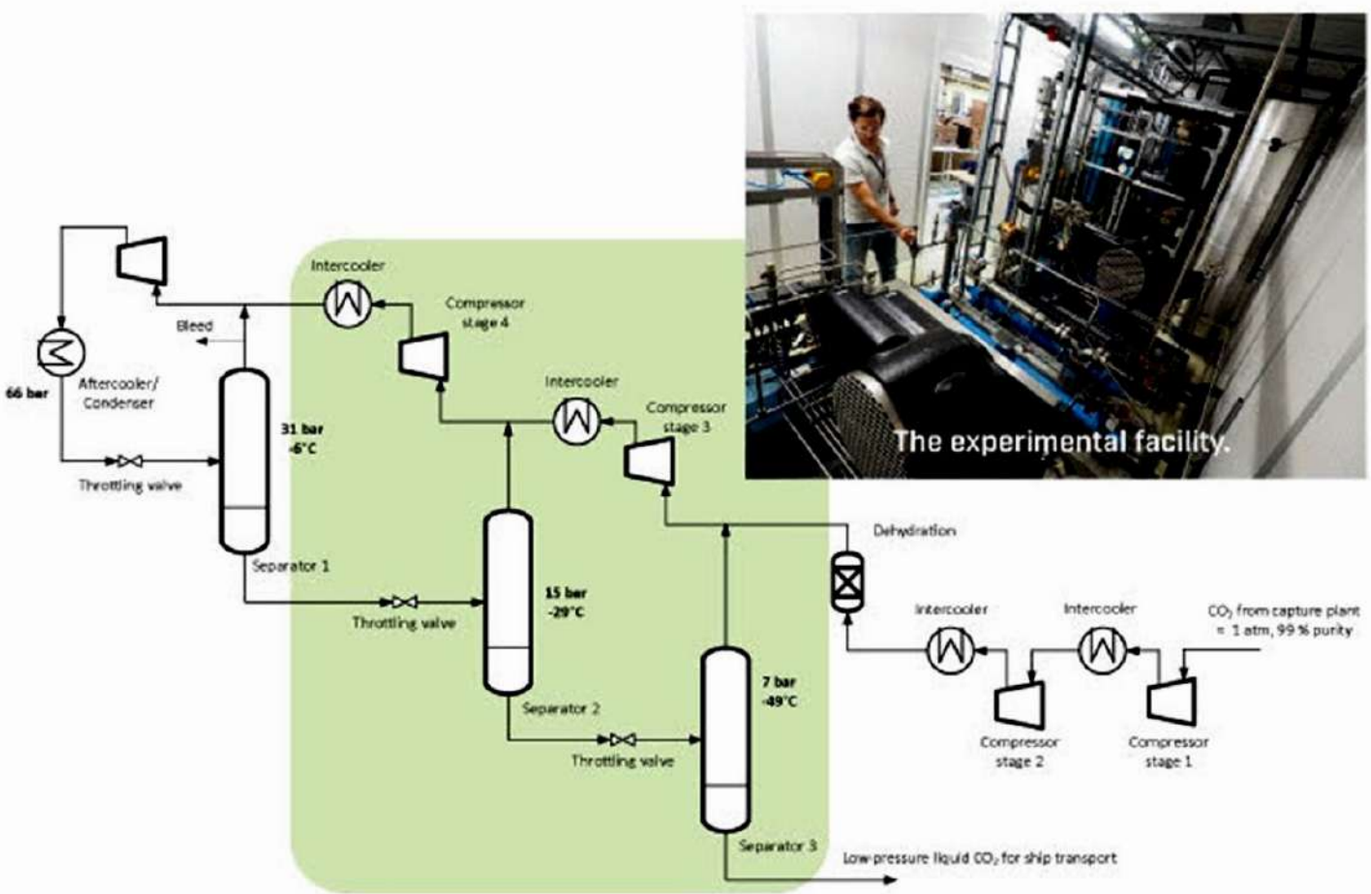

would contribute valuable negative carbon emissions.

The sulphur and nitrogen oxide emissions are regulated by the MARPOL Annex VI. For emission control the sulphur content of fuel for use without abatement measures such as exhaust gas scrubbing is now limited to 0.5% worldwide and 0.1% in S(SOx)ECA zones. An acceptable alternative is to clean the exhaust gases to reduce sulphur missions to equivalent levels to these limits.

The gas cleaning stages of the A3C process inherently remove sulphur oxides to extremely low levels. This would allow vessels incorporating carbon capture to use higher sulphur fuels which may offer economic advantages

The adoption of this technology for onboard CO2 capture is imminent after necessary approval from Ship Classification Societies.

What's happening in Europe ?

DecarbonICE, a project with the aim of leading the industry to carbon negative shipping, has garnered support from a number of major players from the industry. Shipping companies NYK, Sovcomflot, Knutsen OAS and Ardmore, ship builders, including Daewoo Shipbuilding and Marine Engineering, and the mining company Vale, have all teamed up with the Denmark-based Maritime Development Center (MDC) to develop an on-board carbon capture and storage solution that will help the industry achieve the IMO 2050 target of a 50% CO2 emissions reduction compared to the 2008 level.

DecarbonICE is based on two new main ideas for the capture and

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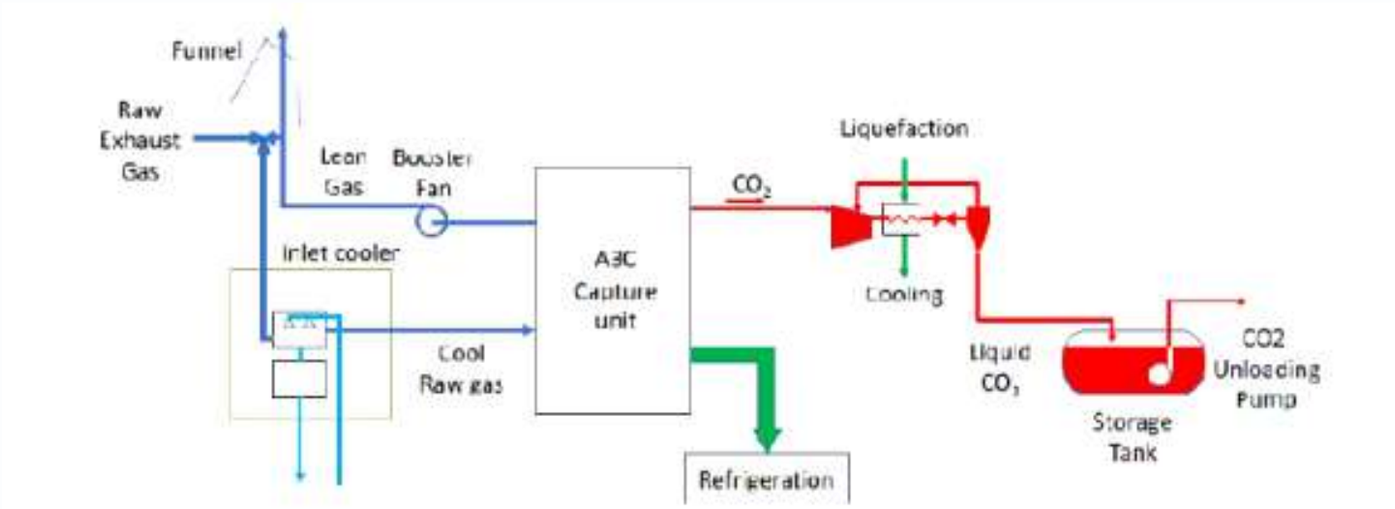

Figure : Integration Of Advanced Cryogenic Carbon Capture process onboard Ships

storage part, respectively. The CO2 and other GHG's in the ship exhaust are captured on board in a cryogenic process and turned into dry ice.

Proven offshore technology is then applied during normal ship operations to transport the dry ice into the seafloor sediments. Here the CO2 will be safely and permanently stored as liquid CO2 and CO2 hydrate.

The concept is not only intended for ship new buildings, but also for retrofitting on existing ships, thereby providing the opportunity to accelerate the transition towards the IMO target. The DecarbonICE Technology is a radical innovative carbon capture and storage (CCS) solution for reducing GHG emissions from the shipping industry with an estimate of 90%. The concept is to freeze the CO2 in exhaust gas from a ship into dry ice powder, cast the dry ice powder into streamlined ice blocks and discharge these into the deep-sea.

DecarbonICE is a collaboration between some of the world's largest yards and shipping companies who want shipping to reduce global warming and contribute to the Paris agreement and IMO CO2 reduction plans.

The capture of the CO2 takes place in an on-board cryogenic plant which produces a Carbon Descent Vehicle (CDV) of pure CO2 dry ice. The CDV is launched at sea in large abyssal plain areas below 3000-meter water depth and penetrates the seafloor deep enough into the seabed sediments that only very primitive life, in the form of bacteria, is potentially affected.

The pressure and temperature at the storage sites will transform the dry ice into liquid CO2 which then reacts with pore water into CO2 hydrate - something the seabed sediments already holds trillion of tons of. The CO2 hydrate is thermodynamically stable within the sediments, and will be safely stored for a minimum of tens of thousands of years.

The solution builds on known technologies and physical principles and can be used on new buildings and retrofitted into ships using existing

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fuels such as HFO, MGO and LNG. When new carbon neutral fuels like biofuels or synthetic fuels (e-fuels) become available, the technology will in combination with such fuels lead to carbon negative shipping, where CO2 is removed from the atmosphere and thus contribute to atmospheric carbon reduction at a significantly lower cost than shore-based carbon capture, according to MDC.

The project will develop conceptual designs and proof of concept for the following sub-systems:

- ***Cryogenic Carbon Capture Plant for both LNG and MGO/HFO engines***
- ***Production system for manufacturing CDV out of CO2 dry ice***
- ***Launching system for releasing CDV to the sea***
- ***Designs for integrating the system into new buildings and retrofits***

What's happening in Japan and Asia ?

Japanese shipping major Kawasaki Kisen Kaisha (K Line) plans to deploy a small-scale, marineuse demonstration plant for CO2 capture onboard one of its vessels in collaboration with project partners Mitsubishi Shipbuilding and classification society Class NK.

The project is supported by Japan's Maritime Bureau of the Ministry of Land, Infrastructure, Transport, and Tourism (MLIT) as part of its programs to support research and development for advancing marine resources technologies.

As disclosed, the project, called Carbon Capture on the Ocean (CC-Ocean), is intended to achieve CO2 capture at sea, a world first.

K Line will collaborate with Mitsubishi Shipbuilding and Class NK to install a small-scale CO2 capture demonstration plant onboard its vessel, conduct test operations of the plant, and measure its performance.

The marine-use CO2 capture demonstration plant will be based on an onshore plant and designed to capture a portion of a vessel's gas emissions.

This project will aim to verify the efficacy of capturing and storing CO2 from a vessel's gas emissions, as well as the operability and safety of CO2 capture facilities at sea.

These demonstration tests are aimed at promoting the development of more compact equipment required by marine environments along with the development of system requirements necessary for stable continuous operation at sea.

The two-year project began in August 2020 with the launch of a HAZID (hazard identification) evaluation of the demonstration plant and deployment on vessels, with verification from ClassNK.

"This demonstration experiment conducted at sea is the first of its kind in the world. The knowledge gained will be used for future development of technologies and systems to capture CO2 from the exhaust gases of marine equipment and ships," ClassNK the Japanese Ship Classification Society said.

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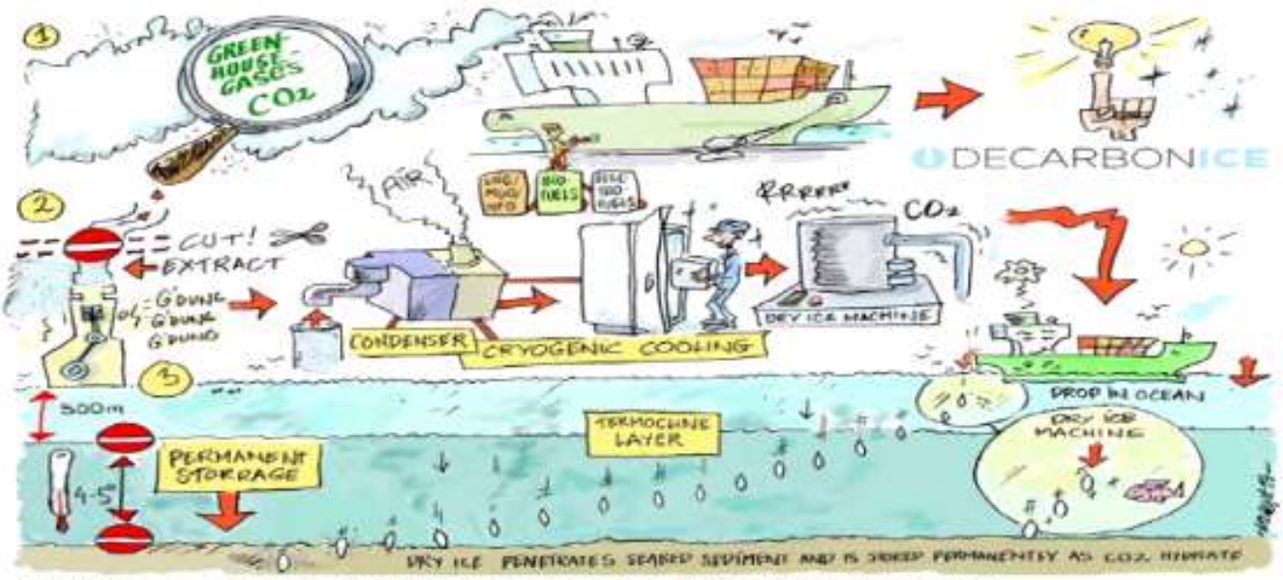

Figure : A cartoon showing the decarbonICE project concept

Figure :CO2 Capture Plant onboard

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Mitsubishi Shipbuilding will begin development and construction of a small-scale CO2 capture demonstration plant and evaluation of system safety.

In June 2021, Mitsubishi Shipbuilding was as scheduled tested the operation of the demonstration plant at its factory, followed by recent deployment of the plant on K Line's Corona Utility, a thermal coal carrier operated for Tohoku Electric Power Co.

By the end of fiscal 2021, the project partners are expected to start operating the demonstration plant on-board the vessel and measuring the system's performance under marine conditions.

"As the world's first marine demonstration test, the project will provide invaluable insights into facilities design and technologies for capturing CO2 emissions and achieving zero emissions onboard vessels," K Line said.

Additionally, the captured CO2 is expected to be recycled as a new CO2 source for Enhanced Oil Recovery (EOR) processes or as raw material in synthetic fuel through methanation, the reaction by which carbon oxides and hydrogen are converted to methane and water. In industry, there are two main uses for methanation, to purify synthesis gas (i.e. remove traces of carbon oxides) and to manufacture methane. In this way, the project will significantly contribute to the long-term reduction of greenhouse gas emissions.

The CC-Ocean project is part of K Line's Environmental Vision 2050.

Figure:Small Scale CO2 capture demonstration plant

Capturing CO2 onboard with scrubbers

Swedish company Alfa Laval has managed to capture CO2 in a recent trial performed in cooperation with Japan's National Maritime Research Institute(NMRI) . using exhaust gas cleaning technology. Initiated by NMRI, the CO2 capture testing project was designed to provide real-world validation of results achieved in the lab. The test involved a full-scale hybrid scrubber system, provided by Alfa Laval, which had been installed on a vessel owned by an unnamed Japanese ship owner.

The ship owner, who had installed Alfa Laval PureSOx, arranged with Alfa Laval and a local shipyard to include the testing in the vessel's sea trials. The scope of the project was limited to showing that a scrubber could perform the CO2 capture on board. According to Alfa Laval, the modified PureSOx system was able to absorb CO2 from the auxiliary diesel engines in port, while operating in closed loop.

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Alfa Laval PureSOx is a proven solution with a long track record in SOx abatement The positive results from the project with NMRI Japan show that scrubber technology could also play a role in removing carbon at sea. Much development is needed before CCS can be deployed at sea, but this preliminary testing showed clear potential in the approach.

Alfa Lava pointed out that decarbonizing the marine industry will demand a wide range of emission-reducing technologies in addition to new fuels, stressing that cooperation in exploring those possibilities is the only way to go.

Figure : Pure SOx Scrubber from Alfalaval also captures CO2

Conclusion

If we consider Earth as our only home we all must believe that this one Earth needs to be protected and help create shared efforts toward solving shared problems like the climate crisis. Shipping is a polluter – its greenhouse gas emissions make up roughly 2.5% of the globe's total – and reliance on international trade means that the sector is predicted to increase its carbon foot print substantially if nothing is done to make ships greener. The shipping industry is looking for carbon free solutions to achieve the IMO 2050 target of a 50% CO2 emissions reduction compared to the 2008 level. While better technical and operational solutions must continue to be pursued, they will only bring the industry part of the way. Low or zero carbon fuel solutions must be introduced and scaled by 2050 to reach the target.

Without a doubt we humans in Earth are at a critical point. With emissions rising year by year, the problem of climate change is getting worse. On the bright side more innovative solutions are emerging. One of them seems very promising. Its name is Carbon Capture and Storage (CCS).

While this method is not being used widespread today, it has the potential to be a great tool in achieving our climate goals.

Carbon capture technology is facing many technical and economic challenges for marine and offshore applications. However, it still has the potential to be an effective method of reducing GHG emissions from future vessels and offshore units, especially in conjunction with lowcarbon fuels. Further technical advances are expected to reduce the scale, cost and complexity of the technology and its wide adoption in international shipping in the very near future.

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Information on the internet available from Ship Classification Societies, Shipping/Shipbuilding Companies, Maritime Development and Research Centres, The UK Transport Department and the International Maritime Organisation.

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ROBOTICS @TNU

The COVID pandemic spurred us to engage the Robot in our daily life. To prevent infection we need to avoid the human contact and therefore, the demand for robots in factories, office, malls and hospitals have been increased in many folds. All they need is the contactless operation in services, delivery, sanitizing, and medical care. Western countries are better prepared for this situation, since they are already using robotics and automation since long time. But manufacturing industries in India are facing major problems due to labour dependency, cost cutting and low efficiency. These are driving them to adopt Robotics and automation in the manufacturing process rapidly. Even the small scale industry, MSME segment is also facing problems of absent migrant labour and social distancing imperatives. Therefore, they are also considering the option to automate their manufacturing process by Robotics and Automation.

However, rather than cheap Chinese Robots, Indian industry is inclining towards home-grown Robots. A lot of Indian startup company rising fund to take this opportunity. Researchers in IITs and other elite institutes are working hard to develop indigenous robot. We are at TNU also in this race since last five years.

We have started developing robots since 2017. Students have been assigned with micro, mini and major projects. Therefore, at the end of four year B.Tech, they have a good experience of how to develop a robot. The robotics and Automation unit at The Neotia University is well equipped with advance equipments like 6 Axis pick and place Robot, SCARA, Plotter, Mobile robots, IOT etc. We have Advanced RTOS equipments for real-time operation. Students also have the 3D printer facility at the lab. The lab itself is Alexa enabled smart, Intelligent and automated. In our futuristic innovation and incubation center we assign international level innovative projects to the students. With these innovative projects, students are participating in national level competition like, NSSC organized by IIT, KGP, IICDC organized by TI & DST, Govt. of India, IIC by organized Intel etc. and they also received many awards. Our students even present and publish their innovative project work in international forum in the form of research papers. We have received a lot of support from our Industry collaborator, Phi Robotics Research Pvt. Ltd. for developing robots. We have also received support from many industries like, Texas Instruments, WABCO, MieRobot to develop robots and solve real life industry problems.

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Our students have developed micro projects like bug robot to major projects like advanced humanoid. They have developed mobile robots starting from line follower robot to follow me robot to gyro based robot to two-wheeler balancing robot to ROS and computer vision enable advanced mobile robot. They have done almost all applications of IOT from Alexa enabled automation to home automation to facial expression based IOT automation. They have also done some interdisciplinary projects like automated irrigation system for agriculture. The students of Robotics and Automation are also experts in Artificial intelligence and Machine learning. They have published a good number of research papers in this topic. They have a huge interest on drone development. They have developed from simple GPS based drone to advanced face detector and criminal finder drone. The list is huge and could not be completed in this limited space.

Development of Drone in progress

However, one project I should mention here is MARIA-Multiple Applications Robotic Intelligent Assistant. It is a multifunctional four feet height advanced humanoid with automatic obstacle avoidance, navigation, and route planning provided as its capability. She can hear voice, provide assistance, recognize and move around autonomously. She has been equipped with advanced face recognition technology to identify different people/ character.

Development of MARIA

Another high-end project we have taken, named Pushpak: A driverless e-Rickshaw for self guided tour. It is equipped with of sensors, cameras, radar and artificial intelligence (AI) to travel between destinations without a driver. It is fully automated and the vehicle able to navigate without human intervention to a predetermined destination over roads that have not been adapted for its use.

However, in this limited space I could not elaborate on these vast projects. Hopefully in the coming issue I would be able to discuss on the technology behind these projects.

ROBOTICS @TNU

Definitely, the students from Robotics and Automation unit of The Neotia University are well equipped with combination of hardware and software with updated course structure and syllabuses with all recent developments. They have the subjects like Motors and Sensors, Microprocessor & Microcontroller, Embedded Systems, Control Systems, Signal System and DSP, Inverse Kinematics, Real-Time Operating Systems, IoT, Machine Design, Motion Planning, Computer vision, Artificial Intelligence, Machine learning, etc. They are experts in C and Python. They have work experience in areas of LIDAR, Drone, ROS, UX DESIGN, and also machine vision using OpenCV. They also have experience of industrial training and industry internships in the company like Amazon, BPCPi, and WABCO are few of them.

Therefore, for the new generation just joining in the professional course – the big question is: how to navigate this automation issue? What are the skills needed to tackle this monumental shift in the technology? Who will be the engineers have value in this emerging automated world?

We will still need good students who can deal with the new projects, manage the existing robots, and maintain them. Therefore, they will have a natural shift from academia to industry. The career opportunities for this newly emerging field required interdisciplinary knowledge of hardware, software and firmware. The new eligibility for industry 4.0 goes to them who can design automation and robotics; and those who can adapt and maintain new equipment.

Therefore, the students of this department undoubtedly have a good opportunity to develop themselves for the career in Robotics and Automation to capture the market demand.

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A CONCEPTUAL FRAMEWORK FOR SMART GOVERNMENT ENTERPRISE AND INDUSTRY 4.0

Government Enterprise Architecture (GEA) is the inherent design and management approach essential across the Government processes coherence leading to alignment, agility and assurance. The Government process of major countries are rapidly advancing in digital Governance through various Mission Mode projects (MMPs) and other e-Governance Projects designed to efficiently deliver services to citizens. However, ensuring interoperability amongst various e-Governance systems, processes and applications across all the Government reference model for analytics is very important. Without the assurance of interoperability of Government process at enterprise level, citizens will have fragmented interactions with several agencies. These largely uncoordinated interactions with limited coherence will significantly degrade the quality and effectiveness of service delivery contrary to the Government of India's (GoI) vision and intent. The conception of Government-wide EA (GEA) is the results of this consideration, and how to implement GEA has become a major challenge among IT policymakers form many countries. One of the major challenge of GEA framework for Government structure is to satisfy the information needs from the core GEA model for government-wide IT policymakers. The IT policymakers and the top level decision makers of the country are not concern with how each parameter introduces GEA deliverables, but concern how national IT strategy is aligned and populated in the form of IT projects, information systems, and other IT assets throughout all references of GEA. This upcoming concept aimed to clarify the direction of enterprise architecture, data analytics, and smart government and how they are related to each other with respect to various line departments like, Agriculture, Healthcare, electronic Food Distribution System (ePDS), Finance, Transport and others. The study on this concept in correlation with Industry 4.0 is also discusses non-functional requirements for smart government architectures, highlights different technologies used, explores various strategies and architectures and studies standards and guidelines.

Industry 4.0 is often used interchangeably with the notion of the fourth industrial revolution. It is characterized by, among others, 1) Even more automation than in the third industrial revolution, 2) The bridging of the physical and digital world through cyber-physical systems, enabled by Industrial IoT, 3) A shift from a central industrial control system to one where smart products define the production steps, 4) Closed-loop data models and control systems and 5) Personalization/customization of products. The goal is to enable autonomous decision-making processes, monitor assets and processes in real-time, and enable equally real-time connected value creation networks through early involvement of stakeholders, and vertical and horizontal integration. In the end, it remains business – with the innovative twist of innovation and transformation of business models and processes: increase profit, decrease costs, enhance customer experience, optimize customer lifetime value and where possible customer loyalty, sell more, and innovate to grow and remain relevant.

Under the over-arching vision of this concept may aim to make all digital services through multiple channels, such as web, mobile and common service delivery outlets. To meet this objective, there is a need for an interoperable ecosystem under the framework of GEA, which will make the right information available to the right user at the right time. In this context, it is important to ensure interoperability amongst various e-Governance systems to upgrade the quality and effectiveness of service delivery through proper feedback mechanism model. This conceptual framework may be used to analyse the requirements of GEA analytics in a smart government ecosystem. This was contextualized by decomposing selected smart government

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architectures that served as a basis for understanding the interrelationships between components. This framework can be used as a guide to help developers and designers in creating government enterprise architectures for analytics in smart Government.

Typically, Governments are the largest organizations. They are further characterized by complex federated structures where individual government organizations work in their respective silos. Often this leads to fragmented government business processes and duplicated systems and technologies, creating obstacles in cross agency interoperability. There exists a positive correlation between the desired level of e-government capability and maturity and the required level of architectural maturity of GEA. The major challenges of GEA is the lack of cross-ministry and agency viewpoint and coordination with proper feedback mechanism through the predictive analytic models at enterprise level.

Most countries promote their departmental agencies and local governments to introduce GEA, with developing standard principles, frameworks, and reference models. Meanwhile, some other advanced countries have been making an effort to develop national level enterprise architecture which is aimed to provide an integrated view of agencies enterprise architecture. However, there are challenges in the GEA programs related to integration and interoperability within and between public agencies. Some researchers find these challenges very hard to overcome.

The Enterprise Architecture (EA) reference model, based on the "The Open Group Architecture Framework (TOGAF)", establishes best-in-class architectural governance, processes and practices using ICT infrastructure and applications to offer ONE Government experience to the citizens and businesses through cashless, paperless, and faceless services enabled by Boundary less Information Flow. This concept also aims at proposing a framework for architecture design which addresses smart government non-functional requirements. In order to achieve this, strategies, trends, standards, technologies, and guidelines related to smart government are explored.

This concept contributed to a preliminary understanding of the basic GEA components and their interrelationships that are required to successfully develop, manage, and implement the intelligent and smart government enterprise architecture under the smart ICT ecosystem across the country. Relying on existing research, a conceptual framework may be proposed to illustrate this contribution to enhance the delivery of smart public services to the citizen and the predictive data trends and information to the policy makers across the country. It's main contribution is the relation between business and applications architecture in the public sector, which is realized using open smart government processes intelligently on real time basis. The framework can be used as a starting point for actual smart government architectures. It should also provide a mechanism to stimulate value generation from analytics in smart cities.

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WATER RECLAMATION AND REUSE: SUSTAINABLE STRATEGY FOR INTEGRATED WATER RESOURCE MANAGEMENT

ABSTRACT

The importance of water reclamation and reuse worldwide and especially for a severe drought-prone agricultural country like India cannot be overstated. With the growth of population and economies around the world, the demand for fresh water is increasing at an alarming rate. The recycling and reclamation of municipal wastewater and its reuse for agricultural, industrial and domestic purposes, along with rainwater harvesting and recharging of aquifers, constitute an essential strategy for integrated water resource management for the drought-prone and arid regions of the world. This article mentions the various uses of reclaimed water and enumerates the associated environmental, economic and social benefits. The advances in water reclamation technology are briefly discussed. The article touches upon the water reclamation and reuse activities in various countries and discusses the current state of affairs in India. It also highlights the importance of rainwater harvesting and aquifer recharge as integral components of water resource management.

INTRODUCTION

The Earth has recycled and reused its water reserve through the natural hydrological cycle driven by solar energy for millions of years. Water reclamation removes impurities from wastewater and makes it reusable for a wide range of beneficial purposes. It is therefore a newer and essential form of water recycling by expending energy through technology-aided processes. Water reclamation and reuse have gained importance in recent times because the demand for fresh water is steadily increasing with the growth of population and economies around the world. The situation has further aggravated due to global warming and is compounded by a strong El Nino event over 2015-16. This has resulted in some of the most intense heat wave conditions ever documented, with temperatures soaring well above 50˚C, causing severe drought in many regions of the world (WMO 2016). This alarming situation calls for a sustainable strategy for integrated water resource management that includes reclamation of wastewater and its reuse, water conservation and watershed management, water harvesting, water budgeting and recharge of groundwater aquifers in the drought-prone and arid regions of the world. For countries like India, which is demographically agricultural based country with vast stretches of drought-prone areas and where agriculture is largely depend on a good monsoon, the implementation of the various strategies of water resource management is of utmost importance. Though this article discusses the different aspects of water reclamation and reuse, it also keeps in focus the larger perspective of integrated water resource management and its necessity for a drought-affected country like India.

RELATED TERMINOLOGY AND DEFINITIONS

Water reclamation refers to treatment of wastewater to remove biodegradable matter, suspended matter, dissolved and colloidal solids, nutrients and pathogens, thus rendering it fit for reuse. Water reuse is the utilization of treated wastewater for beneficial purposes that include both potable and non-potable uses. ***Water reclamation*** and reuse is thus synonymous with ***water recycling*** (Levine et al).

Water reclamation and ***reuse*** may be ***unplanned*** or ***planned***. ***Unplanned water*** reuse constitutes the intake of a city's water supply from a river located downstream from the discharge

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point of treated wastewater. ***Planned reuse*** of reclaimed water involves adequate treatment of a wastewater to ensure water quality for appropriate usage. It can be ***indirect*** or ***direct***. For ***indirect*** reuse, the reclaimed water after treatment, mixes with other supplies or is stored in a man-made or natural storage facility for assimilation, before it is delivered through pipeline to a water treatment plant or distribution system. The storage facility could be a groundwater basin or a surface water reservoir. In ***direct reuse***, the reclaimed water directly goes through pipeline to a water treatment plant or to a distribution system (USEPA 2012).

Reclaimed water is the usage of water more than once before it passes back into the natural water cycle.

Gray water or ***sullage*** is reusable wastewater generated by human activities such as washing or taking bath in residential, commercial and industrial establishments excluding discharges from toilets i.e., wastewater without faecal contamination.

Black water or sewage is faecally contaminated wastewater.

USES AND BENEFITS

Reclaimed water is commonly used for non-potable uses such as irrigation of food and non-food crops, orchards, vineyards, landscapes, parks and golf courses, augmentation of streams and wetlands, groundwater recharge, industrial processes and cooling, construction activities, concrete mixing, toilet flushing, dust control etc.

Water reclamation provides important environmental benefits. It supplements the natural sources of water and is used to create wetlands and riparian habitats which act as breeding ground for fish and habitat of wildlife. Reclaimed water helps to reduce diversion of fresh water from sensitive aquatic ecosystems for agricultural, urban and industrial requirements, which increases stress on such ecosystems. Use of reclaimed water fulfill the considerable amount of natural water usage and reestablishes the flow that stabilize and improve the health of degraded ecosystems. Water reclamation also decreases the discharge of wastewater into sensitive aquatic systems such as estuaries and streams and helps in preservation of habitat and protection of species diversity. Water reclamation lessens discharge of wastewater into aquatic systems such as oceans, rivers and streams, and thus reduces or prevents pollution. In some cases, nutrient rich wastewater might have a beneficial impact when reused for agricultural and landscape irrigation, because it reduces the need for synthetic fertilizers.

Water reclamation also offers economic benefits in the form of financial and resource saving. Reclaiming wastewater and its reuse result in saving of energy and resources. Many industries extract groundwater, treat and transport it, sometimes over large distances, to meet their water requirements. All these operations are carried out by expending energy. This practice depletes the groundwater reserve, a valuable natural resource. Reclamation of wastewater on-site and reusing it for industrial processes and flushing saves both energy and resource. The treatment of wastewater is tailored to meet the water quality requirement for a specific reuse e.g., the water quality required for flushing of toilets is less stringent than that for agriculture use or potable water and requires less energy and hence less expenditure to achieve the low quality water (USEPA 1998).

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In India, water reclamation and reuse projects are essentially community-driven social initiatives whose success depends on the active participation of the whole community (SANDRP 2016). The beneficiary of such projects is also the community, as a whole. Water reuse programs thus provide water security, guarantee income of farmers, generate supplementary income through alternate means of livelihood and improve the quality of life for the whole community. These constitute valuable social benefits of water reclamation and reuse.

WASTEWATER RECLAMATION TECHNOLOGY

The primary objectives of a wastewater reclamation project is to achieve reclaimed water quality goals for an intended reuse application and more importantly, to protect public health, prevent environmental degradation and to save water. The first task in any reclamation process is to identify the constituents of the wastewater and to estimate their concentrations. Untreated municipal wastewater contains a wide range of objectionable constituents such as large gross solid materials, suspended and floating solids, settleable inorganic and organic matter such as grit and sludge, dissolved solids and colloidal solids which are very small suspended particles that pass through membrane filters. In addition to solids of varying size, key wastewater constituents are the microbial and chemical contaminants. Microbial contaminants include a wide range of pathogenic bacteria, protozoa, helminths and viruses. Wastewater also contains a very wide range of chemical contaminants - the variety and concentrations of these contaminants in the reclaimed water depend upon the source of wastewater, mode of its collection system, degree of treatment and the treatment processes employed. Inorganic constituents of wastewater include metals and salts, oxyhalides and nutrients, mainly nitrates and phosphates. Presence of toxic heavy metals in wastewater occurs mostly due to non-compliance with environmental regulations for pre-treatment of industrial effluents. Salinity in wastewater, measured as total dissolved solids (TDS), affects crops and plants. Oxyhalides such as bromate, chlorate and perchlorate are often generated during treatment of wastewater. The treatment facilities must be properly designed and operated to reduce oxyhalide formation during treatment progress. Nutrients i.e., nitrogen and phosphorus, occur in wastewater from human waste and industrial waste must be removed properly as their presence in reclaimed water poses environmental and health hazards. Organic constituents of wastewater commonly include naturally occurring humic substances, faecal matter, kitchen wastes, oils, greases, liquid detergents and wastes from industries.

The success of a wastewater reclamation project depends upon proper planning of infrastructure and facilities, location of the wastewater treatment plant, treatment process reliability, economic viability, financial analyses, public acceptance and water utility management (Levine et al). The major factors that determine the selection of water reclamation technology are the intended water reuse application, reclaimed water quality objectives, characteristics of the wastewater, flexibility of the process i.e., its ability to handle both hydraulic and contaminant overload, costs of installation, operation and maintenance including energy, chemicals and manpower requirements, residue disposal options and regulatory requirements (Water Reuse, 2012).

The wastewater treatment processes are categorized as - preliminary, primary, secondary and tertiary or advanced - and these include both natural

and engineered processes to meet the water quality objectives in a water reuse project. Preliminary treatment includes measuring in-flow of wastewater, screening out large gross solid objects and removal of grit to protect the equipment against unnecessary damage. Primary treatment removes total suspended solids, settleable organic matter as raw sludge and floating matter like scum. Addition to that, it also removes harmful pathogens, regulates hardness, acidity and alkalinity. Secondary treatment removes dissolved organic matter, expressed as BOD load and also nutrients. Secondary treatment processes usually consist of aerated activated sludge basins which recycle part of the activated sludge or fixed-media filters with recycle flow e.g., trickling filters or rotating biocontactors. These basins are followed by solid separation technique through settling or membrane filtration and disinfection as sludge treatment. Advances in secondary treatment processes over the last two decades have seen in the development of membrane bioreactor (MBR) that eliminates the requirement of primary treatment and secondary sedimentation and uses only a fine screen as a preliminary treatment. The advantages of MBR processes include complete removal of solids, significant disinfection capability, fast and highly efficient removal of organics and nutrients and low energy consumption. In the past decade, reduction in the cost of membrane modules, increased service life and improvements in process design and operation have led to many domestic and industrial applications of MBR. Its integrated design allows easy scaling down of the technology which has facilitated decentralized water reclamation. These advances in membrane filtration have made membrane based processes attractive for reuse applications. Disadvantages of MBR include membrane fouling and its adverse effects on plant maintenance and operating costs. Technological challenges that must be overcome include increasing productivity i.e., amount of water produced per unit membrane area. The minimization of membrane fouling is done by improving treatment efficiency through increased oxygen transfer and membrane aeration to lower operational costs of the MBRs. Use of chloramines helps to reduce membrane fouling, besides their usual role as chemical oxidants and disinfectants. The application of nanotechnology in membrane processes facilitates efficient and cost-effective removal of contaminants from wastewater. The success of nanotechnology arises from their very high adsorbing, interacting and reacting capabilities. Due to small size and greater surface area of nanoparticles, a high proportion of contaminants get adsorbed at the surface. Nanomaterials have been used in recent times for varied applications in the field of wastewater treatment such as membrane filtration, adsorption, destroying contaminants by photocatalysis, disinfection and sensing of pollutants (Mukherjee and Kundu 2015). Membrane filtration using a variety of membranes is used to produce drinking water from sea water, brackish water, groundwater, surface water and wastewater (El Saliby et al). In wastewater reclamation, membrane filtration is used as tertiary or advanced treatment to remove dissolved solids, remains of organic compounds including pesticides, colloidal and suspended solids, nutrients and pathogens. Nanomaterials are also used for removing organic and inorganic pollutants by adsorption. Nanosorbents have high and specific sorption capacity due to which the pollutants are held to the surface either by physisorption or by chemisorption. Nanosorbents are used to remove heavy metals from wastewater because of their high adsorption capacity

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and selectivity for specific pollutants at low concentrations and are later regenerated by desorption. Semiconducting oxides and sulfides are used as photocatalysts for removing chemical and biological contaminants from wastewater. Nanomaterials used for this purpose should be photoactive in the visible and near-uv regions, stable towards photo-decay, nontoxic, insoluble in water but hydrophilic. These must be highly reactive towards contaminants, cheap and easily available. Titanium dioxide and zinc oxide satisfy most of the criteria mentioned above and are the most studied.

Disinfection is carried out to reduce pathogens in the reclaimed water. Commonly used disinfectants in wastewater reclamation for both potable and non-potable reuse are chlorine (both as gaseous chlorine and liquid hypochlorites) and uv-irradiation. In addition, chloramines, chlorine dioxide and ozone are being used increasingly for potable applications. Disinfection with nanoparticles of silver, TiO2 and ZnO provide effective ways to neutralize microbes through the generation of reactive oxygen species (ROS) such as hydroxyl radical and peroxides under uv irradiation or visible light.

Tertiary or advanced treatment aims to remove remains of nutrients and organic constituents and to reduce total dissolved solids (TDS) in reclaimed water. Removal of nutrients is required for reuse applications such as stream flow augmentation and groundwater recharge to prevent eutrophication or nitrate contamination of shallow groundwater. Nitrogen is commonly removed by biological nitrification / denitrification processes. Less common methods of removing nitrogen are gas stripping and breakpoint chlorination. Phosphorus may be removed by chemical precipitation with metal ions like Ca(II), Al(III) and Fe(III) which are removed as precipitations by filtration after the activated sludge basin. Organic matter and trace organic chemicals may be removed from reclaimed water by membrane filtration (MF, UF, NF and RO), adsorption to activated carbon, biological filtration and chemical oxidation with chlorine, chloramines, ozone and uv-irradiation. Suspended and colloidal particles including microorganisms are removed from reclaimed water by depth filtration using mono- or dual-media filters of sand and anthracite (Water Reuse 2012).

WASTEWATER RECLAMATION AND REUSE PROGRAMS IN INDIA

Wastewater reclamation and reuse projects are being run efficiently in many countries of the world. Israel leads all nations of the world in reclaiming 80% of its wastewater which is reused in irrigating agriculture and public works and for land improvement. Reclamation of wastewater for non-potable reuse is carried out in many regions of United States and Australia. In Europe, reclaimed water is reused in significant quantities e.g., in Spain, for non-potable purposes.

In a developing country like India, most of the cities and towns neither have the installed capacity nor the collection network to undertake large scale sewage treatment procedure but is able to treat only a small percentage of the total sewage generated (CSE 2010). Also the quality of treatment in most of these sewage treatment plants is poor (CPCB 2007). Even where sewage treatment plants exist, sewage collection networks are poor, so only a small portion of sewage goes for treatment. The rest flows into nallahs

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and drains and ultimately runs into surface water bodies (Hingorani 2011). This untreated wastewater is used for irrigating crops, vegetables, flowers and fodders across the country. Wastewater irrigation increases cropping intensity up to four times over freshwater irrigation and is widely practiced in peri-urban areas. Major food and non-food crops that are irrigated with untreated or partially treated wastewater are as follows (Mekala et al 2008):

- Cereals: Wastewater, discharged in the Musi river in Hyderabad, is used for irrigating paddy fields along the course of the river. Wastewater is used to irrigate wheat in Ahmedabad and Kanpur.
- Vegetables: Vegetables are grown around many big cities of India using wastewater irrigation.
- Flowers: Wastewater irrigation is used to cultivate rose and marigold in Kanpur and jasmine in Hyderabad.
- Fodders: Paragrass, a kind of fodder grass, is cultivated with wastewater irrigation in the Musi river basin in Hyderabad.
- Aquaculture: The East Kolkata wetlands fed by untreated wastewater from Kolkata are the largest single wastewater system used for fisheries and aquaculture in the world.
- Agro-forestry: Plantations and orchards are irrigated with wastewater in Dharwad-Hubli in Karnataka.
- Parks and avenue trees: Public parks and avenue trees are irrigated with secondary treated water in Hyderabad.

Thus wastewater reuse in agriculture and aquaculture has positive impacts such as employment generation, food security for peri-urban farmers, reliable supply of irrigation water throughout the year and recycling of nutrients that help farmers to save on the cost of fertilizer and its reliable supply increases cropping intensity. But reuse of untreated or partially treated wastewater for irrigation has negative impacts as well. Long term use of untreated wastewater for irrigation increases soil salinity and leads to accumulation of heavy metals in the soil, which ultimately breaks down the soil structure. This leads to restrictions in the choice of crops and significant reduction in crop yields in the long run, thus endangering the very livelihoods it generates. Estimates of adverse impacts of the use of wastewater for irrigation have been highlighted in a report which shows elevated levels of metals such as Hg, Cu, Cd, Cr, Pb, Fe, Mn, Ni and Zn in samples of river-, well- and ground-water, soil, food grains and vegetables in five representative cities across India (Amerasinghe et al 2013). In all wastewater irrigated areas, groundwater has been found to contain high salinity and pathogens, which make it unfit for drinking. Also, discharge of wastewater with high nutrient content may cause eutrophication and imbalance in the ecosystem of the receiving water body. Treated wastewater is reused for industrial processes in cooling towers, boilers and for washing purposes. Chennai is known for industrial reuses of reclaimed water in India (Hingorani 2011).

NGINEERED NATURAL PROCESSES FOR WATER RESOURCE MANAGEMENT

Natural processes of water reclamation usually consist of managed aquifer recharge systems and natural or constructed wetlands whose objectives include removal of pathogens, suspended particulates, dissolved organic carbon (DOC), trace organic chemicals and nutrients. All natural treatment processes have a low carbon footprint (i.e., low energy requirement and little

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or no chemical input) with negligible generation of residues (Water Reuse 2012). Some of these managed surface and sub-surface natural processes may be used for rainwater harvesting. Subsurface Managed Natural Systems such as surface spreading basins and vadose zone wells enhance water quality and provide natural storage for reclaimed water or rainwater. ***Surface spreading basins or soil aquifer treatment (SAT)*** are used for slow infiltration of reclaimed water or rainwater through the vadose zone where sorption, filtration and biodegradation improve the water quality. Direct injection wells are used for aquifer storage and recovery (ASR) of highly treated reclaimed water or rainwater directly into a potable aquifer, where the same well is used for both injection and recovery. For injecting reclaimed water into a potable aquifer for drinking water augmentation, the water must be purified to meet the drinking water standards before injection.

WATER CONSERVATION INITIATIVES IN INDIA

In 2016, India has experienced one of the severest droughts after independence which has resulted in a very severe water crisis across the country. This drought has put the surface water bodies under severe stress and has pushed the groundwater aquifers to lower depths. The rural landscape in large parts of India is a picture of parched villages and agricultural fields. Amidst this gloomy scenario of heat and dust, inspiring efforts in the field of water conservation from different parts of the nation present a ray of hope. This section is devoted to the numerous water conservation initiatives and water resource management projects spread across the country (SANDRP 2016).

Surface spreading basins called chowkas have been traditionally used in Rajasthan for rainwater harvesting and recharging groundwater aquifer. Laporiya, a village 80 km from Jaipur, uses the chowka system in which small, interconnected sloping rectangular pits, nine inches deep, are made in pasture land. The pits are bordered with mud embankment which guides the rain water into them. Removal of surface soil increases permeability of rainwater which flows from one chowka to another and finally collects in a pond. This method of rainwater harvesting raises the water table to about 15-40 feet below the surface, keeps the topsoil moist and recharges the vadose zone. The restoration of moisture in the soil allows the cultivation of rabi crop without irrigating the fields by withdrawing groundwater. Smart crop planning led to shunning water-intensive crops such as wheat and soya and instead growing vegetables and fodder, which promoted dairy farming and provided an alternative means of livelihood. The chowka method of rainwater harvesting is now being followed in the neighboring villages and other districts of Rajasthan. Hiware Bazar village in Ahmednagar district is located in the worst drought-hit Marathwada region of Maharashtra. With the help of smart water conservation initiatives, efficient watershed management programs that include water budgeting, shunning water-intensive cash crops like sugarcane and banana and opting for crop diversification to grow vegetables, fruits, flowers, pulses and fodder, the village has been able to raise its groundwater table to barely 20-40 feet below the surface. Dairy farming supplements the income from agriculture. Along similar lines, Patoda in Aurangabad district in Marathwada has become a model of water conservation in the country. It does not allow rainwater to flow out of the

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village by building check bunds across the drainage system and recycles all the wastewater in stabilization ponds for reuse in agriculture. Percolation has recharged the aquifers and as a result the water table has risen. Water usage is strictly monitored by water meters installed in every household and water audit is carried out to ensure optimum water use. Installation of water filtration units has made potable water available from water dispensers. Gayajeetpura of Tikamgarh in the Bundelkhand region of Madhya Pradesh has adopted contour farming in which vegetables are grown in close rows on slopes created in the field so that water trickles down and covers a wider area. This village has partially shifted from water-intensive crops like wheat and soya to organic horticulture which fetches higher prices. Dewas in Madhya Pradesh has adopted rainwater harvesting by digging farm ponds in one-tenth area of the land of each farmer for storing rainwater which is used in irrigating crops. Dharwad in Karnataka uses farm ponds in low-lying areas to store rainwater and irrigate crops with it to harvest 3-4 crops a year. It may be stated at this point that drought is not the only reason behind falling groundwater table – indiscriminate extraction of groundwater using free or subsidized electricity plays a major role in the lowering of groundwater table in India (Rao 2016). Anantapur in Andhra Pradesh and six districts in neighboring Telangana have adopted the concept of networking of bore wells to share groundwater to secure rain-fed crops of all farmers, irrespective of bore well ownership. Every farmer has access to groundwater through a network of pipelines and outlets that link all the bore wells. This participatory groundwater management program has ensured sustained use of groundwater resource. Desilting, reviving and restoring river-beds, lakes, ponds and minor irrigation tanks for rainwater harvesting and recharging the groundwater aquifer have been undertaken in villages of Madhya Pradesh, Rajasthan, Telangana, Jharkhand, West Bengal and Odisha. All these community-driven local water conservation initiatives highlight the importance of the time-tested and local water harvesting structures that provide viable and cost-effective ways to recharge and rejuvenate the depleted groundwater aquifers. Upgradation of these local water conservation structures with governmental support and their integration with the modern water harvesting and conservation techniques may provide a sustainable strategy to attain water security and sufficiency across India.

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NARRATIVE CONCEPT OF GENETICS FROM MENDEL TO GENOME SEQUENCING: MINI REVIEW

ABSTRACT

The concept of genetics developed in Gregor Mendel's memoir on plant hybridization (1866). The pea was the original model among the leguminous plants and used in Mendel's discovery of the laws of inheritance which make the foundation of modern plant genetics. He scientifically analyzed the products of crosses upto three generation by introducing new concepts (in gene, genotype and phenotype) in the science of heredity. The awareness of the Mendelian laws of inheritance expended in the scientific world after the rediscovery by three botanists - Hugo DeVries, Carl Correns and Erich von Tschermak (1900). However, the word 'genetics' was coined in 1906 by William Bateson and became one of the leading advocates of Mendelian genetics. In the 1910s, Mendelian genetics fused with the chromosomal theory of inheritance and evolved the classical genetics. This foundation established the gene as a unit of function, recombination and mutation. These concepts of gene coincided prior (1950) when DNA was not found to be basic material of inheritance. After that the scheme of molecular biology started revealing the complexity of hereditary material functions. Now we know Gregor Mendel as a father of genetics. This study provides basic information of genetics discovery mainly focus over the Gregor Mendel.

Keywords: ***Genetics, Heridity, Hybridization, genotype, phenotype***

INTRODUCTION

Origins of genetics: Mendel

The genetics was approximately known in 1866 when Mendel's memoir was published on plant hybridization [1]. Mendel's intention was not to present general laws of heredity. He was interested in investigation of only a 'law of the development of hybrids' in plants but luckily established the hypothesis in heredity science. Mendel got success because he was fortunate in choosing the diploid plant and got seven pairs of contrasting characters in pea plat as shown in figure1, which was present on four different chromosomes. He crossed pea plant up to F3 generation, considering only one character at one time. His data based on the principal of statistics and established the dominance, Law of segregation, Law of independent assortment. However, Mendel's memoir remained largely unknown until 1900 and expanded throught world after the rediscovery of Mendel's works in 1900 by three botanist Hugo de Vries, Carl Correns and Erich von Tschermak. In 1902 Bateson published a book "A Defence of Mendel's Principles of Heredity" [2] which openly connected Mendel's first law (law of segregation) of heredity and certainly a key event because it applied not only to the plants but also to animals. He coined the term genetics in 1906 and supported the Mendel concept of inheritance. Hugo de Vries published a book "Intracellular Pangenesis" which supported the existence of hereditary particles in all cells of an organism in 1889 [3, 4]. Further, Johannsen was explained the biological meaning of the 'term' gene as well as genotype and phenotype in 1909, which dominated until the emergence of the molecular concept of the gene [5].

Assimilation of information on chromosomes into genetics

In 19th century, the morphology of chromosomes and the mitosis and meiosis was relatively known. The August Weisman suggested remarkable behavior of chromosomes during cell division was important for the knowledge of variation and heredity. 1902, Walter Sutton and Theodor Boveri proposed the chromosomes as the bearers of the Mendelian factors. He defined the process the plants but also to animals. He coined the term genetics in 1906 and supported the Mendel concept of inheritance. Hugo de Vries published a book "Intracellular Pangenesis" which supported the existence of hereditary particles in all cells of an organism in 1889 [3, 4].

NARRATIVE CONCEPT OF GENETICS FROM MENDEL TO GENOME SEQUENCING: MINI REVIEW

started work on heredity with Drosophila melanogaster (fruit fly) using both the chromosomal theory of heredity and Mendelian genetics. He was the main architect of the fusion between Mendelian genetics and the chromosomal theory of inheritance.

In 1915, he published important book in the history of genetics 'The Mechanism of Mendelian Heredity'. Now, scientific world easily understand, why two copies of gene exist in all cells of a diploid organism and provided mechanistic way of law of segregation or purity of gametes [6]. Muller's X-ray induced mutagenesis experiments introduced the notion that a gene is a unit of mutation. Revolution started and scientist investigated the biological processes linked with genomics and began the sequencing of human genome projects in 1990 as listed below in pictorial form.

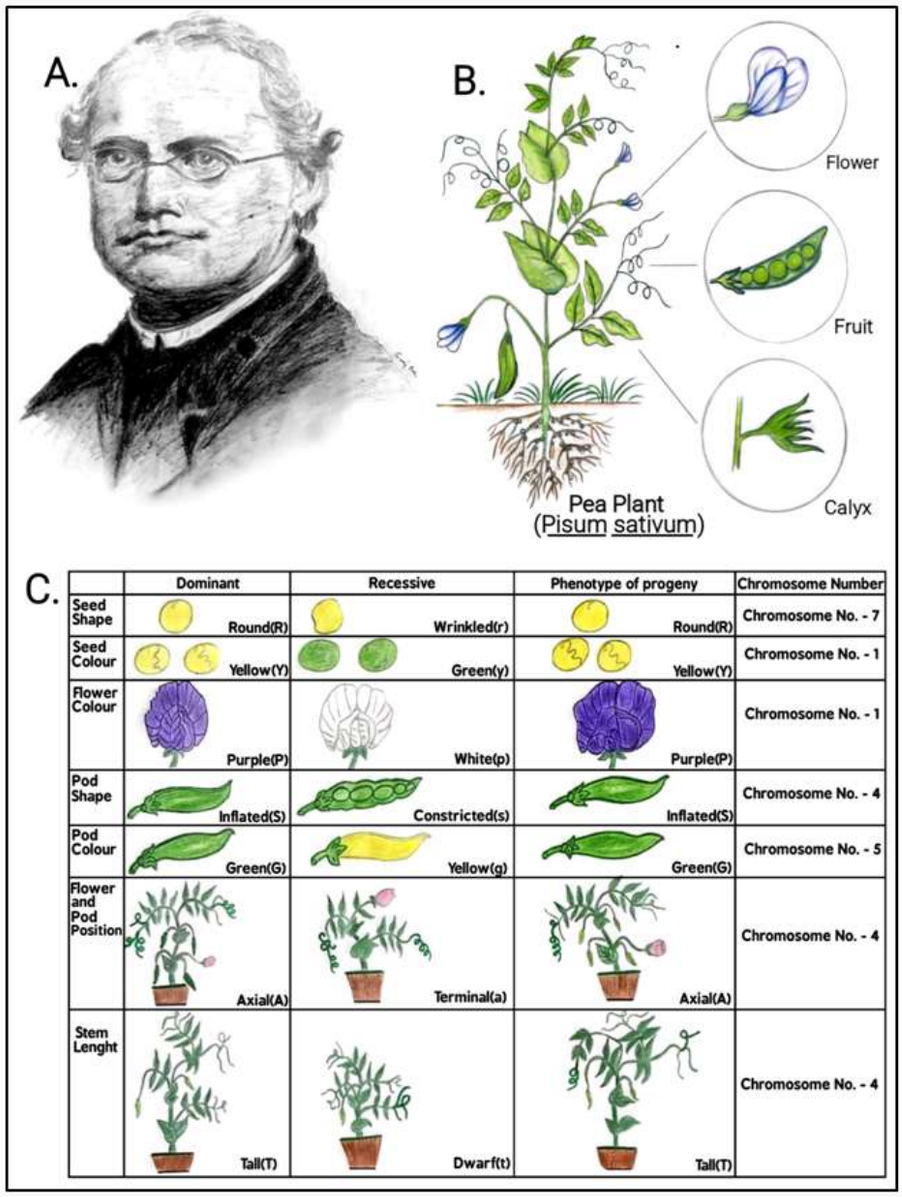

Fig.1 A. Gregor Mendel, father of genetics. B. Pea plant (***Leguminous*** family) was used in investigation of law of inheritance by Gregor Mendel. C. Seven contrasting pairs of character of pea plant were considered in Mendel studies which was present on four different chromosomes are insisted above in the figure.

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NARRATIVE CONCEPT OF GENETICS FROM MENDEL TO GENOME SEQUENCING: MINI REVIEW

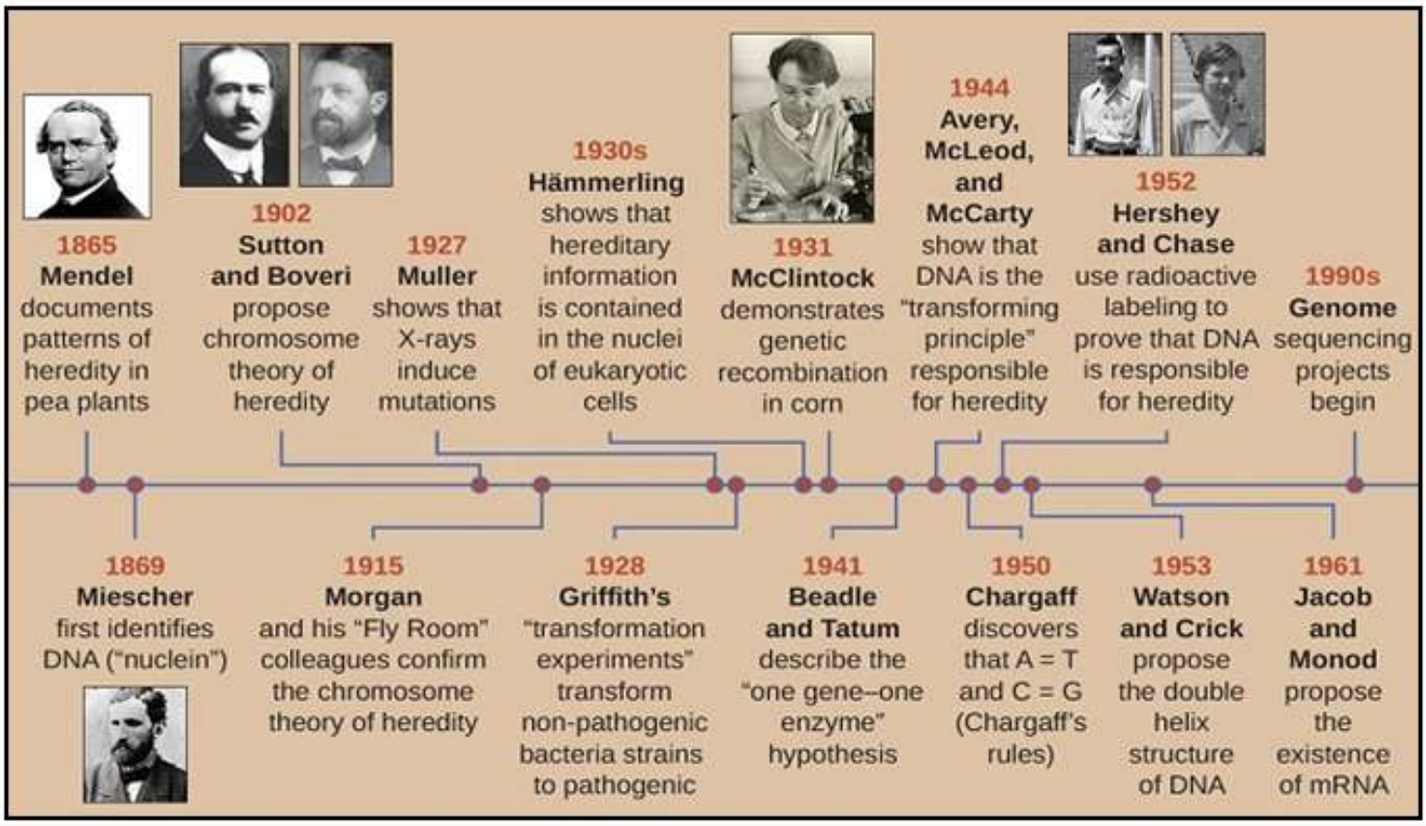

Fig.2 The scientific work and associated members are enlisted here from Mendel to initiation of genome sequencing projects (1990)

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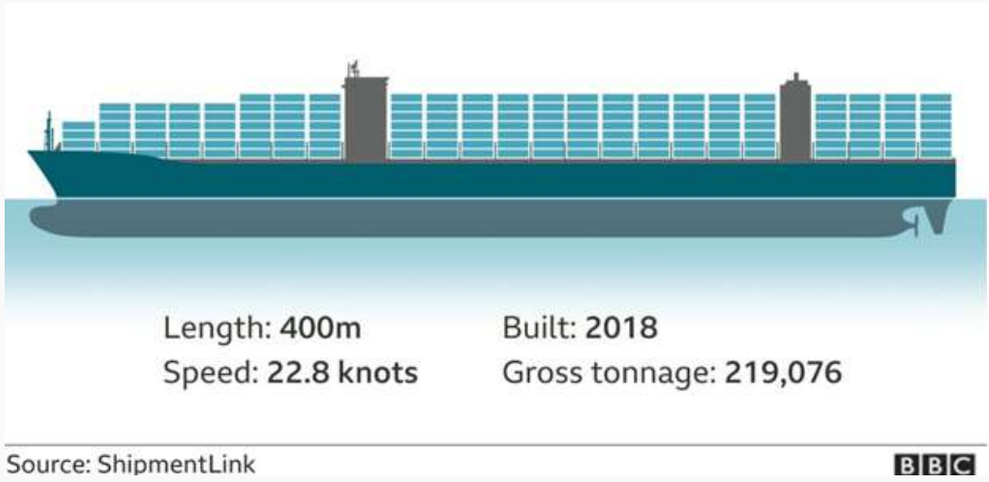
THE GROUNDING OF MV EVER GIVEN THE LARGEST CONTAINER SHIP OF THE WORLD IN THE SUEZ CANAL

The Suez Canal is an artery of world trade, connecting the Mediterranean with the Red Sea, and providing an avenue for vessels to pass between Asia and the Middle East and Europe. The main alternative, is a passage around the Cape of Good Hope at the southern tip of Africa, which takes considerably longer.

On an average, nearly 50 vessels per day pass through the canal; although at times the number can be much higher - accounting for some 12% of the World trade. It is particularly important as an avenue for oil and liquefied natural gas, shipments to Europe from the Middle East.

Nearly 19,000 ships passed through the canal in 2020, according to the Suez Canal Authority - an average of 51.5 ships per day.

The Suez Canal crosses the Suez Isthmus in Egypt – is a strip of land between the Mediterranean and the Red Sea. The canal is 193km (120 miles) long and incorporates three natural lakes.



In 2015, Egypt's government opened a major expansion of the canal that deepened the main waterway and provided ships with a 35km (22 mile) channel parallel to it.

INCIDENT OF GROUNDING (Impact of the ship touching the seabed)

The nightmare scenario, then, is for this crucial route to be blocked - which exactly is what happened with the grounding of the Ever Given in the month of March 2021.

The ultra large container ship MV Ever Given, flying the Panamanian Flag , has the capacity to carry 20,000 20-ft shipping containers, according to Reuters news agency and on the fateful day of 23rd March 2021 the container giant “Ever Given” accidentally blocked the canal.

On 23 March 2021, at 07:40 (05:40 UTC), Ever Given was travelling through the Suez Canal, when it was caught in a sandstorm. The strong winds, which exceeded 40 kn (74 km/h; 46 mph),resulted in the "loss of the ability to steer the ship", causing the hull to deviate. The ship then ran aground at the 151 km (82 nmi) mark (measured from Port Said on the Mediterranean Sea; 10 km (5.4 nmi) from Suez Port on the Gulf of Suez), and turned sideways, unable to free itself, blocking the canal on both sides. The crew consisting entirely of Indian nationals was accounted for and no injuries were reported.At the time of the incident, the ship was travelling from Tanjung Pelepas, Malaysia, to the Port of Rotterdam, Netherlands. It was fifth in a northbound convoy, with fifteen vessels behind it when it ran aground near the village of Manshiyet Rugola.

Acording to an analysis of data from ship-tracking websites by Evert Lataire,

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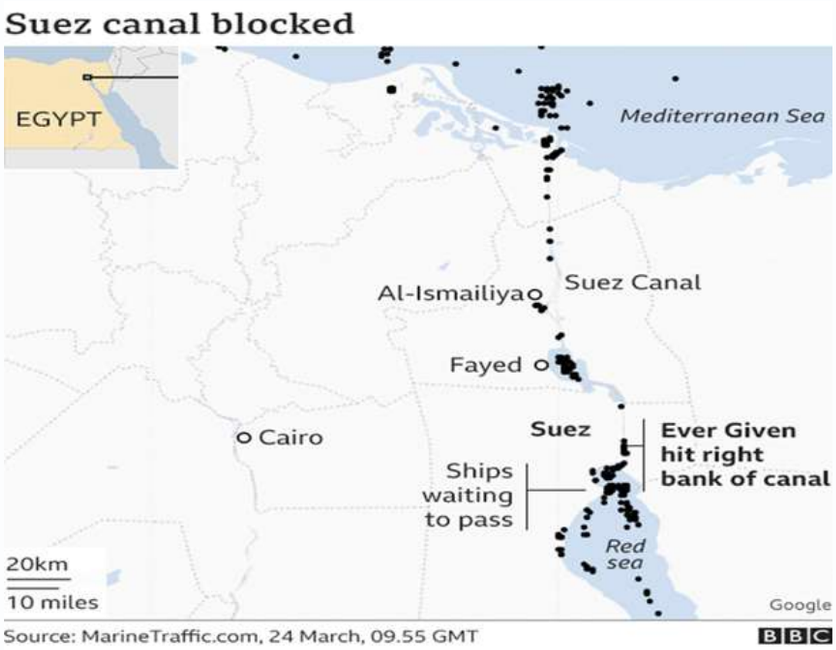
head of Maritime Technology division at the University of Ghent, the bank effect, which may cause the stern of a ship to swing toward the near bank when operating in constricted waterway, may have contributed to the grounding, along with the lateral forces of west-to-east winds pushing sideways against the northbound ship. Since most of the focus of modern ship design is directed towards efficiency and stability at sea, the effects of hydrodynamics in shallow waters, especially in light of the rapidly growing size of ships in the past decade, remain somewhat obscure and in need of further study.

Over 300 vessels at both ends of the canal were obstructed by Ever Given, including five other container ships of similar size.These included 41 bulk carriers and 24 crude oil tankers. The affected vessels represented roughly 16.9 million tonnes (37 billion pounds) of deadweight. Some docked at ports and



anchorages in the area, while many remained in place. The Ever Given's sister ship, Ever Greet, was affected by the disruption,as were two Russian Navy vessels: Steregushchiy-class corvette Stoikiy and Altay-class oiler Kola.

SALVAGE

The job of salvaging the ship was given to a world renowned salvage company SMIT Salvage, a subsidiary of Boskalis .

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For the refloating of the 224,000-ton container vessel approximately 30,000 cubic meters of sand was dredged to help free the vessel and a total of eleven harbor tugs and two powerful seagoing tugs (Alp Guard and Carlo Magna) were deployed.

It took almost six days before the ship was refloated and the canal was declared free again. It was a herculean task for the SMIT Salvage to refloat the ship and make the canal free for shipping traffic.

Peter Berdowski, chief executive of Dutch salvage company Boskalis, said the Ever Given had been refloated at 15:05 (13:05

(GMT) on 29 th March 2021, "thereby making free passage through the Suez Canal possible again".

How much did the blockage cost?

About 12% of global trade, around one million barrels of oil and roughly 8% of liquefied natural gas pass through the canal each day.

SCA chairman Osama Rabie declared that the Canal's revenues were taking a

THE GROUNDING OF MV EVER GIVEN THE LARGEST CONTAINER SHIP OF THE WORLD IN THE SUEZ CANAL

$14m-$15m (£10.2m-£10.9m) hit for each day of the blockage!!

Prior to the pandemic, trade passing through the Suez Canal contributed to 2% of Egypt's GDP, according to Moody's.

Separately, data from Lloyd's List showed the stranded ship was holding up an estimated $9.6bn of trade along the waterway each day. That equates to $400m and 3.3 million tones of cargo an hour, or $6.7m a minute.

The Suez Canal blockage didn't just affect the global shipping industry or the Egyptian economy - countless businesses, from domestic transport providers to retailers, supermarkets and manufacturers were also impacted.

LEGAL CLAIMS & ARBITRATION

It still is an undisclosed figure. The world will probably never get to know the actual compensation that was paid to the Suez Canal Authority and other stakeholders.

A reliable source based in UK reveals that a London based law firm owned by Indian Master(Ship's Captain),Ex T S Rajendra Batch 1980-81, turned Barrister from Lincoln's Inn, London that negotiated the arbitration valued the compensation at USD 550 million.

Let us hope we have been able to find the real solution and the Canal does not face grounding problems in future.

TAKE AWAY

For the students of Nautical Science simulator based case studies on such incidents should be included in their academic curriculum to understand the art of ship handling.

Capt Subir K.Chatterjee

Bachelor of Nautical Science
School of Maritime Studies

FEW NEW DESIGNS OF LOW POWER HYBRID FULL ADDER

ABSTRACT

Among all arithmetic operations, addition operation is a widely used operation in digital computing systems. The circuit which performs addition operation is called adder. We know an adder gives the results of sum & carry. In a binary digital system, for one bit addition including the previous carry bit is done by a logic circuit called full adder. Full adder (FA) circuits are the basic digital circuits which are used in almost all multiplier architectures and hence it is the basic building block in many of the digital signal or image processing systems. There are the different logic styles which are used to design the FA circuits, among them hybrid logic style is the most common way to implement FA circuits. A hybrid FA is primarily based on XOR-XNOR gates combinations. So XOR–XNOR circuits are the main driving issue for the performance of any hybrid FA circuits in consideration with the delay, power and area. In this article few state-of-art structures of hybrid FA circuits are analyzed along with few new designs are implemented and their performances are compared using Tanner EDA simulator in 250nm technology.

INTRODUCTION

Low power VLSI design has become one of the major research areas for past few decades in electronics industries due to portable electronic products. The proficient technique to decrease the dynamic power consumption of any VLSI chip is achieved by reducing the number of transistors, switching activity and reducing the supply voltages. Adders are the building blocks in many arithmetic operations such as multiplication, division, subtraction, memory address calculation etc [1] in processors and DSP systems. Therefore the performance of such VLSI chips can be enhanced by improving the performance of full adder (FA). Hence design of a low power FA is attracting much attention of researchers for past few decades. Various techniques have been reported and they are all concerned on reducing the area, power dissipation and delay [2]-[4]. In this article few new designs of hybrid full adder are proposed and their performance are compared with other state-of-art designs. In order to design a new low power hybrid full adder, we begin with various types of one-bit full adder circuits which are simulated and analyzed using standard EDA tool. Such available designs are based on different low power techniques such as, conventional CMOS [5], GDI [6], along with few hybrid structures [7]-[11]. The comparisons have been carried out in terms of transistors count, power dissipation and propagation delay.

Motivations of This Research

Technology is getting advanced and we are entering into an age where people are more becoming dependent on electronic gadgets to lighten their burden with the usage of laptops, cell phones and many more devices. As days are passing almost all electronic gadgets is getting smaller, faster having better response with low power consumption. So there is a constant evolution in the design of these circuits to meet new and better requirements.

The hybrid logic utilizes the best advantages of different logic styles to enhance the performance and efficiency of any logic design. Full adder design is the most popular design in which the hybrid logic structure is used. The core circuit used in the hybrid full adder is the XOR-XNOR circuits. The main advantages of the hybrid logic structure are it consumes optimized power-area-delay (PAD) and provides better response. The main objective of the research is to imply an optimized architecture of hybrid FA unit to make it more efficient in terms of power, area

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and delay. Moreover, with the advent of portable devices, it is highly desirable that a low power FA unit is employed.

DEFINITION OF 1-BIT ADDER

A binary adder is a digital circuit that performs addition of binary numbers. As the number of bits in digital word increases, the demand for fast addition also increases. There are different types of fast adder circuits available to make faster additions of multiple bits like carry save adder (CSA), carry skip adder (CSKA), ripple carry adder (RCA) etc [12]. In all these different types of fast adder circuits the basic building blocks are 1-bit adder circuits. An 1-bit adder circuit is of two types, 1) half adder and 2) full adder.

Half Adder

In half adder, it adds two binary digits where the input bits are termed as augend and addend and the result are two outputs one is the sum and the other is carry. There is no provision of introducing previous carry input in a half adder. To get the sum output from the truth table as shown in table 1, XOR operation is performed to both the inputs, and to produce carry AND operation is performed to both inputs [12].

Table 1. Half Adder Truth Table

Inputs		Outputs	
A	B	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

By using a half adder, we can design simple addition with the help of logic gates. Let's see examples of adding two single bits,

0+0 = 0

0+1 = 1

1+0 = 1

1+1 = 10

These are the possible single-bit combinations. But the result for 1+1 is 10, therefore the result must be re-written as a 2-bit output. Thus, the equations can be re-written as,-

0+0 = 00

0+1 = 01

1+0 = 01

1+1 = 10

In the last result the bit '1'of '10' is called carry-out. 'SUM' is the least significant bit of result output and 'CARRY' is most significant bit result. From the truth table it can be found that an 1-bit adder can be easily implemented with the help of the XOR Gate to generate 'SUM' and an AND Gate to generate the 'Carry' output as shown in figure 1. The half-adder is useful when we want to add one binary digit quantities. The simplest expression uses the half adder operations are,-

Sum= A XOR B

Carry= A AND B

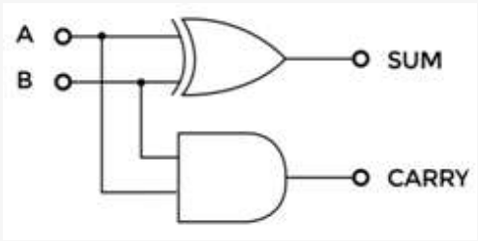


Figure 1. Half adder schematic using logic gates

Full Adder

Full Adder takes three input bits and adds them to generate sum and carry output. The first two inputs are A and B while the third input is the carry input from the previous stage as Cin. The output carry is designated as Carry and the sum output is designated as Sum. The truth table of Full adder is shown in table 2.

Table 2. Full Adder Truth Table

Inputs			Outputs	
A	B	C_{in}	Sum	Carry
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

According to Truth Table, Logical Expression for Sum:

= A'. B' .Cin + A' .B. Cin' + A .B'. Cin' + A. B. Cin

= Cin .(A' B' + A B) + Cin' (A' B + A B')

= Cin XOR (A XOR B) -----(1)

FEW NEW DESIGNS OF LOW POWER HYBRID FULL ADDER

According to Truth Table, Logical Expression for Carry:

= A' .B. Cin + A .B'. Cin + A. B. Cin' + A. B. Cin

= A .B + B. Cin + A. Cin -----(2)

Another form in which Carry can be implemented:

= A. B + A. Cin + B. Cin (A + A')

= A .B Cin + A .B + Cin .A + A'. B. Cin

= A. B .(1 + Cin) + A .Cin + A' .B. Cin

= A. B + A .Cin + A.' B. Cin

= A .B + A. Cin (B + B') + A.'B. Cin

= A .B. Cin + A. B + A. B' .Cin + A'. B. Cin

= A .B .(Cin + 1) + A. B' .Cin + A' B .Cin

= A .B + A. B' .Cin + A' .B. Cin

= A.B + Cin (A' B + A B')

Therefore, Carry = A.B + Cin .(A XOR B) -----(3)

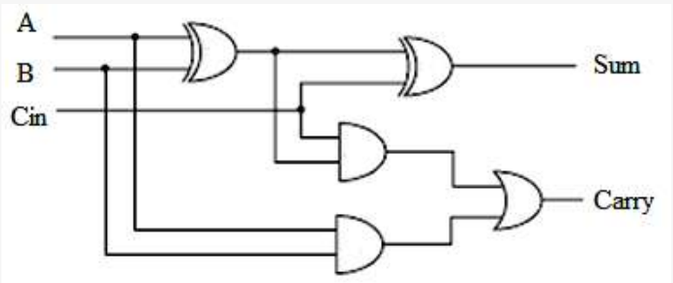


Figure 2. Full adder schematic using logic gates

Conventional CMOS Logic Full Adder

The schematic which is shown in figure 2 can be implemented using Complementary Metal-Oxide-Semiconductor (CMOS) gates. So each XOR gate will consist of 12 MOS transistors. Each AND gate and OR gate will consist of 6 transistors. Therefore the FA circuit using CMOS gates can be built with 42 transistors which are quite large in number. The other approach is static CMOS AND OR INVERT (AOI) logic. Static CMOS AOI full adder cell design is the most conventional approach. The CMOS full adder uses 28 transistors as shown in figure 3, with PMOS pull-up transistors and NMOS pull-down transistors as a regular CMOS structure. The main advantage of this logic is its robustness against supply voltage, scaling (W/L) and the transistor sizing [9]. The disadvantages of this structure are its high input capacitance and take more area because of implementing large PMOS transistors in its structure.

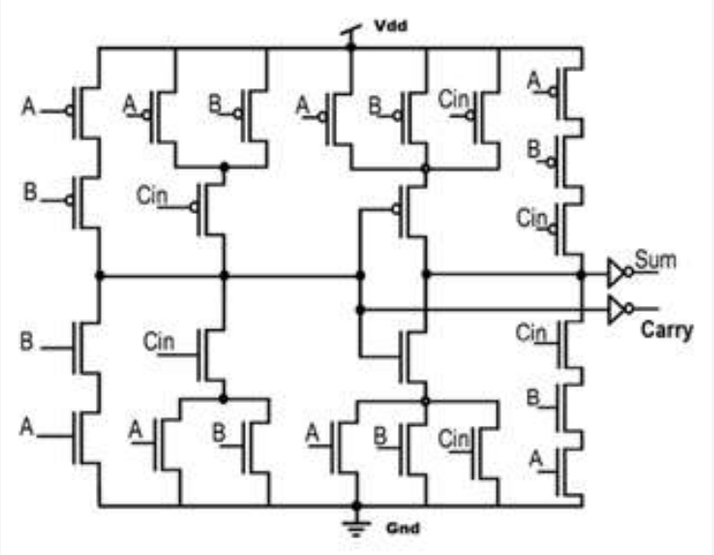


Figure 3. Conventional 28-T CMOS logic full adder schematic

Pass Transistor Logic Full Adder

Pass Transistor Logic is one of the logic styles where less number of transistors is used than the regular CMOS Logic style. The main advantage of this logic is that it reduces the area, size and power dissipation is reduced. But, the main disadvantage of PTL is that these gates produce either weak '0' or weak '1' output. There are many full adder circuits available using pass transistor logic. Among them Bui et. al reported a 10 transistor based circuit which becomes significant in design efficiency [13].

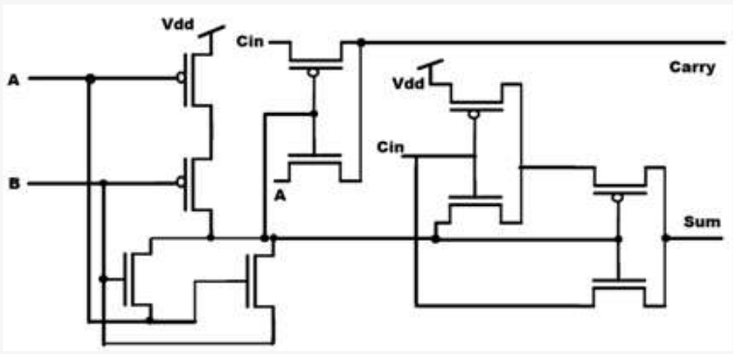


Figure 4. Full adder circuit using pass transistor logic [13]

Complementary Pass Transistor Logic Full Adder:

The Complementary Pass Transistor logic (CPL) full adder circuit is another type of design using 32 transistors as shown in figure 5. This adder logic provides high speed, full swing output, good driving capability but its power dissipation is high because of its many intermediate switching nodes and more transistor count [9]. The layout of the pass transistor circuit is not symmetrical due to irregular transistor arrangement.

Double Pass Transistor Logic Full Adder

DPL stands for double Pass Transistor Logic. In double pass transistor logic XOR gate, there will be four inputs and one output. Actually, it has two inputs and also considering the complements of the inputs so total four inputs are there. Based on DPL logic a full adder can be designed using 26 transistors [2] as shown in figure 7.

Transmission Gate Full Adder (TGA)

A transmission gate (TG)is defined as an electronic element that will selectively block or pass a signal level from input to output. It consist of two MOSFETs one N-channel responsible for correct transmission of logic

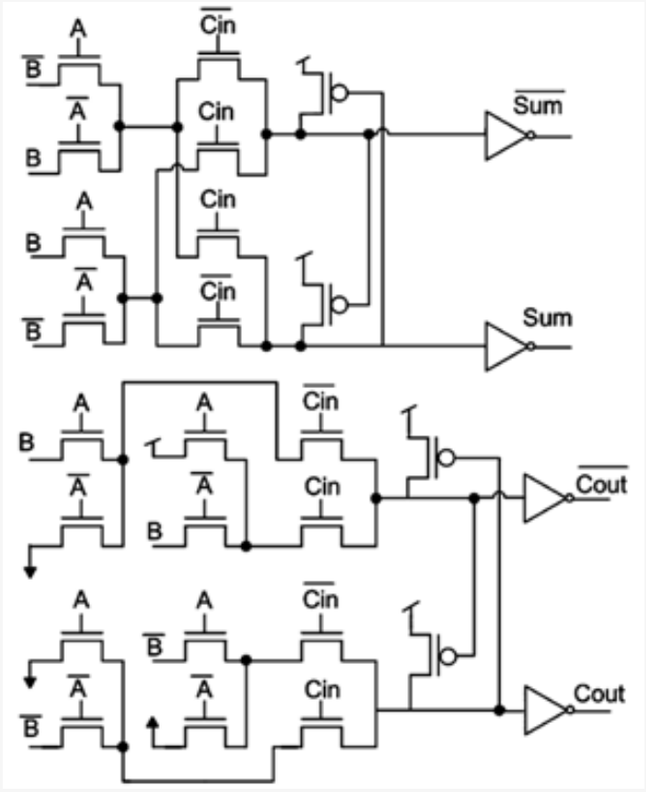


Figure 5.Complementary Pass Transistor Logic Full Adder [9]

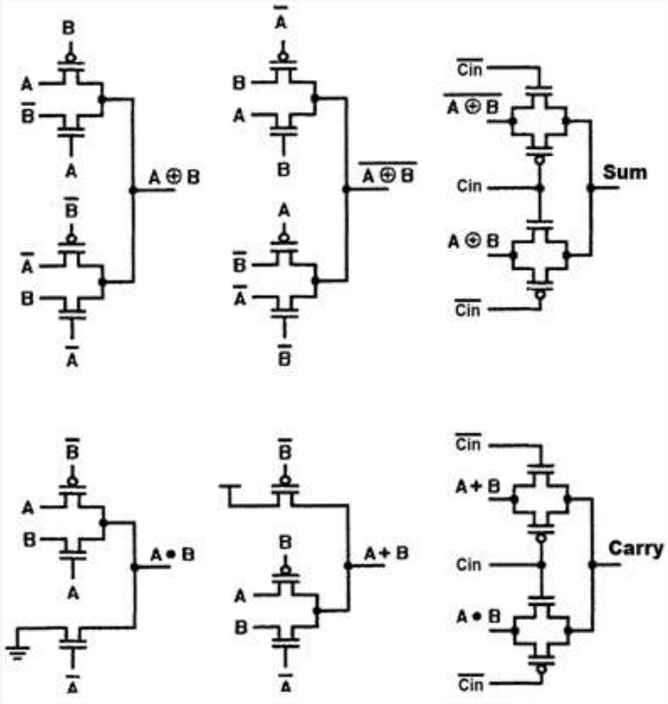


Figure 6. Double Pass Transistor Logic Full Adder[2]

zero and one P-channel which is responsible for correct transmission of logic one. Figure 8 shows the schematic of a transmission gate.

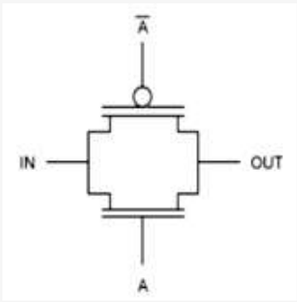


Figure 7. Transmission gate cell

So transmission gates are widely used as CMOS design style to implement digital function. In this hybrid structure the full adder logic is designed with transmission gate logic which is similar to the pass transistor logic but in transmission gate logic both the transistors are used which are connected to each other in parallel, to one type of transistor used in pass transistor logic. Full adder implementation based on TG logic uses 20 transistors [9].

Transistor Function Full Adder (TFA)

The TFA logic design uses 16 transistors [9]. Among the 16 transistors 6 are used in the design of the XOR circuit as it uses its two inputs in complementary form, two more transistors are used to invert the XOR to get the XNOR output so a total of 8 transistors among the 16 are used for the XOR-XNOR circuit. Almost half the number of the transistors issued only to implement the XOR-XNOR logic. There are two possible short circuit paths to ground for this circuit. The circuit uses pull up and pull down logic as well as complementary pass logic. The disadvantage of this circuit is its driving capability. But on the other hand the transistor count of this circuit is low and it gives balanced generation of sum and carry out signals. Moreover the power consumption of the circuit is less as compared to other designs.

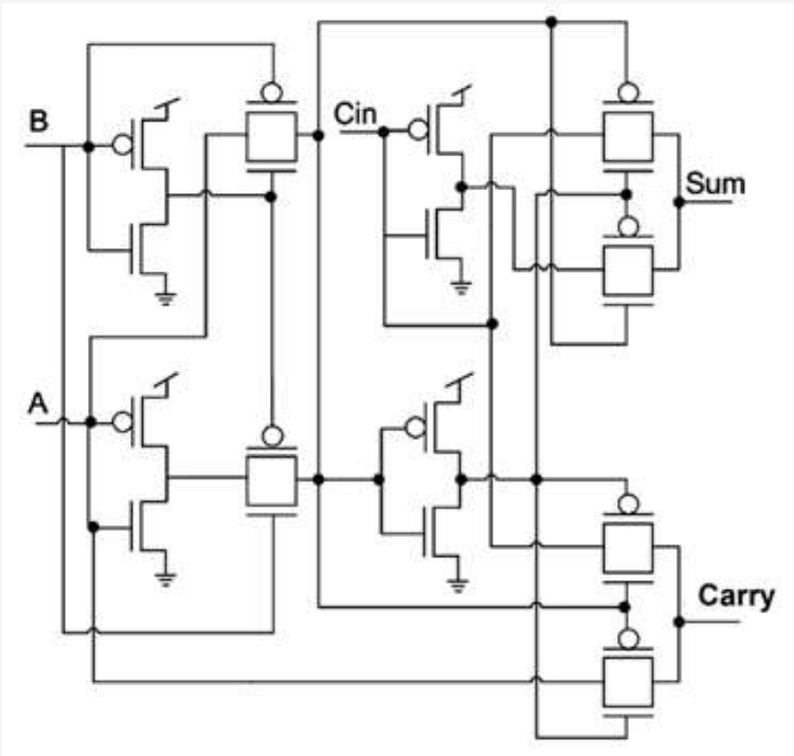


Figure 8. TGA [9] schematic

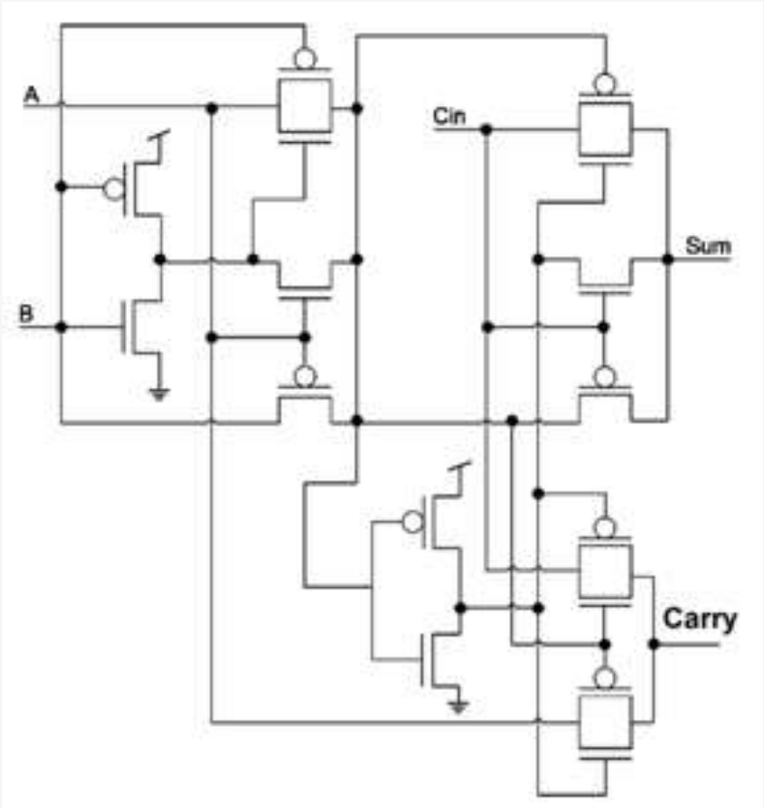


Figure 9.TFA [2] architecture

FEW NEW DESIGNS OF LOW POWER HYBRID FULL ADDER

New-HPSC Full Adder

HPSC stands for hybrid pass logic with static CMOS output drive. This circuit is made up of 20 transistors. This circuit is based on pass transistor logic design. The circuit design is divided into three modules. Module 1 generates the XOR-XNOR logic using only six transistors, because pass transistor logic implements XOR operation more efficiently than the CMOS. Module 2 is the sum circuit which is also based on pass transistor logic. The module 3 is the carry circuit which is created using a novel circuit structure [14].

New 14-T Hybrid Full Adder

In this logic design more than one logic are used to implement the full adder design. The logics that are used are pass transistor logic and transmission gate logic. Here also the circuit is divided into three modules. Module 1 is the XOR-XNOR module which uses the pass transistor logic like the new-HPSC adder design using 6 transistors to produce the XOR- XNOR output. The module 2 is the sum circuit module which uses both the transmission gate logic and pass transistor logic, taking just 4 transistors to produce the output. The module 3 is the carry circuit module which is implemented using the transmission gate logic. This module also takes 4 transistors like the sum module to produce the output. Overall the circuit takes just 14 transistors to implement the full adder logic design.

Hybrid Full Adder Logic Design Using High Performance 10T XOR-XNOR:

In this hybrid logic design style, the full adder structure is divided into three modules [10]. Module 1 generates the XOR-XNOR outputs of two input signals with full swing. These XOR-XNOR signals are fed into the next modules of sum and carry. Module 2 and Module 3 are the sum and carry modules which produce the sum and carry outputs respectively using the output signals of the XOR-XNOR module. The main advantage of this hybrid logic is that we can

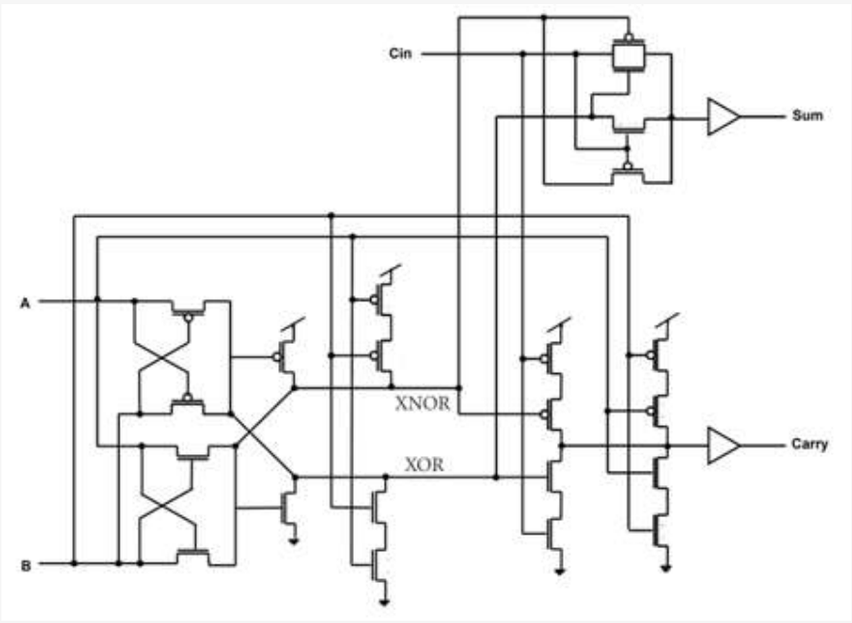


Figure 10.New-HPSC [14] FA architecture

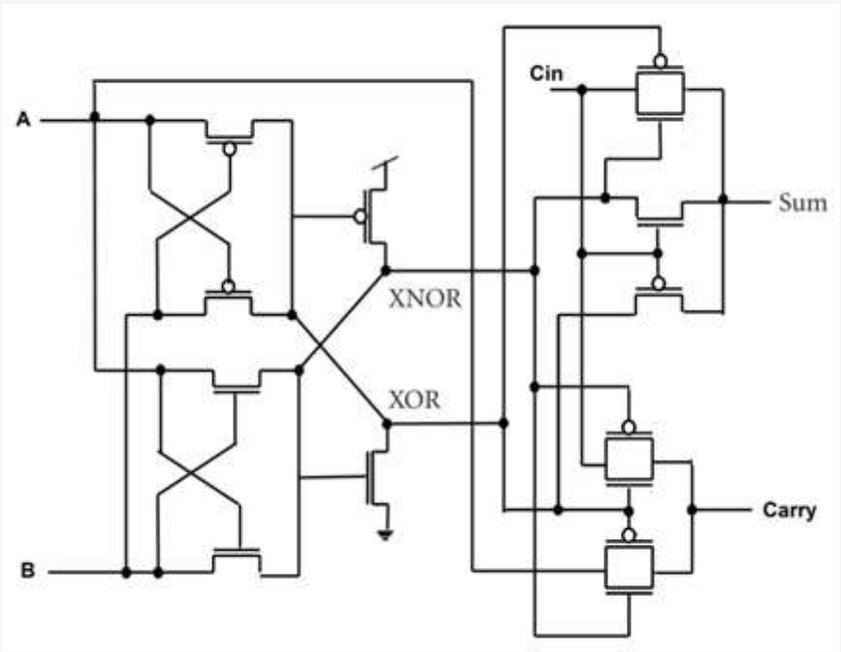


Figure 11. New-14T [14] Hybrid FA architecture

optimize each module at an individual level thereby reducing the number of transistors used and hence the power consumed by the logic design. The XOR–XNOR circuit using ten transistors (10-T) is shown in figure 13. The XOR–XNOR circuit is based on CPL and cross-coupled structure. The aspect ratios of all the transistors are shown against each transistor in figure 12.

The second module is to generate the sum output considering the Cin and outputs of the XOR- XNOR circuit as the input signals. Four different designs of the sum circuit module are shown in figure 14.

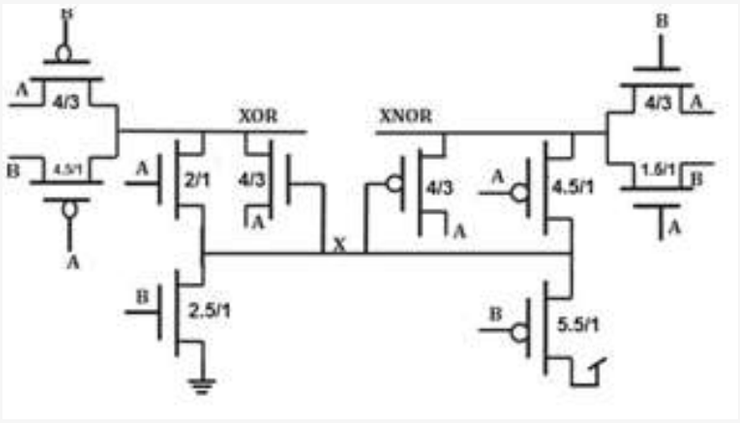
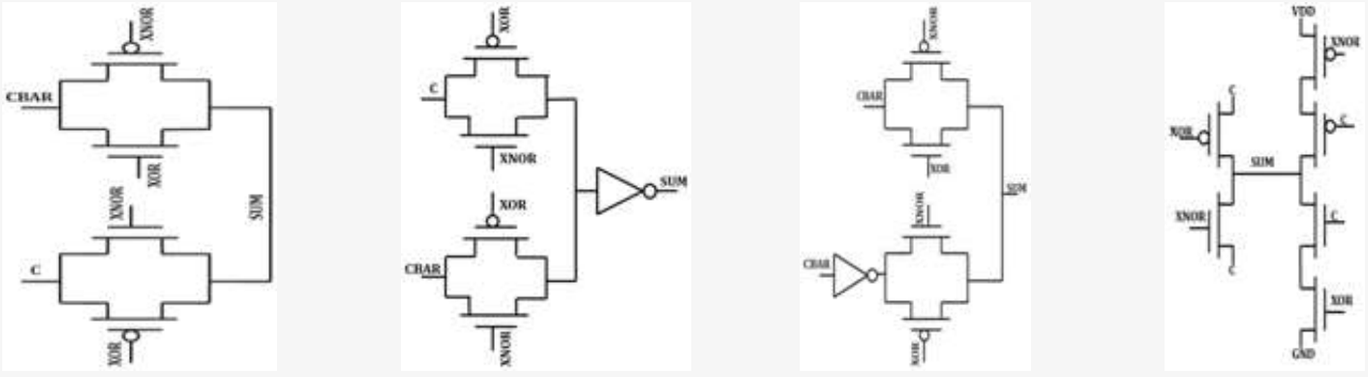


Figure 12.High performance 10T XOR-XNOR module [10]

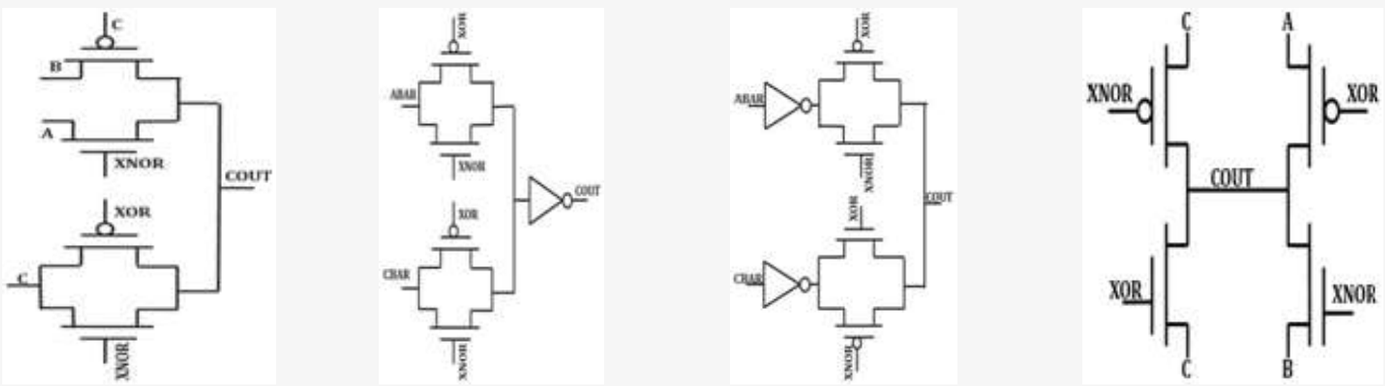


(a) (b) (c) (d)

Figure 13. Sum circuit modules [10]: (a) design 1 (b) design 2 (c) design 3 (d) design 4

The sum circuit in fig. 13(a) is based on the transmission gate logic , using the transmission gate as 2 is to 1 multiplexer and employed using four transistors. The inputs to the gates are the output of the XOR-XNOR circuit and Cin and $\overline{C}$in are the inputs to the source terminals of the two transmission gates. The circuit gives full swing output with high speed and low power consumption. But the drawback of this circuit is that it has driving capabilities problem. To overcome the problem of the driving capability an inverter is used at the output and the circuit now looks like fig. 13(b). The addition of an inverter causes higher power consumption and delay is also increased. In fig. 13(c) at the input side a buffer is used ($\overline{C}$in followed by an inverter), using a buffer at the input will give the circuit more driving capability in the cascading systems. This is because the buffer at the input restores the level of output of the previous stage. In fig. 13(d) the sum circuit is designed based on the CMOS logic style. Six transistors are used to implement the sum module and this design provides good driving capability and high robustness. In module 3, the carry circuit Cout is implemented. The circuit takes the

output of the XOR- XNOR circuit and the previous carry Cin as the inputs to the circuit. Here four designs of carry circuit are given in figure 14 with respect to the four designs of the sum circuit implemented in module 2.



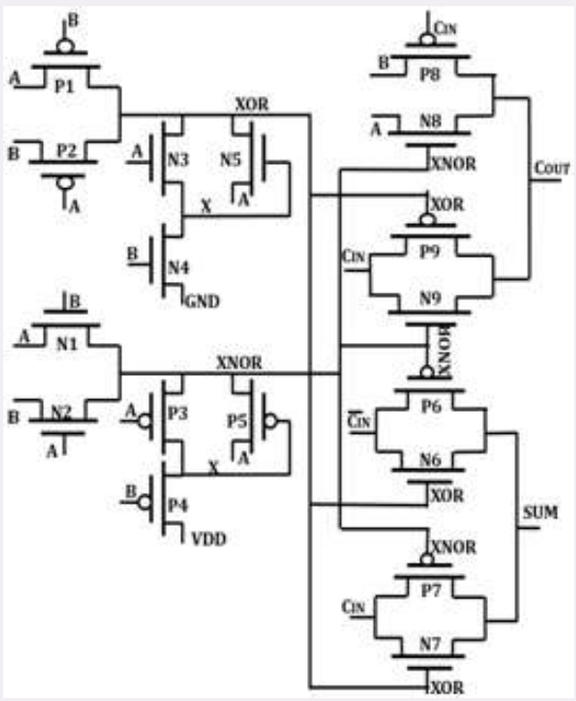
(a) (b) (c) (d)

Figure 14.Carry circuit modules [3]: (a) design 1 (b) design 2 (c) design 3 (d) design 4

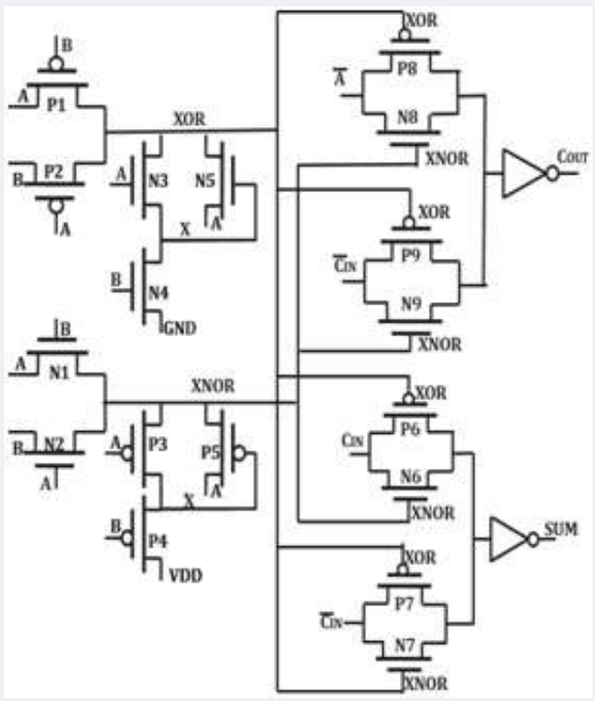
Here in most of the designs the transmission gate logic is used as multiplexer. In the fig. a, the Cout is generated by passing the value of either A (or B) or Cin at the output based on intermediate signals (XOR and XNOR outputs of module 1).To provide better driving capability to the circuit in fig. a, a buffer ($\overline{C}$in followed by an inverter) is added at the output or the input as shown in fig. b and fig. c. however the addition of an extra inverter increases the power consumption and also the delay of the circuit. In fig. d a CMOS style carry circuit is shown, it uses only four transistors and the power consumption is less with better performance in delay. A full adder logic design can be made by combining the three discussed modules (module 1, module 2, and module 3). Here four full adder designs are given by combining the different XOR-XNOR circuit in module 1 and the four various designs of sum circuit in module 2 and carry circuit in module 3. The four designs are shown in figure 16.

In the figure 16(a), hybrid full adder is designed using the XOR-XNOR circuit of module 1 and the transmission gate logic based sum and carry circuit in module 2 and module 3 respectively. The circuit uses 20 transistors and gives full swing output with high robustness. The main drawback of this circuit is that when it is cascaded into multiple stages, it has some driving capability problem. To overcome this driving capability problem another circuit (Design 2) is designed using 26 transistors. In this the driving capability problem of the Design 1 circuit is overcome by adding a buffer at the output of the sum and carry module. The addition of buffer at the output increases the power consumed by the circuit and also the delay of the circuit. Another way of overcoming the driving capability problem is implemented in Design 3 where inverters are used at the input of the sum and carry modules. This helps to restore the degraded output coming from the previous full adder stage. In the Design 4 a full adder circuit is designed using the CMOS logic style. The circuit is shown in fig. d. This design uses 20 transistors for generating the sum and carry. This circuit gives the best performance and response in terms of PDP among the four designs.

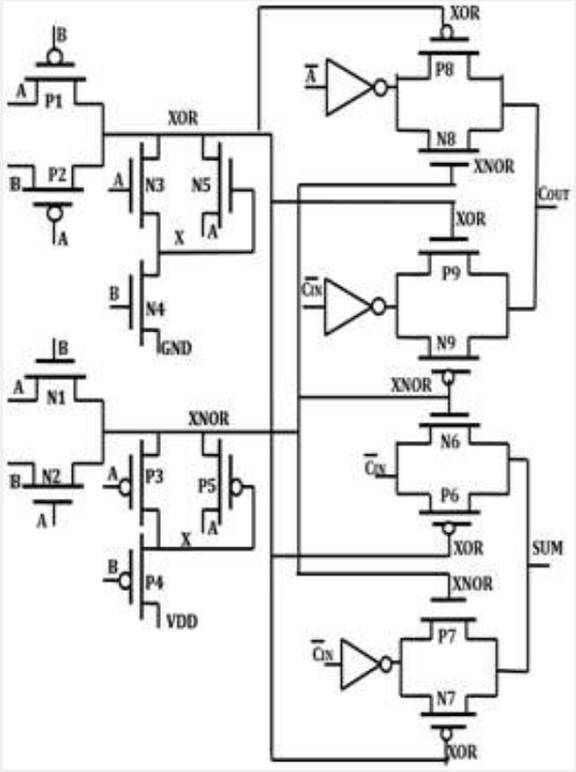
FEW NEW DESIGNS OF LOW POWER HYBRID FULL ADDER



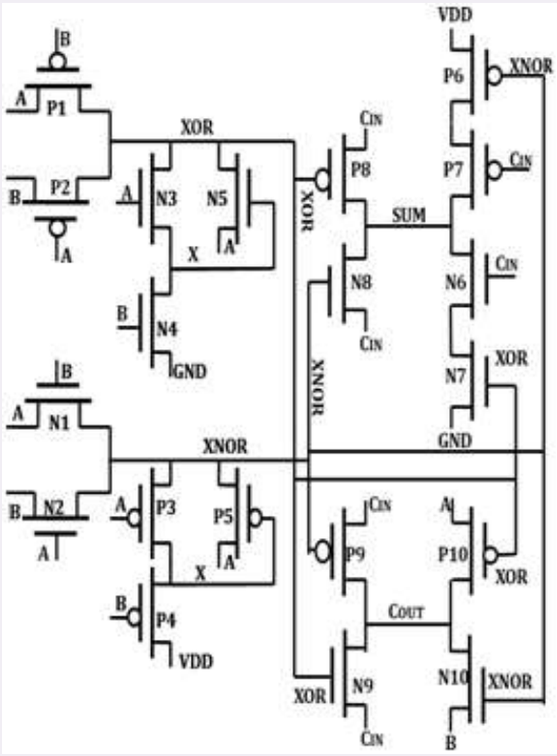
(a)



(b)



(c)



(d)

Figure 15. Various hybrid Full adder designs [1]

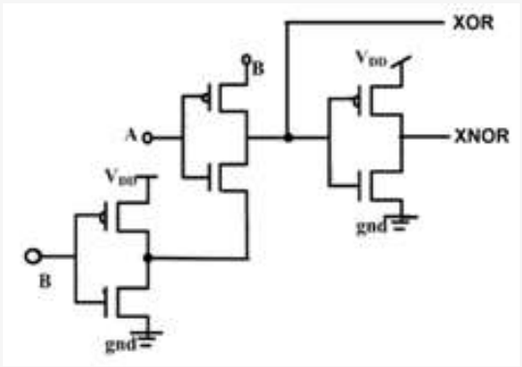
FEW NEW DESIGNS OF LOW POWER HYBRID FULL ADDER

PROPOSED HYBRID FA CIRCUITS

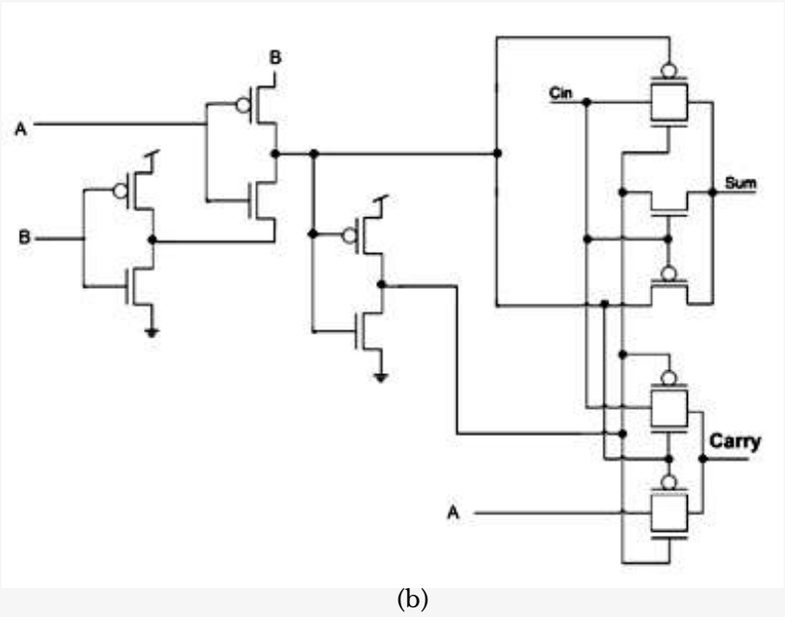
In order to improve the performance of the hybrid FA circuit here we are proposing three new architectures of FA. These circuits are implemented using various ligic styles of XOR-XNOR gates. The details of these circuits are discussed in the next sections.

Proposed Hybrid FA using GDI XOR-XNOR

The circuits discussed in this investigation uses three basic modules, the first module which consists of the XOR-XNOR circuit module, the sum circuit module and the carry circuit module. Most of the designs have concentrated on the 1st module of the XOR-XNOR module which is vital as the output of this module should have enough driving capability to drive the sum and carry module. We have seen that high performance 10T XOR-XNOR circuit [10] was one such design of the module 1. Then we have the transmission gate logic implementation of XOR-XNOR circuit which requires a total of 8 transistors as seen in TGA and TFA [7]. The New 14T uses 6 transistors but the main drawback of it is its delay. The New-HPSC uses 10 transistors for implementing the XOR-XNOR module. All these designs have their strengths and weaknesses in terms of delay and driving power capability. In this investigation the proposed XOR-XNOR module consists of GDI 6 transistors in total. Among 6 transistors 4 are used in the implementation of the XOR logic, the rest two is for an inverter which inverts the XOR output to make it XNOR. This module of XOR-XNOR logic is used with the transmission gate logic implementation of the sum and carry module in the TFA logic design. This design uses 14 transistors. The design of the GDIbased XOR-XNOR module and the proposed GDI TFA is shown in figure 16(a) and (b).



(a)



(b)

Figure 16. (a) GDI XOR-XNOR circuit, (b) proposed hybrid full adder using GDI XOR-XNOR

Proposed TFA Based Hybrid FA

Here 18 transistors are required to design a proposed hybrid full adder circuit. New Transmission Logic Full Adder is implemented in this circuit which is a ratioless design. Among 18 transistors, the number of both PMOS& NMOS is 9 respectively. In this design, only 8 transistors are used for construct XOR- XNORand 2:1 MUX is used.

Proposed 16-T Hybrid FA

We have also implemented a new architecture of FA using 16 transistors. The schematic of the design is shown in figure 18. It is a ratioed design and the sizes of the transistors at 250nm technology are shown in table 3.

FEW NEW DESIGNS OF LOW POWER HYBRID FULL ADDER

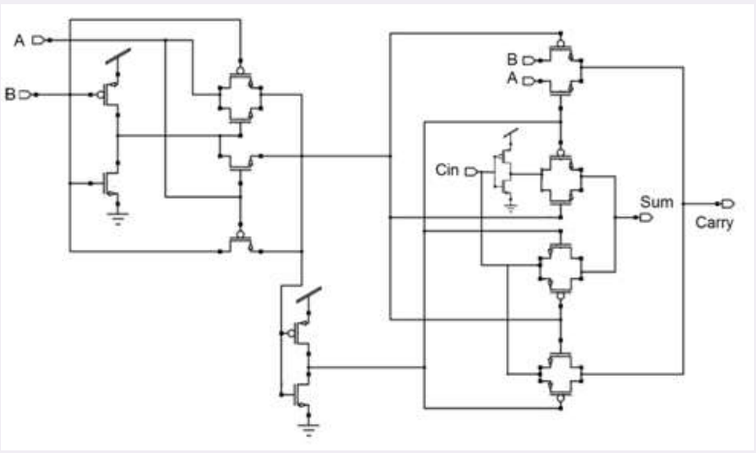


Figure 17. Schematic Diagram of proposed TFA Based Hybrid Full Adder

Table 3. Transistor sizes at 250nm technology of the proposed 16-T Hybrid FA

Transistor name	Width	Length, nm
PMOS_1, NMOS_1	1.5u	250
PMOS_2, NMOS_2	1.5u	250
PMOS_3, NMOS_3	1.5u	250
PMOS_4, NMOS_4	1.5u	250
PMOS_5	2u	250
NMOS_5, PMOS_6, NMOS_6, NMOS_7, PMOS_7, PMOS_8, NMOS_8	670n	250

SIMULATION RESPONSES AND ANALYSIS OF THE EXISTING AND PROPOSED HYBRID FULL ADDER DESIGNS

All the circuits are simulated using 250nm technology using standard EDA simulator. The supple voltage used for all the circuits is 2.5V. The inputs to the circuits are 8 bits data with patterns A= 00001111, B=00110011 and Cin=01010101. The rise time and fall time considered for all the simulations are 1ns for both. The simulations are carried out for 80ns. The delay of the circuit is measured using the delay syntax in T-spice environment. The complete analysis of all the circuits containing the number of transistors, the carry out delay, the sum delay, the critical delay, the power consumed, and the PDP of all the full adder logic design is given in table 4.

An evaluation of a logic design in VLSI is always based on their performance in terms power-area-delay or (PAD). So it is very important that we closely look into the response of these hybrid full adder designs in terms of PAD. The power of the various hybrid full adder logic designs are shown in figure 19:

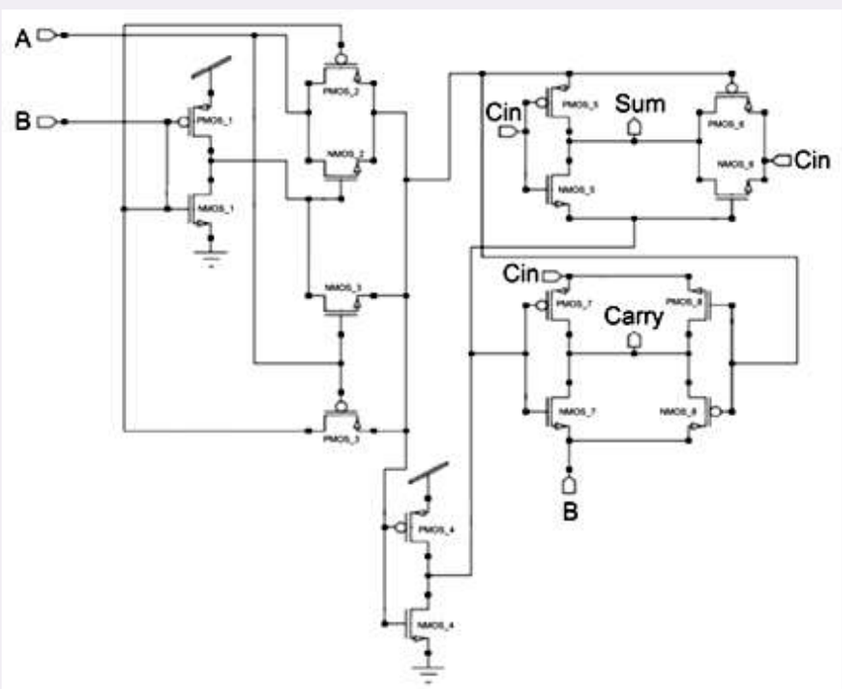


Figure 18. Schematic Diagram of proposed 16-T Hybrid Full Adder

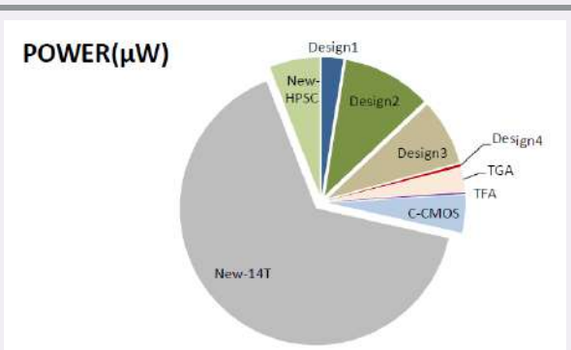


Figure 19. Power(µW)consumption of various FA

Table 4. Simulation Results

Name of Designs.	No of transistors.	Carry delay (ps)	Sum delay (ps)	Critical path delay (ps)	Power (μW)	PDP (10^{-18})
TGA [9]	20	12.0540	56.67985	56.67985	12.56795	712.35
TFA [2]	16	4.0405	76.97745	76.97745	0.828148	63.75
New-14T [14]	14	89.5608	70.8674	89.5608	289.8235	25956.82
New-HPSC [14]	26	602.8017	250.38405	602.8017	26.29284	15849.37
Design1 [10]	20	6.7622	46.487	46.487	11.17	519.26
Design2 [10]	26	424.1008	216.513	424.1008	46.26759	19622.12
Design3 [10]	26	36.6416	79.36	79.36	34.30586	2722.51
Design4 [10]	20	3.4031	73.3708	73.3708	1.380838	101.31
Proposed GDI TFA	14	16.6367	253.81	253.81	3.795186	963.25
Proposed 18-T TFA Based FA	18	11.9719	33.6780	33.6780	0.9668806	32.5626
Proposed 16-T FA	16	7.0779	78.53	78.53	1.495	117.26

From the pie graph it is evident that the hybrid full adder logic design which consumes least power is the transistor function adder (TFA) hybrid full adder logic. It is then followed by the hybrid full adder design of Design 4 and Design 1 of Kandpal [10]. In terms of area the comparison of these hybrid logic designs is shown in figure 20:

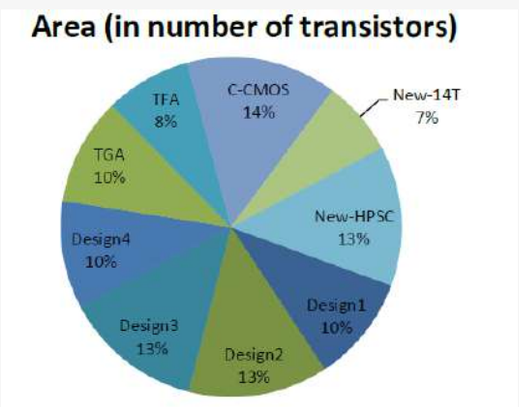


Figure 20. Area (in number of transistors) of various FA

The least amount of area is taken by the New-14T, as it uses only 14 transistors. It is then followed by transmission gate adder (TGA) hybrid logic. The TGA takes 2 transistors more than the New-14T. The comparison of all the hybrid full adders on the basis of delay is shown in the figure 21:

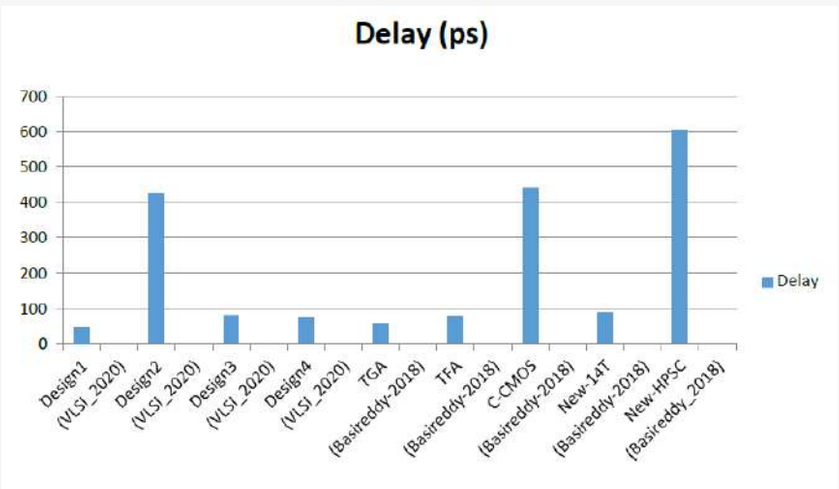


Figure 21. Delay (ps) of various FA

FEW NEW DESIGNS OF LOW POWER HYBRID FULL ADDER

From the graph it is evident that delay of the new-HPSC full adder logic design is highest. It is followed by CMOS full adder logic design which is the conventional way of designing full adder and the Design-2 of Kandpal [10]. The final parameter is the power-delay product or (PDP). It is one of the vital parameters which help in determining the performance of a particular logic design. The PDP of the hybrid logic design is shown in the figure 22.

The PDP is measured in taking log scale on the y-axis for better representation of the graph. On the basis of all the parameters and analysis, it is evident that the best among all of them is the transistor function adder (TFA). In terms of PAD, it also performs well as power consumption is low, area that it takes is also minimal (requires only 16 transistors), and the delay of the circuit is also commendable. The output responses of the proposed Hybrid FAs are shown figure 23.

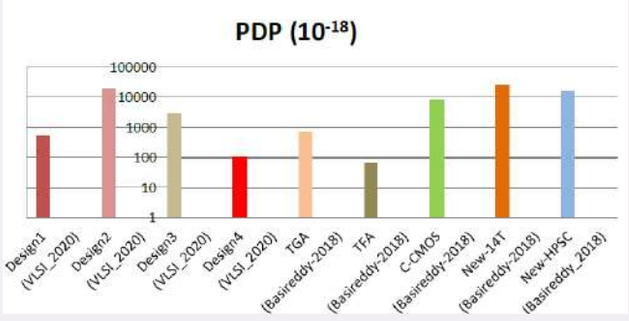


Figure 22.PDP of Various FA

From the simulation results it has been found that the proposed GDI TFA based FA circuit design is area efficient as it uses only 14 transistors for the hybrid full adder logic design as compared with most of the existing technologies. The New-14T [2] also uses 14 transistors but the power consumption is much higher compared to proposed design. In the proposed 18-T TFA based FA circuit, power dissipation, delay, power delay product is minimum compared to other state of art hybrid designs.

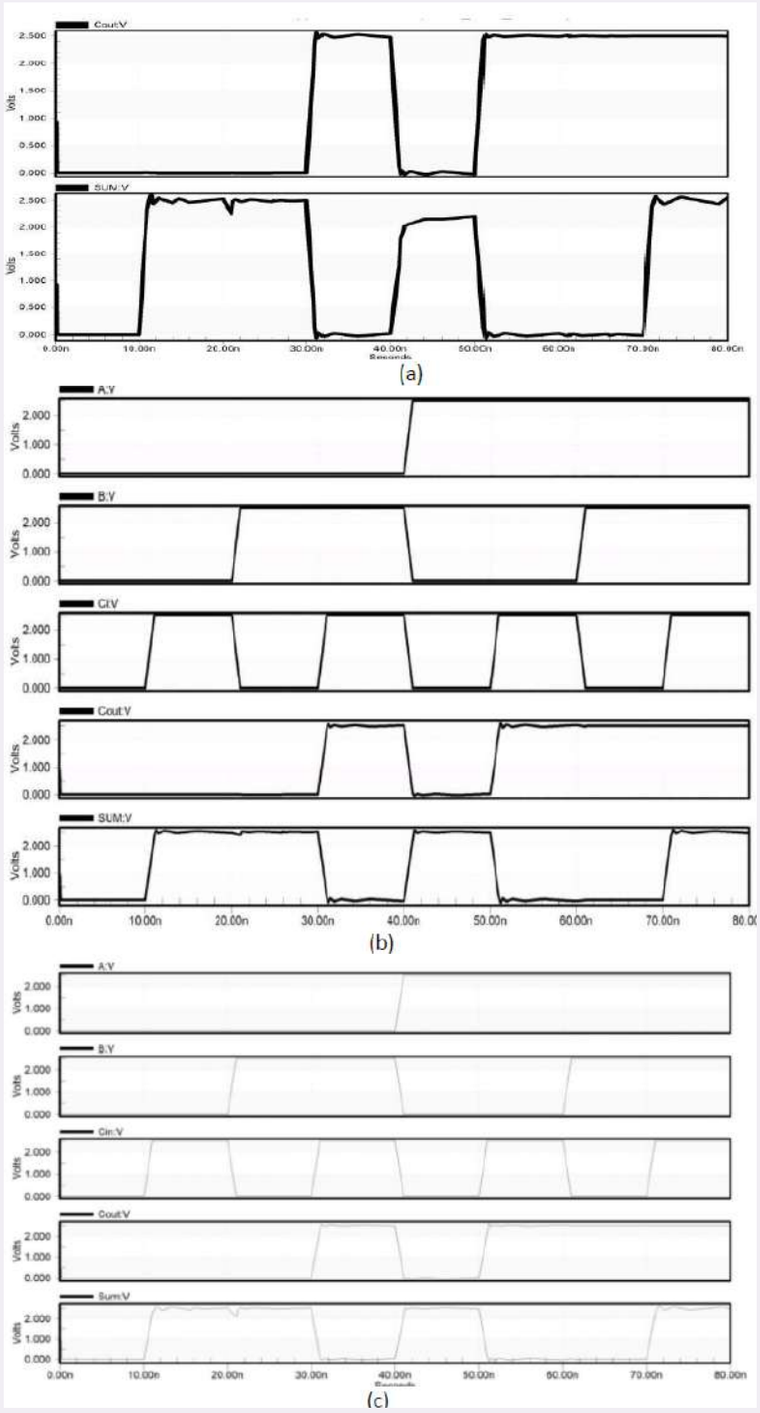


Figure 23. Transient responses of Proposed FA architectures (a) GDI TFA based FA, (b) 18-T TFA Based FA, (c) Proposed 16-T FA

FEW NEW DESIGNS OF LOW POWER HYBRID FULL ADDER

CONCLUSION AND FUTURE SCOPE

To enhance the efficiency of the digital electronics and computer system, a low power hybrid full adder circuit is required. There are several approaches and logic style to create a low power hybrid full adder. By detailed study of existing hybrid FA architectures, we try to make few modified hybrid full adder circuits. We discussed about the detailed design and analysis of the modified circuit and proposed three new hybrid full adders architecture. These simulation results of modified full adder circuits presented in this report shows significant improvement in terms of PDP. The proposed GDI TFA based FA is efficient in terms of area as it uses a GDI based XOR_XNOR circuit. In future the layout analysis will be done at different technology nodes.

Parts of this research have been carried out as undergraduate project in the department of Electronics and Communication Engineering of Neotia Institute of Technology, Management and Science under Maulana Abul Kalam Azad University of Technology.

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THE ENERGY SCENARIO AND FUTURE PLANNING OF INDIA

The Energy Scenario World population is expected to grow at around 1 % while GDP (Gross Domestic Product) is expected to grow around 3 %. GDP per capita can be considered a reasonable proxy for global energy demand. Demand for natural gas is expected to rise significantly, especially due to its use in power generation. Liquefied Natural Gas (LNG) becomes a significant energy carrier globally.

Fossil fuel based thermal power, hydro-electric, and nuclear constitute the conventional sources of power. Taking into consideration the profile of energy sources in India, coal has a dominant position. Coal constitutes about 51 % of India's primary energy resources followed by Oil (36 %), Natural Gas (9 %), Nuclear (2 %) and Hydro (2 %). Non-conventional sources are less than 5 % of total installed capacity in India. The present installed capacity (as in March 2006) is about 1, 25,000 MW, consisting of coal based plants (56 %), gas based plants (10 %), hydro-electric (26 %), nuclear (3 %) non-conventional (5 %). For next few decades, India would need to exploit all possible options to create reasonably large capacity base on the energy side. It needs to increase the coal generation, extract oil and gas reserves through all conceivable means wherever possible. It ought to additionally depend on import of coal, procure coal and gas reserves abroad and exploit completely the huge hydro electric potential which is over 1,50,000 MW. So far about 32,000MW i.e. 20 % of the hydroelectric potential has been exploited. An increase in the capacity of power generation based on the coal reserves of the nation, which are of the order of 200 billion tones is inexorable. Atomic projects have ended up being successful and effective. Atomic power plants are one of the essential choices that India is seeking since mid-1980s and early 1990s. India has immense gas holds, both on the Western, and all the more especially, around the Eastern coast. In addition, various LNG terminals have likewise been created and are, no doubt created with the goal that the utilization of gas could be supplemented through import of Liquefied Natural Gas. India is one of the minority countries which has been successful in employing wind turbine technology and today of the total capacity of 1,25,000 MW in the country about 5 % is constituted by the various non-conventional sources of generation, wind being the largest contributor.

India has the least per capita energy consumption among other countries in the world. The consumption of energy by India is 540 kgoe in 2008, whereas 1,803 kgoe is consumed by the world, 4,560 kgoe by OECD nations, and 1,600 kgoe by China. India's energy use productivity for creating Gross Domestic Product in Purchasing Power.

Parity is superior to numerous nations and even contrasted with the world normal. It is normal that with a development rate of 9 %, TPES necessity for India in 2021–2022 will be around 1,192 mtoe which will further expand to around 2,043 mtoe by the year 2031–2032. The power utilization per capita for India is only 566 Kwh and is far below most nations on the earth. Despite the fact that 85 % of towns are supplied with electricity, around 57 % of the domestic units in the country and 12 % of urban families, i.e. 84 million family units in the nation, don't have accessibility to electric power. Power utilization in India is required to ascent to around 2,280 Bkwh by 2021–2022 and around 4,500 Bkwh by 2031–2032. The Human Development Index (HDI) is figured from the literacy rate, infant mortality rate and GDP plotted against per capita power utilization. It is observed that for consumption over 4,000 kWh/per person the

THE ENERGY SCENARIO AND FUTURE PLANNING OF INDIA

curve plateaus out and straightens. Power capacity has risen at a rate of 5.87 % per annum over the last 25 years. The aggregate supply of power has climbed at the rate of 7.2 % for every annum over the same period. This reflects a change in Plant Load Factor (PLF). In any case, the utilization is still compelled as force deficiencies proceed with torment to the nation. Availability Based Tariffs (ABT) and unscheduled exchange charges of force presented since 2003 for interstate offer of power has narrowed down the fluctuations in voltage and frequency. The deficiencies are additionally ascribed to insufficient ventures in distribution and transmission. Expanding the generation capacity has attracted wide range of investment. Aggregate Technical and Commercial (AT&C) misfortunes which incorporate theft of electricity, non billing, wrong billing, inefficient transmission and distribution losses surpassed 40 % for the nation in general in 2005. Hence, the State Electricity Boards remain monetarily sick and are unable to draw in accounts for venture. The degree of power deficiency differs from state to state.

The Planning Commission of India has set a focus of including more than 78,000 Mw in a five year plan starting from 2007. Historically the plan targets have been missed and actually for this five year plan the target is likely going to be missed as capacity addition till February 2011 was just 40,000 MW. At last, the 1.1 What Is Energy? 3 historical backdrops of attention on speculation in power generation brings about stacking more power on a deficient transmission and distribution (T&D) system. Industrial and commercial units have been forced to look for standby generation to meet their demand on a 24×7 support.

The division is commanded by vast state imposing business models at both federal and state levels. Private distribution of electric power has been acquainted, yet it is confined to specific regions. An uneven playing field saturates the commercial center wherein the Central Power Sector Unit get ensured post-government forms of 14–16 % with full installment supported by the GOI.

State Power Sector Utilities (SPSUs) are given zero or low returns by Regulators who are under consistent pressure not to raise tariffs, which are as of now around the most astounding on the planet in PPP terms for mechanical, business and family customers. The power tariffs are framed based on the premise of industrial users cross subsidizing agricultural and domestic power users. In almost all the states, the farmers are provided with un-metered power and in turn they pay an exceptionally high amount towards the horse power of their pumps. This prompts a zero peripheral expense of power which promotes wasteful use and over abuse of ground water. The local division likewise has an extent of subsidies depending upon the level of utilization including vigorously financed force for the poorest fragment wherein families pay a low amount aggregate added towards month to month billing.

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MICROBIAL BIOFILM: AN OVERVIEW AND CLINICAL IMPACTS

Microorganisms exist in two forms, one is known as the free-living planktonic cells, other is termed as the biofilm (Gupta et al. 2016; Chakraborty et al. 2018a). The first description of biofilm dates back to the 17th century, when Anton Von Leeuwenhoek, observed microbial aggregates on scrapings of plaque from his teeth (Chandki et al. 2011). Moreover, with the gradual advancement of time, there has been a global hike in biofilm related morbidity and mortality which is about 80% of the total microbial infections (Davies 2003). Biofilm happens to be a conglomeration of microbial population often adhering to various biotic or abiotic surfaces thereby producing a self-secreted matrix commonly termed as the extracellular polymeric substance or EPS (Gupta et al. 2016). This matrix has been reported to play a very crucial role for the survival of the bacteria inside a biofilm. Additionally, they have also been found to protect the bacteria by preventing the diffusion of the antimicrobials through them (Cortes et al. 2011). Several organisms have been found to form biofilm to get protected from the external stress (Anderson and O'Toole 2008; Hall-Stoodley and Stoodley 2009). Among them, ***Staphylococcus aureus*** and ***Pseudomonas aeruginosa*** are the two major organisms that can cause biofilm associated infections. S. aureus happens to be Gram-positive, spherical shaped bacteria which can cause various infections in human host including skin and soft-tissue infections (Azmi et al. 2019). On the other hand, ***Pseudomonas aeruginosa*** is a Gram-negative opportunistic pathogen which is responsible for causing endocarditis, respiratory and urinary tract infections, septicemia, gastrointestinal infections and many more (Goossens 2003; Wagner and Iglewski 2008). Hence, efficient strategies are to be adopted fast to manage the biofilm threats in order to weaken the infections (Römling and Balsalobre 2012; Vuotto and Donelli 2019).

In our research laboratory, we mainly work with these two organisms with regards to their biofilm inhibition and disintegration ability under the influence of different natural and synthetic compounds. So far, we have been able to explore several such compounds which have shown efficient antibiofilm activity to treat S. aureus and ***P. aeruginosa*** related biofilm infections. In this direction, compounds like thymoquinone, tetrazine capped silver nano-particle, caffeine have shown promising results in biofilm inhibition of ***P. aeruginosa*** (Chakraborty et al. 2018a, Chakraborty et al. 2020, Chakraborty et al. 2021). Additionally, tryptophan has shown significant antibiofilm effect against the biofilm inhibition of both S. aureus as well as ***P. aeruginosa*** (Chakraborty et al. 2018b; Paul et al. 2021). Apart from these, a very interesting observation was noted in case of the compound 1,4-naphthoquione. The compound not only showed biofilm inhibiting property against S. aureus but it also showed biofilm disintegration of the same (Paul et al. 2020; Paul et al. 2021). Besides, compounds like piperine, cuminaldehyde, lapachol are still under study. Thus, in the near future we hope to come up with more effective strategies to combat biofilm-linked challenges and shed light on the possible solutions.

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CLASSIFICATION OF BENIGN AND MALIGNANT TUMORS BASED ON SHAPE FEATURES

ABSTRACT

One of the most fatal diseases to which all human beings including researchers, scientists, and doctors are still bowing their heads down is cancer. It is a disease which can be prevented to take away lives if properly detected in time. Cancer will take a catastrophic shape, claiming over 12 million lives by the year 2030, according to the survey report of World Health Organization (WHO). Detecting cancer in time is a very challenging task till date. Many researchers, scientists and doctors are still finding ways to detect cancer in early stages which can prevent taking lives. Patients having tumors are suggested to go for Fine Needle Aspiration Cytology (FNAC) test which requires capturing fluid from the tumor area followed by viewing the cell sizes, shapes, population etc through microscope to confirm the presence of cancer. This paper proposes an automated system that can classify benign and malignant tumors, by estimating area, perimeter and area divided by perimeter features from the cell nuclei followed by classification through regression.

INTRODUCTION

In today's world, one of the major threats to the mankind is the mortality due to cancer. Thus, to fight against cancer is the big challenge to both medical practitioners and scientific researchers. In the early stage cancer is vulnerable to treatment while in the most advanced stage it is usually almost impossible to treat. So designing a system for detecting the presence of malignancy at early stages is very much required. To screen the entire population with the available man power present today takes a long time . So an automated system for the preliminary screening is required. To confirm the diagnosis of most cancers, a biopsy needs to be performed in which a tissue sample is removed from the suspected tumor and studied to check whether cancer cells are present or not using a microscope. Among different biopsy technique FNAC is used popularly for confirmation of cancer due to its low cost. In FNAC the tissues and cells that are collected are placed in Leishman Giemsa (LG) stain. The pathologist then places the sample in a slide and the sample is viewed using microscope. For malignant cells, both the cells and the nuclei characteristically display pleomorphism-variation in size and shape. Thus , cells within the same tumor are not uniform, but range from large cells, many times larger than their neighbors, to extremely small and primitive appearing. Characteristically the nuclei contain abundant chromatin and are dark staining (hyperchromatic). The nuclei are disproportionately large for the cell and the nuclear to cytoplasm ratio may approach 1:1 instead of the normal 1:4 or 1:6.The nuclear shape is variable and often irregular and the chromatin is often coarsely clumped and distributed along the nuclear membrane. Large nucleoli are usually present in these nuclei [1]. Sometimes the nuclei are overcrowded to form a cluster of nuclei. The pathologists identify these types of features to detect cancer. This process is time consuming to analyze every cell with constant supervision. If they fail to distinguish each nucleus properly the result can be ambiguous or even the diagnosis may get wrong. Also the quality of the slide affects the results. The chemical composition of reagents used for preserving and staining greatly affects the color and morphology of the exfoliated cells. Differential staining of slides may resultin non uniformcolor values . If the image of the slide is very dark then finding out the feature of the nuclei are very difficult. Bright images with good contrasts are needed to distinguish nucleus from cytoplasm and red blood cells. Lack of sharpness may increase the difficulties in the detection of nucleus boundary. The slides may also contain dirt and presence of extraneous particles which may lead to false detection of cancer. So it can be concluded that detection of cancer manually is very difficult.

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Therefore scientists and researchers are currently trying to adopt different image processing techniques for automatic detection of cancers from the FNAC images. During this process the images containing the cells will be forwarded to an automated system for identification.

Many research works have been conducted in the development of automated computer-aided diagnostic system for the diagnosis of cancer pattern in medical images to improve the diagnosis results. A multi-classifier system was designed for discriminating benign from malignant thyroid nodules using routinely LG-stained cytological images (Daskalakis et al., 2008). Majority voting based automatic classification of papillary and medullary thyroid carcinomas was done (Gopinath and Gupta, 2010b).

Support Vector Machine Based Diagnostic System for Thyroid Cancer using Statistical Texture Features was designed and reported (Gopinath and Shanthi 2013)[2].Here initially, segmentation of region of interest (ROI) was performed by region-based morphology segmentation. The developed diagnostic system utilized statistical texture features derived from the segmented images using a Gabor filter bank at various wavelengths and angles. Finally, the SVM and k-nearest neighbor were used as machine learning algorithms to identify benign and malignant states of thyroid nodules.

Computer-aided diagnosis of breast cancer using Gaussian mixture cytological image segmentation was presented by Kowal [3]. In order to extract the nuclei features, segmentation procedure that integrates results of adaptive thresholding and Gaussian mixture clustering was implemented. Next, tumors were classified using four different classification methods: k-nearest neighbors, naive Bayes, decision trees and classifiers ensemble. Diagnostic accuracy obtained for conducted experiments varies according to different classification methods and fluctuated up to 98%for quasi optimal subset of features.

In George and Elbagoury [4] paper, they present an intelligent classification system for breast microscopic cellular image. At the first phase, segmentation of nuclei boundaries with the determination of meaningful features for the detected cell areas are done. The nuclei boundaries are extracted based on Hough transform in conjunction with watershed algorithm. Features describing texture and shape are calculated for each segmented region. These features contribute to the identification of the normal and abnormal cells. A clustering step is then performed for the classification of benign and malignant nuclei. The detected boundaries for the nuclei are expected to present an ellipse-like shape and several features to describe this characteristic are chosen. Ten features are calculated from the extracted shape of the detected region boundary namely perimeter, compactness, smoothness, eccentricity, solidity, equivalent diameter, extent, major axis length and minor axis length. In order to overcome the limitations, the proposed technique tries to develop an automated system that classifies an input FNAC image into benign class or malignant class. This system eventually reduces diagnosis time and can be treated as a helping tool for the pathologists, who in many cases require a preliminary screening of the images. The FNAC images obtained contains nucleus and cytoplasm; of which nuclei contain significant information rather than the cytoplasm. The cytoplasm is mostly discarded by using a saturation threshold mask. The cytoplasm discarded image obtained is used to calculate area, perimeter and area divided by perimeter features of the cell nuclei. These features are used and tested using XYZ classifier, which is a machine learning tool. Fig-1 shows a block diagram depicting the overall design of the classification system.

The rest of the paper is divided into four sections. Section II describes the acquisition process of the medical images. Section III describes the working methodology of the proposed system. Experimental discussions are done in section IV. Finally, section V provides concluding remarks of the system.

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MATERIALS

A. Image Acquisition

To develop an automated system, image acquisition plays an important role. Improper acquisition may lead to misclassification. The images are directly captured from the slides prepared with the patient's fluid taken from the tumor area. To classify an image into either of the two classes, namely benign and malignant, each image goes through a series of image processing techniques followed by feature estimations and classification. To develop the system, FNAC images of real patients are taken from Theism medical diagnostic centre, Kolkata, West Bengal, India during the period from June-2014 to October-2014.

THE PROPOSED TECHNIQUE

To develop the automated system the classification accuracy gets highly challenged by the variation of the staining process, which is done during the slide preparation. The image perceived through the microscope looks darker if the intensity of staining is high. Some slides may even contain dirt particles which if not detected and eliminated before the classification process, may lead to misclassification.

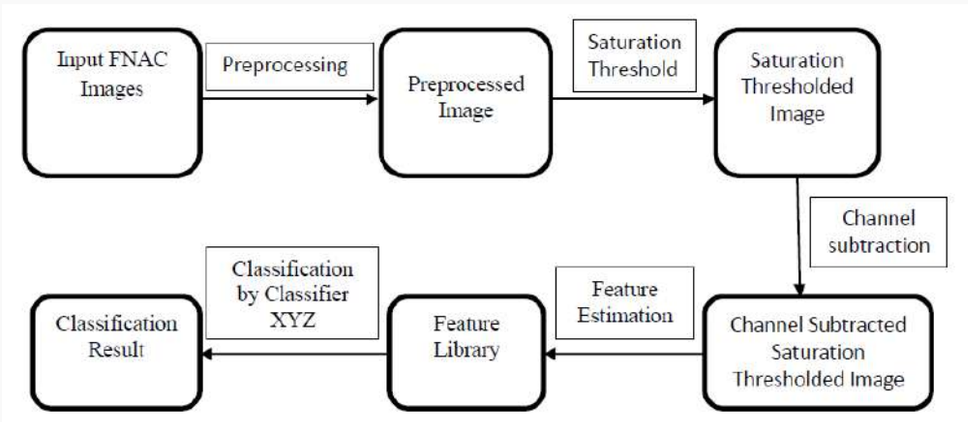

Fig-1 A block diagram of the classification system

Though some researchers had showed binarization of the image data sets could not be done due to the intra-nuclei gray level intensity variations present. In many cases cell nuclei are overlapped with each other or sometimes forming monolayer sheets. Unless and until boundaries of cell nuclei are fully distinguished, binarization would be difficult. Since proper binarization cannot be done, calculation of features such as area, perimeter, roundness, abnormality in shape and size cannot be estimated to conclude an input image belongs to which class. So an appropriate preprocessing mechanism is to be selected that can fairly segment the cell nuclei from the image background consisting of cytoplasm, Red Blood Corpuscles (RBC), noise etc.

A. Preprocessing

To design an automated system through image processing, the very first step includes the preprocessing of the input images. This phase transforms a low quality image to a convenient quality that can effectively support feature estimation and classification process. This phase includes noise reduction, contrast enhancements and some basic filtering needed to process the images.

B. Saturation Threshold

The classification task mainly depends on the shape and size of the cell nuclei. The most difficult and challenging task is to segment the cell nuclei from the background cytoplasm regions. In many cases distinguishing individual nucleus from the set of overlapped nuclei is very difficult. The situation gets more complicated if the cytoplasm is almost of same color as that of the nuclei. In our proposed work we have taken a RGB image as input followed by converting it to Hue Saturation Intensity (HSI) Image. Hue is a color attribute that describes pure color. Saturation describes the degree by which a pure color is being diluted by white light. Intensity refers to the brightness value. After thorough

experimentations, it has been observed that the nuclei region appears within 0 to 0.4 of the saturation value. This threshold range is used to create a mask which when multiplied with the original RGB image extracts the nuclei regions from the input images. This image is the saturation threshold image.

It has been also experimentally observed that this saturation threshold image contains only nuclear region if the image is of good quality, where proper staining is done. If staining work is not good then distinguishing cell nuclei from the cytoplasm is very difficult, leading to a bad quality saturation threshold image which also contains the cytoplasm along with the nuclei. If all nuclei appear with same quantity of cytoplasm then it wouldn't have been a problem. It is due to the variation of the cytoplasm attachment with the nuclei, classification process generally lead to wrong result. Fig-2 shows the result of good quality and bad quality results of saturation threshold image.

To make a solution of this problem another mechanism is applied which removed most of the cytoplasm regions from the input images. In this new mechanism the RGB image obtained from the saturation threshold image is split into its three channels namely, red, green and blue and also the grayscale representation is obtained. Then an image subtraction operation is done between the blue and the green channel. From the resultant image obtained, the grayscale representation is also subtracted. The final subtracted result contains mostly nuclear region. This image is called as channel subtracted saturation threshold image. Now we get the actual information about the nuclei by getting rid of the cytoplasm.

The saturation thresholded image when splitted into red, green and blue components, it has been seen that the nuclei region appears darker in the green component. It is mainly due to the staining process, the color of the nuclei appears pinkish, which is basically composed of red and blue component with a little portion of the green component. Thus the value of the red and green component lies within 230 to 255 and the value of green component lies within 0 to 40. Other than the nuclei region, the background appears whitish due to the intensity values of the red, green and blue components have high values within the range of 230 to 255. When the first image subtraction operation is done between the blue and the green components, the nuclei region appears whitish having intensity values ranging between 180 to 255 and the background intensity appears darker because high intensity value of the green channel gets cancel out with the high intensity value of the green channel. The nuclei region of the subtracted image appears whiter because the blue component has high intensity values and the green component has very low intensity values, which when gets subtracted still produces high intensity values. Now the gray level component of the saturation thresholded image is subtracted from the first subtracted image. The nuclei portion of the gray level component appears grayish with intensity values ranging between 90 to 120. When the second image subtraction is done, the resultant image has a darker background and comparatively deep grayish intensity level in the nuclei region. It is due to the high intensity level present in the nuclei portion of the first subtracted image, which when subtracted by the lower intensity of the gray level component, the nuclei region of the final subtracted image appears dark grey having the background blackish. The following images in Figure3.(a) ,(c) show original images and 3.(b), (d) and show images obtained after the image subtraction operations.

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C. Feature Extraction

Generally the tendency of the malignant nuclei is to have irregular nucleus boundaries. These irregular boundaries occur due to overlapping of many nuclei or due to the abnormal growth of the nuclei. Both of these symptoms guarantee the presence of cancer. Thus counting the shape property of the nuclei provides substantial amount of information in detecting cancer. The boundaries of each nuclei are obtained from the channel subtracted saturation thresholded image. From each boundaries, shape features such as chain codes, area, perimeter, area divided by perimeter are estimated.

To represent a boundary by a connected sequence of straight line segments of specified length and direction, freeman chain codes are used. These representations are generally based on 4- connectivity or 8-connectivity of the segments. The directions of each segment are coded as a numbering scheme as shown in Fig-4.

Digital images are usually acquired and processed in grid format with equal spacing in the x- and y-directions, so a chain code can be

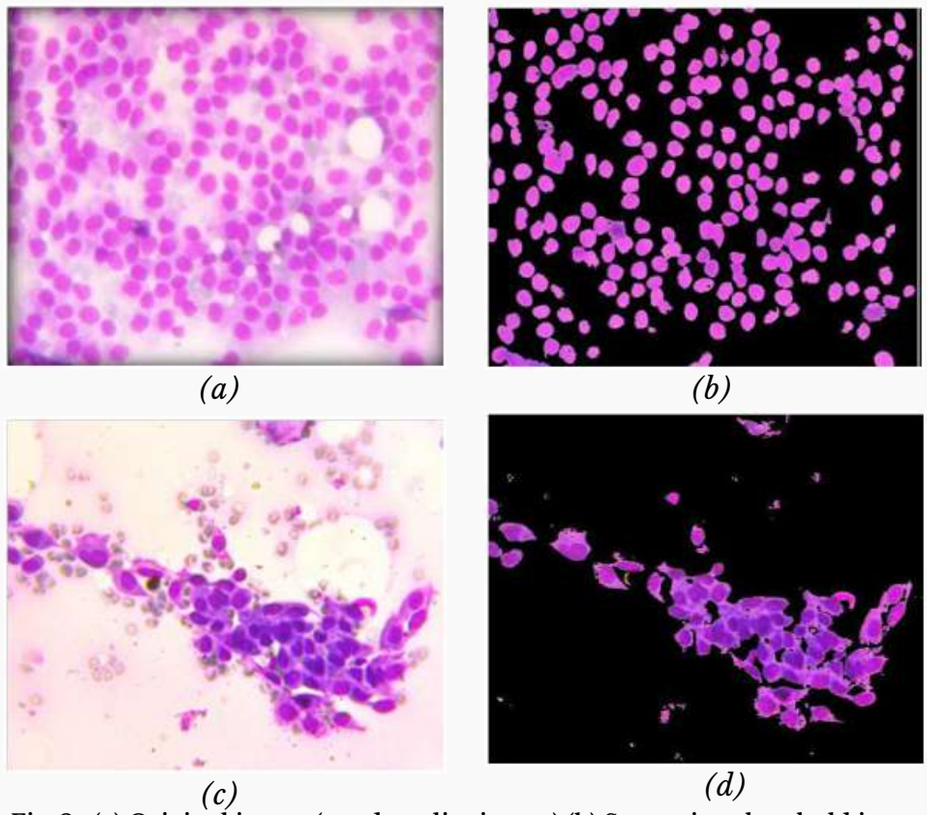

Fig-2 : (a) Original image (good quality image) (b) Saturation threshold image of (a). (c) Original image (poor quality) (d) Saturation threshold image of (c)

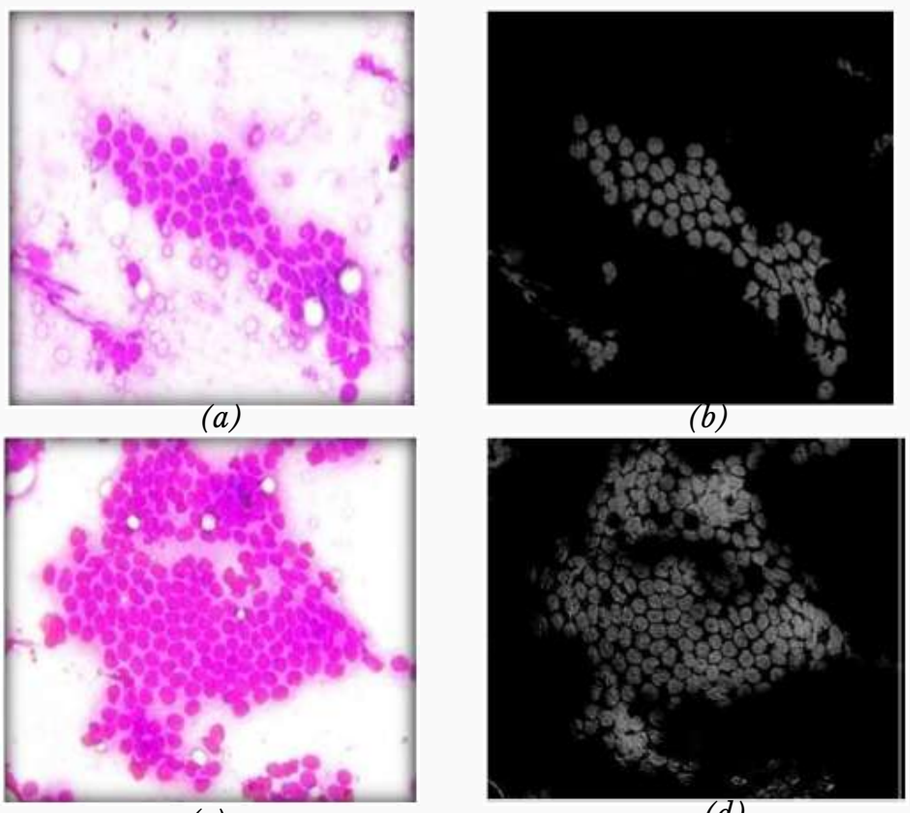

Fig- 3 (a) and (c) original Image. (b) and (d) channel subtracted saturation thresholded image.

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generated by following a boundary in, say, a clockwise direction and assigning a direction to the segments connecting every pair of pixels starting from a point say origin. The following Fig-5 demonstrates the use of chain code from a given image staring from origin O.

The Freeman chain codes contain a list of direction numbers from 0 to 7 in case of 8-connectivity. For each boundary the total number of each direction is calculated and at last, a histogram of direction values is computed for all the boundaries obtained in each image. This histogram is treated as the chain code feature of an image.

The results obtained from chain code histogram in section X indicates impressive source of information within the shape property of the nuclei. Further analysis depicts the benign nuclei have similarity in shape and size. Moreover, they also posses a smooth contour which leads to small area and perimeter of the nuclei. On the other hand the malignant nuclei vary in shape and size. They even don't posses smooth contours due to irregular shape, thereby leading to large area and perimeter of the nuclei. Area can be calculated as the number of pixels presents in a

Fig- 4 (a) 4-connectivity (b) 8-connectivity

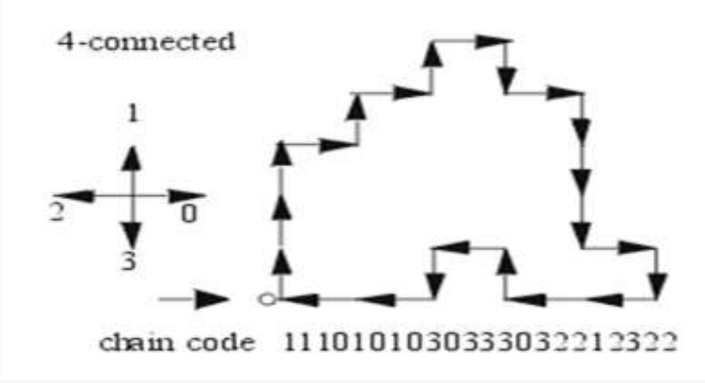

Fig-5 chain code of 4-connectivity

connected component, where as perimeter can be calculated by the following formula if x1,x2,x3,.....xN is the boundary coordinate list

From the channel subtracted saturation thresholded image, binarization has been done and for each connected component area, perimeter and area divided by perimeter is calculated. A histogram comprising of various zones are computed for area, perimeter and area divided by perimeter for all the connected components in an image. This histogram is the feature vector. Table 1 describes the zones created for various features.

For classification we have used a machine learning software WEKA (Waikato environment for knowledge analysis). It is a popular suite for machine learning software written in JAVA, developed at the University of Waikato New Zealand. It is a free software under the GNU general public license.

EXPERIMENTAL RESULTS

To train and test the system we have taken images in the ratio 2:1 respectively. After finding the feature sets of the training images, training has been done using classification via regression. Table 1 depicts the accuracy of chain code was 75.43% which showed the path to further enhance the research work based on the shape and size domain of the nuclei. Table 2 depicts the performance of the system showing 93.85% accuracy from area, perimeter and area divided by perimeter features.

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CONCLUSION

This paper proposes a system that can easily classify between benign and malignant tumors from FNAC images. Segmentation of nuclei has been done through channel subtracted saturation thresholded scheme which eliminates most of the cytoplasm and noise parts from the FNAC images. The shape and size of the nuclei vary for malignant cases, where as it remains similar similar in case of benign nuclei. To track this feature, freeman chain code calculation has been done which showed about 75.43% of accuracy, thereby showing impressive source of information in the shape property. Further refining the research on this domain, it has been found that benign nuclei have less area and perimeter size. On calculating area, perimeter and area divided by perimeter feature for each nucleus obtained and classifying via regression the system attained about 93.85% of accuracy. The two methodologies are being tested for logistic classifier and regression classifier, which is been shown in table 1 and 2 respectively. From the results we see that classification via regression produces better result. The achievement of 93.85% of accuracy on real patient's FNAC images helps us to build our hope to design an automated system that can help doctors and pathologists to detect cancer positively as possible.

Table 1. Zones Created For Various Shape Features

Zones for area feature	*Zones for perimeter feature*	*Zones for area divided by perimeter feature*
Zone1 <= 0.00009	Zone1 <= 0.00025	Zone1 <= 0.00009
0.00009< Zone2<= 0.00025	0.00026<= Zone2<= 0.0005	0.00009< Zone2<= 0.00025
0.00026<= Zone3<= 0.0005	0.0006<= Zone3<= 0.00075	0.00026<= Zone3<= 0.0005
0.0006<= Zone4<= 0.00075	0.00076<= Zone4<= 0.0009	0.0006<= Zone4<= 0.00075
0.00076<= Zone5<= 0.0009	0.0009< Zone5<= 0.0025	0.00076<= Zone5<= 0.0009
0.0009< Zone6<= 0.0025	0.0026<= Zone6<= 0.005	0.0009< Zone6<= 0.0025
0.0026< =Zone7<= 0.005	0.006<= Zone7<= 0.009	0.0026< =Zone7<= 0.005
0.006< =Zone8<= 0.009	0.009< Zone8<= 0.09	0.006< =Zone8<= 0.009
0.009< Zone9<= 0.09	0.09< Zone9<= 0.25	0.009< Zone9<= 0.09
0.09< Zone10<= 0.25	0.26<= Zone10<= 0.50	0.09< Zone10<= 0.25
0.26< =Zone11<= 0.50		0.26<= Zone11<= 0.50

Table 2. Performance of Logistic Classifier Using Different Feature Sets

Methodology used	*Precision or Accuracy for Logistic Classifier*		
	Benign Class	*Malignant Class*	*Overall (weighted average)*
Freeman Chain Code Histogram on Channel Subtracted Saturation Threshold image	52.77%	85.89%	75.43%
Histogram of Area, Perimeter, Area Divided by Perimeter on Channel Subtracted Saturation	69.44%	89.74%	83.33%

Methodology used	*Precision or Accuracy for Logistic Classifier*		
	Benign Class	*Malignant Class*	*Overall (weighted average)*
Threshold image			

Table 3. Performance of Classification Via Regression Using Different Feature Sets

Methodology used	*Precision or Accuracy for Classification via regression*		
	Benign Class	*Malignant Class*	*Overall (weighted average)*
Freeman Chain Code Histogram on Channel Subtracted Saturation Threshold image	22.22%	94.87%	71.92%
Histogram of Area, Perimeter, Area Divided by Perimeter on Channel Subtracted Saturation Threshold image	88.88%	96.15%	93.85%

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THE ROLE OF MULTI-OMICS IN ESTABLISHING PERSONALIZED NEOANTIGEN(IMMUNOTHERAPY)-BASED TREATMENTS FOR CANCER

ABSTRACT

Neoantigens are mutated, foreign proteins that tumor cells display on their surfaces. These neoantigens bind to Major Histocompatibility Complex (MHC) molecules, allowing T-cell receptors to recognize them specifically. They are good targets for cancer immunotherapy because they can generate tumor-specific T-cell-mediated anti-tumor responses. They are entirely foreign to the body and have a very low likelihood of causing autoimmunity. The preliminary findings offer optimism for the creation of neoantigen-based tailored vaccinations and adoptive T-cell transfer, as well as for the treatment of immunologically cold malignancies. The most challenging problem is predicting neoantigens with accuracy. For the accurate identification of neoantigens, the investigations used a variety of methods. To find neoantigens, researchers used whole-exome sequencing followed by an MHC binding affinity prediction method. However, it resulted in a large number of anticipated neoepitopes that could be tested in the lab. The methods were developed over time, and the combination of transcriptomics and mass spectrometry-based immunopeptidomics resulted in more precise neoantigen identification. All of this was made possible by advances in sequencing technology and the introduction of sophisticated mass spectrometry instruments. Nonetheless, the field is hampered by the need for many computer tools, which increases the process's total complexity. A one-stop computational workflow will aid the clinical translation of neoantigen-based tailored cancer vaccines.

INTRODUCTION

Cancer cells express specific peptides due to non-synonymous somatic mutations. These peptides may be overexpressed in tumor cells compared to normal cells, or they may be tumor-specific. Tumor-specific antigens, also known as neoantigens, are altered peptides that are not expressed by normal cells but only by tumor cells. On their surfaces, tumor cells release neoantigens that bind to MHC class I or II proteins and are recognized by CD8+ or CD4+ T lymphocytes. Tumor neoantigen is not a natural part of the organism and is not found in normal cells, tissues, or organs. Neoantigens have become a popular immunotherapy target because of their unique expression on tumor cells (Boon et al., 1997). The groundbreaking discovery of ipilimumab, which targets the immunological checkpoint protein anti CTLA4, re-energized the field of immunotherapy. It improved the prognosis of patients with metastatic melanoma. Ton N. Schumacher et al. cited a study by Rosenberg et al. that found that infusing melanoma patients with corresponding tumor-infiltrating cells that have been grown ex vivo can stimulate immune responses(Schumacher & Schreiber, 2015). In stomach cancer, Hodgkin's lymphoma, renal cell carcinoma, lung cancer, and head and neck cancer, antibodies targeting another immune checkpoint molecule, PD-1, have been proven highly effective. These clinical symptoms demonstrated immunotherapy's efficacy. Neoantigens are expected to elicit a more robust immunological response because they are not impacted by central or peripheral tolerance((Schumacher & Schreiber, 2015).

Individualized RNA and peptide-based vaccinations are safe, dependable, and effective in inducing an anti-tumor response, according to the evidence gained from the trials. T-cells activated in response to neoantigens are thought to play a critical role in the clinical response of tumor-infiltrating lymphocytes transferred via adoptive T-cell transfer(Zhou et al., 2019). For viral-mediated malignancies, tumor antigens can come from a viral etiology. The

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epitopes that resulted from the open reading frames (ORFs) Tumor-specific neoantigens could arise from non-synonymous genetic variations such as single-nucleotide variants (SNVs) and other structural variants such as gene fusions, frameshift mutations, insertions and deletions (indel), and intron retentions in all other malignancies(Jiang et al., 2019) The advancement of Next Generation Sequencing (NGS) technologies have simplified the process of finding changes in the protein-coding section of a tumor's genome, allowing for the detection of neoantigens. To predict a class of neoepitopes, the RNA-seq data was combined with exome sequencing analyses. However, it was projected that a large number of epitopes would be tested for immunogenicity. Only a small percentage of them were found to be immunogenic. As a result, proteomics and genome sequencing techniques were combined to produce a modest number of precise neoepitopes (Bassani-Sternberg, 2018). Zhang et al.'s research potentially link human colon and rectal cancer characteristics to genetics (Zhang et al., 2014).

The development of a new type of multi-omics platform known as 'Proteogenomics' resulted from improved and high-throughput techniques in both the domains of genomics and proteomics. Proteogenomics is a recently discovered technique for discovering and quantifying protein sequence changes linked to cancer in cancer research. Besides the sources mentioned above, protein variations formed from alternative post-translational modification sites can give neoantigens. The introduction of Data-Dependant Acquisition (DDA) and Data-Independent Acquisition (DIA) in shotgun proteomics has resulted in extensive profiling of a vast number of proteomes(Polyakova et al., 2015). Suhas Vasaikar et al. were able to describe several subtypes of colon cancer as well as identify cancer-testis antigens and neoantigens in their research(Vasaikar et al., 2019) The National Cancer Institute has also established a Clinical Proteomic Tumor Analysis Consortium for proteomic characterization of malignancies previously identified by The Cancer Genomic Atlas (TCGA).

Proteogenomics is the method of analyzing the proteome using personalized genetic data (Polyakova et al., 2015). Tumor heterogeneity, the necessity for a non-malignant comparator to sequence, the lack of a distinct tryptic digestion pattern of HLA-ligandomes, insufficient sequencing coverage, and high false discovery rates are significant problems in this research. However, sophisticated MS instrument advancements will help overcome the difficulty and aid in the correct prediction of neoantigens.

The processing of genomes and proteomics data and identifying tumor-specific antigens rely heavily on computational tools and algorithms. There are several tailored vaccines targeting neoantigens in clinical trials, despite many hurdles and breakthroughs. The advancement of improved instruments and intricate bioinformatics and algorithms will lead to more accurate neoantigen prediction. Combining a multi-omics approach with a precise bioinformatics-based platform will pave the way for individualized neoantigen-based targeted therapy for various cancer types.

NEOANTIGENS OR MUTATED ANTIGENS

Any particle or molecule recognized as a foreign substance by the immune system is considered an antigen. Toxins, chemicals, bacteria, viruses, and any other substance that the body does not recognize as self are examples of antigens. On the surface of cancer cells are antigens that can provoke an immunological response. Antigens that

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remain on the tumor cell surface or are discharged into the bloodstream have been identified in the majority of human malignancies. They are detected by immunological cells, which trigger a response(Tumor Antigens - Hematology and Oncology, n.d.). Oncofetal, oncoviral, overexpressed/accumulated, cancer-testis, lineage limited, mutated, post-translationally changed, and idiotypic tumor antigens can be categorized into several categories depending on molecular criteria. Both fetal organs and malignant cells express oncofetal antigens.

Oncofetal malignancies are tumors that are induced by viral infections and express antigenic viral proteins in their cells.

Antigens that are overexpressed or accumulated express in normal and malignant cells, but their expression level is slightly higher in cancerous cells. Antigens that are specific to a single cancer histotype are known as lineage-restricted antigens. Antigens that have been mutated are exclusively expressed in malignant cells.

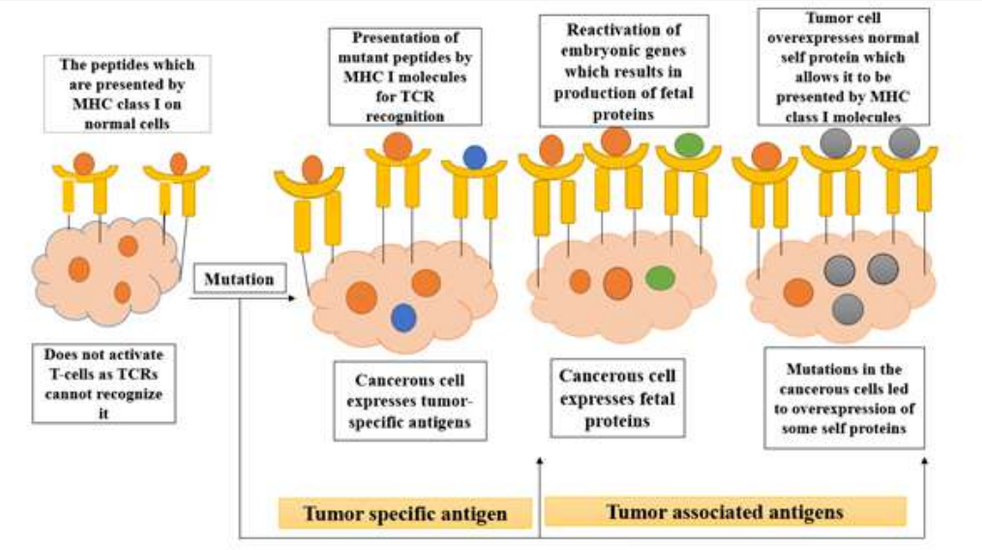

Fig.1 Classification of tumor antigens

They may arise as a result of a genetic mutation or a variant unique to tumor formation. Tumor antigens that have been post-translationally modified originate as a result of changes made during post-translational modifications. In malignancies where malignant cells exhibit a specific clonotype, idiotypic antigens are generated.

Tumor antigens can come from a variety of places. The following are some of the mechanisms:

- When viruses cause cancer, viral DNA is inserted into the host genome.
- Carcinogens have the potential to alter oncogenes or tumor suppressor genes. It has the potential to create new protein sequences.
- Missense mutations in genes other than oncogenes or tumor suppressor genes that can result in the formation of tumor-specific antigens
- Disruption of membrane

homeostasis in tumor cells can release several proteins that potentially act as antigens, typically present at extremely low levels or only during embryonic development.

When tumor cells die, they expel a variety of substances and proteins. Some of which may behave as antigens (Tumor Antigens - Hematology and Oncology, n.d.).

T-cell treatments are directed at these tumor antigens. These tumor antigen targets are recognized by T-cell receptors, which activate cytotoxic T-cell cells, resulting in cell death.

Some characteristics should be present in the tumor antigen targets. The following are the details:

- They need to be tumor-specific.
- Addiction to Tumors
- Immunogenic in origin

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Based on their existence in tumor cells and normal cells, tumor antigens are categorized into two groups.

Tumor-Associated Antigens (TAA) and Tumor-Specific Antigens (TSA) are two types of antigens found in tumors (Effern et al., 2020).

Neoantigens are peptides produced from non-synonymous tumor-specific mutations that are recognized as foreign by immune cells. These tumor-specific antigens are expressed by tumor cells. Neoantigen-specific T-cell receptors (TCRs) recognize them specifically.

Though tumor antigens-based targeted immunotherapy faces many challenges, such as controlling the development of strong autoimmune reactions or tumor escape and immunosuppression, the proper delivery of cancer vaccines associated with chemicals that block immunosuppressive agents; checkpoint blockade inhibitors or adoptive T-cell-based therapy all have promising prospects(Vigneron, 2015). The ability to predict neoantigens accurately might aid in triggering an anti-tumor response in patients without the risk of autoimmune responses. It is also expected to make a significant contribution to cancer immunotherapy.

A BRIEF HISTORY RELATED TO THE PREDICTION OF NEOANTIGENS THROUGH DIFFERENT APPROACHES

The original focus was on determining the characteristics of a few well-known mutations. The plan was to create small peptide segments based on previously reported mutant BRAF, KRAS, and p53 sequences. The peptides generated were used to activate T-cells collected from the patient's or healthy donor's blood. The clonally grown T-cells were tested for their ability to suppress tumors with those mutations. The method of cDNA library screening became the most popular and was widely utilized for neoantigen detection. He used this strategy to recognize antigens that can activate T-cells by overexpressing cDNA libraries and mixing MHC molecules with T-cells. CDK4, MUM1, CTNNB1, CDC27, TRAPPC1, ASCC3, HHAT, FN1, OS-9, PTPRK, CLPP, PPP1R3B in melanoma, EF2, ACTN4, ME1, NF-YC in lung cancer, HLA-A2, HSP70-2, and KIA1440 in renal cancer are some of the neoantigens found by this approach. This method is labor INTENSIVE and has a poor throughput(Lu & Robbins, 2016). Researchers began employing Whole-exome sequencing technology to uncover mutations in cancer genomes after the discovery of high-throughput sequencers. An in-silico examination of these altered genes would anticipate epitopes that MHC molecules would recognize. T-cell-specific neoantigens will be identified using the common epitopes. The limitations of the cDNA library screening approach can be overcome with this method (Robbins et al., 2013).

Mass spectrometry was used in the other strategy to discover neoantigens. The isolation of HLA molecules from the surface of tumor cells was followed by the extraction of peptides from them in this approach. To detect neoepitopes, the eluted peptides were sequenced using mass spectrometry. This approach was used to detect a peptide produced from a mutant Elongation factor 2(EF2) gene in lung cancer as a T-cell epitope. The lack of sensitivity was a fundamental flaw in this strategy (Hogan et al., 1998).

In 2012, researchers used next-generation sequencing (NGS) technology to identify immunogenic tumor cells in murine models. Due to the decreased accuracy of MHC-binding prediction methods, the methodology suffers. Scientists created lengthy peptides that surrounded

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T-cell epitopes and stimulated Antigen Presenting Cells (APCs) to get around this. CIRH1A, GART, ASAP1, RND3, TNIK, RPS12, ZC3H18, and LEMD2 are the altered antigens discovered using this method (Robbins et al., 2013).

Recently, researchers have combined whole-exome sequencing, transcriptome sequencing, MHC-binding affinity prediction, and mass spectrometric approaches to detect neoantigens. Thus, the science of 'Proteogenomics,' which combines proteomics and genomics data, assists in finding tumor-specific neoantigens (Verma et al., 2020).

PROTEOGENOMICS- THE DEFINITION AND WAY FORWARD

The human genome provides a treasure trove of data about human growth, physiology, medicine, and evolution. Genomic science has progressed through four stages. The discovery of chromosomes, which are the cellular basis of heredity, was the starting point. The discovery of the molecular foundation of heredity, the DNA double helix, was the next step. The identification of genes, the informational basis of heredity, was the third stage of development. The field began to grow with the introduction of recombinant DNA technologies, which made cloning and sequencing easier for scientists. The research was spurred forward by a strong desire to decode genes and whole genomes(Lander et al., 2001). The structure and sequencing of a polynucleotide were reported twelve years after Watson and Crick's seminal discovery of the double-helix structure of DNA. Holley and colleagues sequenced the 77-nucleotide yeast alanine tRNA as the first polynucleotide. Viruses and viroid, plasmids, organelles, eubacteria, archaea, fungus, mammals, and plants were among the DNA and RNA sequences generated by the earliest, difficult, demanding, and labor-intensive sequencing procedures(Kulski, 2016; RajBhandary & Köhrer, 2006).

When the human genome was widely sequenced, it was a significant milestone. Bacterial Artificial Chromosomes (BAC) clones were utilised to sequence a 25-fold larger genome than any previously sequenced genome. Each BAC clone used to have a 100 kb piece of the human genome in it. Amplification of the BAC clone in bacterial culture, isolation, and trimming to create fragments of size 2-3 kb are the processes followed in the BAC-based sequencing approach. The resulting pieces were then subcloned onto plasmid vectors, amplified in bacterial culture, and the DNA extracted. The computing capacity was used to build the BAC insert sequence in contigs (contiguous stretches of assembled sequence reads) of each created BAC clone in plasmid sub clone equivalents. Following the completion of the Human Genome Project, the sequencing methods underwent a substantial alteration. The emphasis shifted away from BAC-based methods and toward Whole Genome Sequencing (WGS). The DNA is directly broken into fragments of various sizes and placed into various plasmid sub-clones in this method. This significantly boosted the rate of sequencing(Mardis, 2008). The development of the Polymerase Chain Reaction (PCR) technology, which uses thermal cyclers and a heat resistant enzyme called Taq polymerase, allowed researchers to amplify random or unique sequences for de novo sequencing, was one of the remarkable events that contributed to revolutionising the genomics field.

The discovery of reverse transcriptase was the next major event(Weiss, 1998). It paved the path for using cDNA reverse transcribed from RNA to sequence RNA. As a result of all of this,

a large number of cDNA sequences known as expressed sequence tags were created. All of these developments culminated in the establishment of GenBank in 1982 (http://www.ncbi.nlm.nih.gov/genbank). The increased efficiency of computer tools in storing and analysing nucleotide sequences, as well as the usage of automated sequencers, resulted in an unanticipated growth in the amount of DNA and RNA sequences. Nonetheless, the sequencing method relied on capillary sequencing devices similar to those used in the Human Genome Project. However, with the invention of new sequencing technologies and procedures known as Next Generation Sequencing (NGS) Technologies, the situation altered. These methods improved sequencing accuracy while reducing time and expense.

NGS technologies were designed to leverage a variety of parallel techniques to sequence many samples quickly and efficiently, resulting in a higher percentage of sequence coverage in a shorter amount of time. The following are some of the features of NGS technology. It employs a cloning-free method that depends on shotgun sequencing of DNA or cDNA transcribed from RNA fragments. The linker/adapter sequences are ligated to the DNA/cDNA fragments, template libraries are generated, and library amplification is performed. The time it takes to generate data differs significantly between NGS and capillary-based equipment. Though NGS instruments take longer to generate reads, the sequencing operations are carried out in parallel, resulting in a substantially larger number of sequence reads and total bases per instrument run. Depending on the instrument, the number of reads can range from a few hundred thousand to tens of millions (Head et al., 2014).

It may be said that the area of genomics is always evolving, with new technology opening up new avenues for genetic and biological research. Starting with the Maxam and Gilbert chemical degradation DNA sequencing method and progressing to the Sanger DNA chain termination sequencing method, sequencing techniques have advanced significantly to their current state. It is still progressing from second-generation sequencing platforms to third-generation single-molecule sequencing technologies that have just appeared.

The Institute for Genomic Research (TIGR) was the first of its type to use a shotgun sequencing and full sequencing approach to automate the genome sequencing of two bacterial species, Haemophilus influenzae and Mycoplasma genitalium. The automated sequencers grew in popularity and continued to evolve until they reached their current state.DNA sequencing is now utilised to predict functional genomics, Single Nucleotide Polymorphisms (SNPs), and transcript arrays in the postgenomic age. Since the introduction of Gene Chip microarrays, DNA array technology has grown rapidly, and several gene expression studies in both prokaryotes and eukaryotes have been undertaken(Fleischmann et al., 1995; Fraser et al., 1995; Kiechle & Zhang, 2002).

With all of these advancements (high-throughput NGS Platforms), scientists and researchers claim that sequencing studies (genomics and transcriptomics) will help detect pathogens, improve crops, characterise ecological diversity, identify unknown etiologic agents, discover novel targets and therapeutics, and so on. Overall, this would add to our basic biological knowledge.

Since 1838, when Berzelius developed the term "Protein," derived from the Greek term proteios, which means "first

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The field of proteomics has likewise progressed and developed significantly. It all started with the traditional protein purification procedures. Ion-exchange chromatography, size–exclusion chromatography, and affinity chromatography were among the chromatography-based approaches covered. In clinical and pharmaceutical laboratories, liquid chromatography and high-performance liquid chromatography were widely utilised. Enzyme-linked immunosorbent test (ELISA) or Western Blotting could be used to examine specific proteins. Separating proteins from a complicated mixture is done using gel-based methods (Sodium dodecyl sulphate polyacrylamide gel electrophoresis, two-dimensional gel electrophoresis, and two-dimensional differential gel electrophoresis). Tiselius devised a moving boundary approach for analysing protein electrophoresis in 1930, which helped to expand electrophoretic techniques. In 1975, O' Farrell developed 2D-polyacrylamide gel electrophoresis (2D Page) for protein separation.. The premise of the technique was that proteins would be separated in the first dimension based on their isoelectric point, followed by a separation based on their molecular mass. In two samples, 2D Page electrophoresis was used to discover novel proteins and measure their relative abundances(O'Farrell, 1975). In two samples, 2D Page electrophoresis was used to discover novel proteins and measure their relative abundances. In 1997, the 2D differential in-gel electrophoresis (DIGE) method was invented, allowing three different protein mixtures to be separated. Varying cyanine fluorescent dyes with different excitation and emission wavelengths are covalently bonded to the proteins in 2D-DIGE. The method is used to make quantitative comparisons of protein abundance levels. Edman Degradation, which was invented by Pehr Edman, can be used to sequence amino acids in proteins or peptides. The peptides are cleaved at the N-terminal link, but all other peptide bonds remain intact. The commonly used automated Edman degradation (protein sequenator) can sequence peptides of up to 50 amino acids. Protein microarray technology was first developed in 1989. Roger Ekins was the one who created and introduced it. Protein microarrays were used as a high-throughput method to aid in the analysis of protein function. Because mRNA profiles may not necessarily indicate protein expression, it overcomes a shortcoming of DNA microarray technology. Analytical protein microarrays, Functional protein microarrays, and Reverse-Phase Protein Microarrays are the three types of protein microarrays. Analytical Protein Microarrays identify proteins by trapping them with antibodies, Functional Protein Microarrays evaluates protein binding activities, and Reverse-Phase Protein Microarrays analyse materials collected directly from spotting tissue or cell lysates(Ekins, 1989). Analytical Protein Microarrays identify proteins by trapping them with antibodies, Functional Protein Microarrays evaluates protein binding activities, and Reverse-Phase Protein Microarrays analyse materials collected directly from spotting tissue or cell lysates. The identification of biomarkers was made easier thanks to protein microarrays. However, protein microarrays can't be utilised to figure out how a whole genome works. The development of Mass Spectrometry (MS) as a versatile proteomics tool for analysing proteomes aided in the accurate and sensitive analysis of composite protein mixtures. MS-based quantitative proteomics

approaches include isotope-coded affinity tag labelling (ICAT), stable isotope labelling with amino acids in cell culture (SILAC), and isobaric tag for relative and absolute quantification (iTRAQ). X-ray crystallography and NMR spectroscopy are the two most used high-throughput techniques for determining the three-dimensional (3D) structure of proteins. The structural analyses aid in a better understanding of the biological significance of the research (Sutandy et al., 2013; Yates Iii & R, 2011).

Mass spectrometry is used to quantify the molecular weight of proteins by measuring the mass to charge ratio (m/z). The following are the overall steps of the procedure:

- Proteins from the samples are removed and digested with proteases to generate peptide molecules, which are then changed into gas-phase ions.
- Ions are separated based on their m/z charge, and the m/z values for each ion are detected and analysed.

The most often used techniques for ionisation of molecules are matrix-assisted laser desorption ionisation (MALDI), surface enhanced laser desorption ionisation (SELDI), and electrospray ionisation (ESI).

The mass analyser is the chamber where ions are separated, and the ions are separated in the presence of an electric or magnetic field. MS can be used to identify post-translational changes . Liquid chromatography is generally combined with tandem mass spectrometry (MS/MS) to generate the data. It is also known as shotgun proteomics. The spectra generated by this method are matched with the theoretical which is formed of all the peptides present in a reference sequence database. Some of the reference sequence database which are used for peptide identification are Ensembl, RefSeq, or UniprotKB (Cristea et al., 2004).

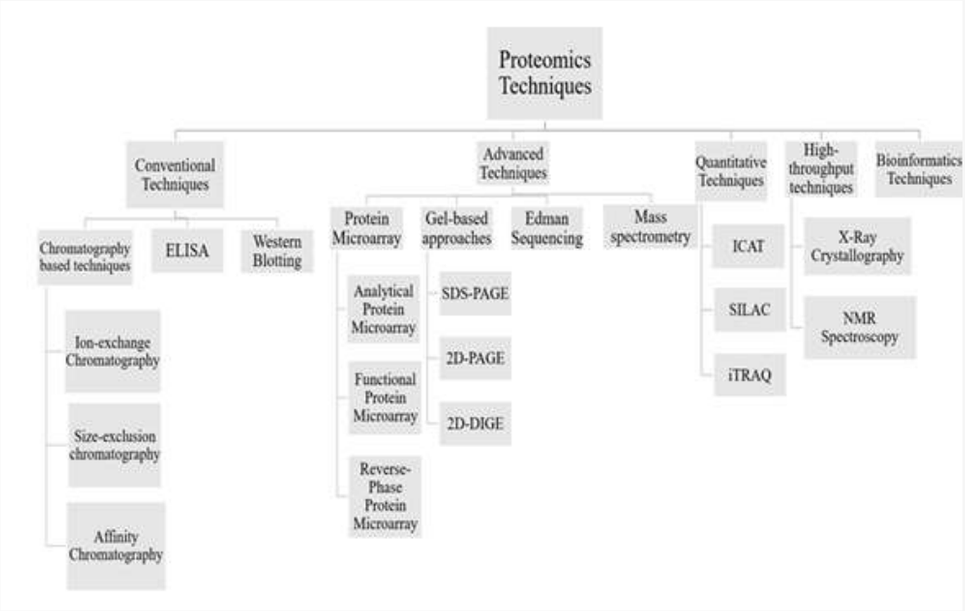

Fig 2. The Different Proteomics Techniques

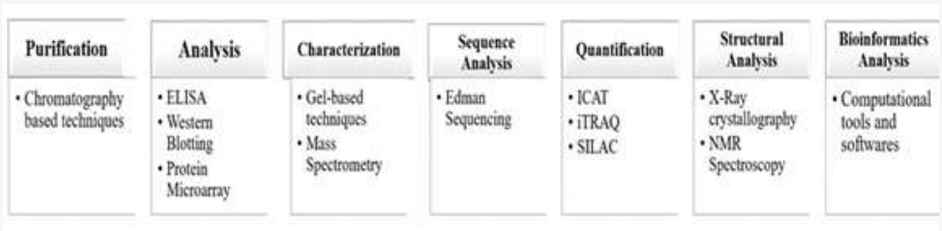

Fig 3. An overview of different proteomics technologies and their applications

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The most current strategy is to combine the two sciences of genomes and proteomics to produce Proteogenomics, a new branch of research. In 2003, George Church and his colleagues used proteomics data to forecast the set of Mycoplasma pneumoniae ORFs (Open Reading Frames). They created a "Proteogenomic" map by detecting peptides in a Mycoplasma pneumoniae whole-cell lysate and annotating ORFs with those peptides(Jaffe et al., 2004). As a result, the term "proteogenomics" was coined. Unlike shotgun proteomics, which examines MS/MS spectra against a reference sequence database such as RefSeq, ENSEMBL, or UniprotKB, the Proteogenomics approach identifies novel peptides by examining MS/MS spectra against customized protein sequence databases derived from both genomic and transcriptomic sequence data. These databases have all of the information about sequence variants. The Proteogenomics technique improves protein sequence databases and allows for protein-level confirmation of gene expression. The term "proteogenomics" refers to a method of analyzing proteomes utilizing personalized genetic data. In a traditional shotgun proteomics technique, the usage of a reference genome database does not represent the personalized genetic properties of the supplied sample. The importance of analyzing genetic variants represented in the proteome for cancer research is evident, as these variants may drive cancer growth and progression. Intragenic and intergenic peptides are two types of peptides that have been identified. Based on the annotation of the relevant gene model, intragenic peptides can be further subdivided into the protein-coding gene, pseudogene, and long noncoding RNA gene. Peptides from foreign protein-coding loci (intergenic peptides) or peptides derived from single amino acid variations are the unique peptides discovered using the Proteogenomics technique. Alternative splice junction peptides resulting from gene fusions, intron retentions, and other RNA editing events may also be included (Verma et al., 2020). The majority of Proteogenomics applications aimed to confirm the protein-level expression of sequence variations predicted from the genome sequence. This method has been utilized widely in model organisms such as ***Plasmodium falciparum, Drosophila melanogaster, C. elegans, Arabidopsis thaliana,*** and ***Anopheles gambiae*** a variety of purposes. It is used to detect aberrant protein variations in various cancer tissue samples in both humans and mice. As a result, the Proteogenomics approach may be used to identify novel protein-coding areas; new translation start sites, alternative splicing, RNA editing, gene fusions, and other sequence variants. Biomarker development, disease prediction, and the identification of novel pathways are all made easier due to it.

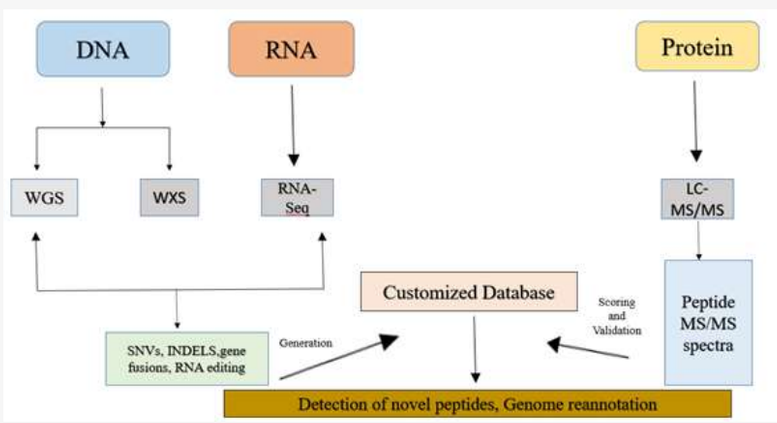

Fig. 4 An Overview of Proteogenomics Approach

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THE PROTEOGENOMICS APPROACH IN NEOANTIGEN IDENTIFICATION AND CANCER TREATMENT

It is not always easy to link disease manifestations to genes. Changes in the predicted protein can be caused by a variety of factors, including genetic mutations. Changes in post-translational modifications, changed pathways, and so on are among the other reasons. A tumor can have many mutations, but not all are driver mutations, meaning they don't help the tumor grow and develop. As a result, employing a genomics method to uncover possible targets becomes rather challenging(Rodriguez & Pennington, 2018). Proteins are the building blocks of living creatures, while genomes hold all information about a person. The goal of proteomics is to characterize all of the proteins in a cell or organism. The information gathered is used to classify an organism's normal and sick states. The development of biomarkers and assessing the status and progression of cancer are two of the most critical applications in cancer research. The discovery of new biomarkers aids in cancer patient screening and early diagnosis. It can also be used to track how well a therapy is working. Proteomics has also helped researchers better grasp cancer etiology. Proteomics information can also be utilized to develop targeted medicines. Proteomics is a powerful tool for supplementing data obtained by genomics-based techniques and gaining insight into the disease (Shruthi et al., 2016).

The need for Proteomics can be summarized in the following points:

·It is not possible to correlate mRNA (messenger Ribonucleic acid) levels with corresponding protein levels.

- mRNAs can also be noncoding and do not express any protein
- Alternative splicing may give produce multiple protein products
- Genomics data cannot provide information about post-translational modifications
- The translocation of protein cannot be known from sequence data

Proteins can be degraded in due course of time.

As a result, comprehending the proteome is necessary for a thorough comprehension of the genome. According to the findings, all alterations at the proteome level cannot be observed at the genetic level. Proteins are the target of the majority of anti-cancer therapy. As a result, combining proteomics with genomes and transcriptomics has become a popular method for doing fundamental, translational, and clinical research.

Researchers are using a combination of genomic and proteomic data to understand better the underlying mechanisms of complex biological processes and disorders such as cancer. In cancer, the Proteogenomics approach can use both genomics and proteomics data to identify novel biomarkers and therapeutic targets arising from both genetic mutations and protein modifications. It shall help in better diagnosis and prognosis of cancer patients.

Similarly, utilizing genomes data and proteomics techniques, the Proteogenomics methodology can detect tumor-specific antigens. All antigens that have been modified due to chromosomal mutations, alternative splicing events, gene fusions, or alternative protein modifications can be anticipated. To accurately identify neoantigens, the anticipated antigens are analyzed in silico for MHC binding affinity. As a result, the proteogenomics method can evaluate all events resulting in altered proteins and properly predict tumor-specific neoantigens.

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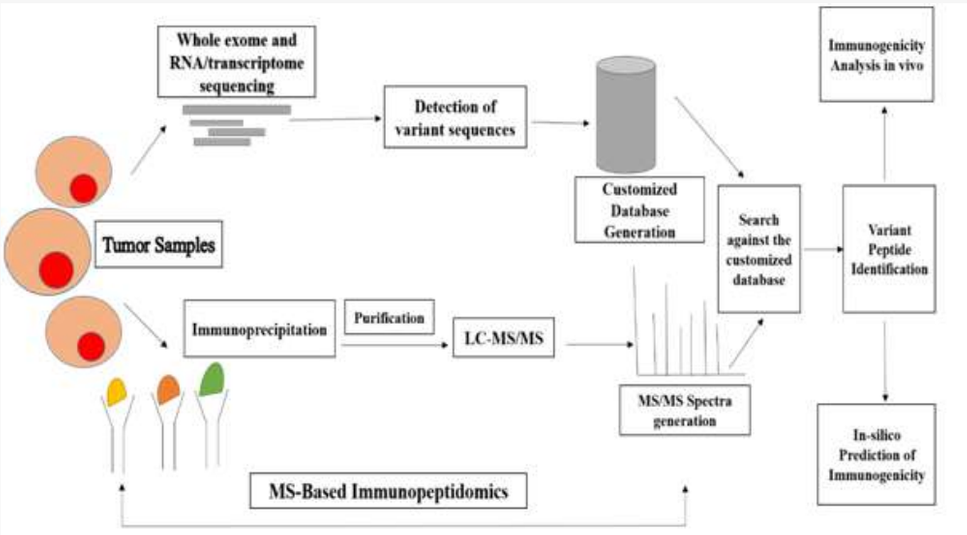

Fig 5. A customized workflow to predict neoantigen using a multi-omics approach

CONCLUSION

The accumulation of mutations in the cancer is the primary cause of cancer. Only cancer driver mutations may be identified and characterized using genome sequencing. Sanger Sequencing devices could not handle large-scale genome sequencing from cancer samples. The area was transformed by next-generation sequencing technology, which allowed for rapid, efficient, and large-scale genome sequencing. It completely changed the breadth and scope of cancer research. It made it possible to sequence a significant number of cancer genomes. NGS technology enabled researchers to get substantial levels of redundant sequence coverage and to discover subclones of cells in malignancies quickly. The speed with which data is analyzed is still a concern. NGS technology can detect sequence mutations, minor indels, CNAs, structural rearrangements, and loss of heterozygosity in tumor DNA samples. Genomic approaches can also reveal information on mutational load. It can reveal information about the efficacy of immune checkpoint inhibitors as well as identify cancer-specific proteins. Researchers have been able to quantify gene expression and find alternative transcripts and allele-specific expression thanks to developments in sequencing techniques. Translocations, transversions, and other structural changes can result in mutations, identified via transcriptomics sequencing and employed as a new targeting therapy (Berger & Mardis, 2018; Dellaire et al., 2013).

The National Cancer Institute's Cancer Genome Atlas effort was a watershed moment in the area of cancer genomics. Around 20000 primary cancer and matched normal samples of 33 cancer types were described. In 2006, the National Cancer Institute and the National Human Genome Research Institute collaborated on a project. The information assists in the improvement of diagnostic and therapeutic techniques. (www.cancer.gov/bout-nci/organiation/ccg/research/structural-genomics/tcga) Takahiko Koyama and Laxmi Parida used transcriptome data from the TCGA to discover new genes linked to metastasis. Worldwide, researchers are making the TCGA data used for finding novel biomarkers, therapeutic targets and helping to prevent cancer.

With all of these developments and benefits, the following problems must still be overcome:

- Challenges unique to each sample

For the characterization of cancer genomes, the quantity and quality of tumor tissue samples remain a problem. Tumor samples contain a high number of non-malignant cells, such as immune cells, in addition to a small amount of genetic material.

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This limits the information that may be gleaned from somatic mutations. The chemical may lead to chemically changing DNA in tumor tissue stored and preserved as formalin-fixed, paraffin-embedded (FFPE)tissue blocks.

- NGS-Specific Challenges

The computational requirements and run times for WGS, WXS, and RNA-seq data analysis are extremely high. To address this problem, tailored panels are routinely employed to screen a large number of individuals for the presence of clinically relevant mutations. From a therapeutic standpoint, the focused panel technique is useful for finding essential mutations in low purity tumor samples. Whole-genome/exome sequencing, on the other hand, can only reveal information about intratumoral heterogeneity or the presence of tumor-specific neoantigens.

- Need for sequencing a non-malignant comparator

The matching non-malignant DNA can be utilized as a reference to distinguish between somatic mutations and germline variations. Variants must be screened out using databases of recurrent somatic and germline mutations without a non-malignant comparison. It will increase the number of false negatives and positives.

- Computational analysis challenges

The complexity and size of the NGS data collected are growing. The algorithms for analyzing data and identifying each sort of variant are quite complex. The amount of time it takes to complete each sort of analysis becomes extremely important.

- Challenges faced during transcriptomics analysis

Because RNA is a more labile molecule than DNA, it requires special processing and quality checks before being used in an assay. The methods of preservation should also be precise. The analysis of RNA-based assays complicates computer techniques and adds time and cost to the process.

Whole exome sequencing data from tumor samples and non-malignant cells can be utilized to predict neoantigens using neoantigen prediction algorithms in terms of neoantigens. In addition, the Immune Epitope Database (IEDB) has specific data analysis tools. The comparison to RNA sequencing aids in finding variants that are likely to be transcribed and are, therefore, of interest. Thus, with increased computational tools and software/, the genomics data shall provide all the necessary details to establish precision and personalized therapy (Berger & Mardis, 2018).

Proteomics also continually produces a large amount of data describing the differentially expressed proteins in a normal and sick cell or tissue states. Correct data interpretation and analysis are required for a comprehensive understanding of tumor pathophysiology and the discovery of novel targets for cancer immunotherapy. A draught of the human proteome based on MS has been released. This paper demonstrates the developments in MS-based approaches and data processing. Because of tumor heterogeneity, proteomics techniques become more complicated when used in cancer research. A study was reported by Gustafsson O J et al. to combine MALDI with imaging (MALDI imaging mass spectrometry; MALDI-IMS) to extract valuable facts from formalin-fixed tissue blocks (Gustafsson et al., 2013; Sallam, 2015; Wilhelm et al., 2014). It can also be used to create peptide reference datasets used in future investigations for peptide identification. Shipitsin M et al., in a separate study, employed tissue microarrays to avoid sample variance interfering with biomarker

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prediction of cancer aggressiveness. Proteomics procedures typically take one of two approaches: "shotgun" or "targeted." (Shipitsin et al., 2014)

MS approaches have gone through a number of stages of development. The efficiency of the instruments has improved with each advancement. Advancements in this discipline include MALDI-MS and ESI-MS and advances in protein separation techniques such as liquid chromatography and gas chromatography. The MS-based technique also enables researchers to investigate epigenetic biomarkers and their potential in cancer detection and treatment. Selected reaction monitoring (SRM) has been utilized in studies to detect mutant proteins. Cancer research, on the other hand, has several hurdles. They are as follows:

- Tumor heterogeneity
- Sample variables
- Improper study designs
- Storage and interpretation, and analysis of massive data generated.
- Reference databases are not accurate
- Extreme hydrophobic or hydrophilic peptides are very difficult to be eluted out of the liquid chromatography (LC) column

Peptide phosphorylation can be identified using various advanced MS instruments and techniques, such as Immobilized Metal Affinity Chromatography (IMAC) in combination with a hybrid-linear-quadrupole ion-trap Fourier transform mass spectrometer or a hybrid ion-trap Orbitrap. Mass spectrometer advancements aided in the provision of high-resolution and high-accuracy MS data. The time it takes to find peptides has been cut in half, and the percentage of false positives has dropped dramatically. A mass spectrometry-based immunopeptidomics (MS-immunopeptidomics) technique is used to identify neoantigens. MHC-bound peptides are eluted from tumor samples with antibodies that recognize HLA and sequenced using a mass spectrometer. The generated MS/MS data is compared to databases to forecast neoantigens accurately. The sorting of low abundance peptides is the most challenging aspect of this approach.

The advent of advanced high-throughput next-generation sequencing technologies and revolutionary mass spectrometers led to the emergence of Proteogenomics combining both genomics and proteomics. The intricate relationships between single nucleotide variants (SNVs), the expression of transcripts, and the translation of proteins can be explored through this method. They can lead to a greater conceptualization of the underlying pathogenesis of cancer. The significant challenges in this approach are sample preparation, data acquisition, and processing for genomics, transcriptomics, and proteomics(Barbieri et al., 2016). Complex bioinformatics techniques and algorithms aid in determining the repercussions of genetic alterations at the proteome level. This method overcame the challenges of traditional shotgun proteomics techniques in terms of the reference protein sequence database. To improve access to proteome datasets, a large number of proteomics data repositories have been created. SNVs that target PTM sites have also been identified using computational techniques and algorithms. . Though it requires a huge amount of computational power, it has been possible to answer questions like whether non-synonymous SNVs affect protein function or the effect of single amino acid variants on protein stability.

Integration and analysis of RNA sequence data, protein expression data, and genetic variation data

THE ROLE OF MULTI-OMICS IN ESTABLISHING PERSONALIZED NEOANTIGEN(IMMUNOTHERAPY)-BASED TREATMENTS FOR CANCER

can aid in disease knowledge and accurately predict tumor-specific antigens or neoantigens. For the molecular characterization of malignancies, the International Genome Consortium initiatives were established. The Clinical Proteomic Tumor Analysis Consortium (CPTAC) of the National Cancer Institute is a recent breakthrough for studying the molecular basis of cancer utilizing a proteogenomics approach.

It was founded in 2011 to determine the proteogenomic characteristics of colorectal, breast, and ovarian cancers to learn more about proteomic-centric subtypes, driver mutations, and cancer pathways. It is being expanded to include different cancer types. The International Cancer Proteogenome Consortium (ICPC) and the Applied Proteogenomics Organizational Learning and Outcomes (APOLLO) were established to examine commonly diagnosed malignancies and bridge the gap between research and healthcare systems.

(www.proteomics.cancer.gov/programs/cptac)

All of these will pave the way for the discovery of sample-specific tumor-specific antigens, paving the path for precision and personalized treatment.

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THE ROLE OF MULTI-OMICS IN ESTABLISHING PERSONALIZED NEOANTIGEN(IMMUNOTHERAPY)-BASED TREATMENTS FOR CANCER

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IMPACTS OF PANDEMIC ON WASH IN SLUMS

This epidemic has changed everything for us; our thoughts, our habits, our whole life. We are ordinary people who may not have so much science in our heads but we understand very well the importance of our essential things like food, clothing and shelter. UN has mentioned 17 SDGs for human wellbeing and SDG 6 is the most important goal for all the people who are living all over the world. The goal is access availability to water, sanitation and hygiene for all. We can debate whether water is a blessing or a curse that's another topic. Despite floods, heavy rainfall disasters we all should agree that water is the lifeline for all living creatures.

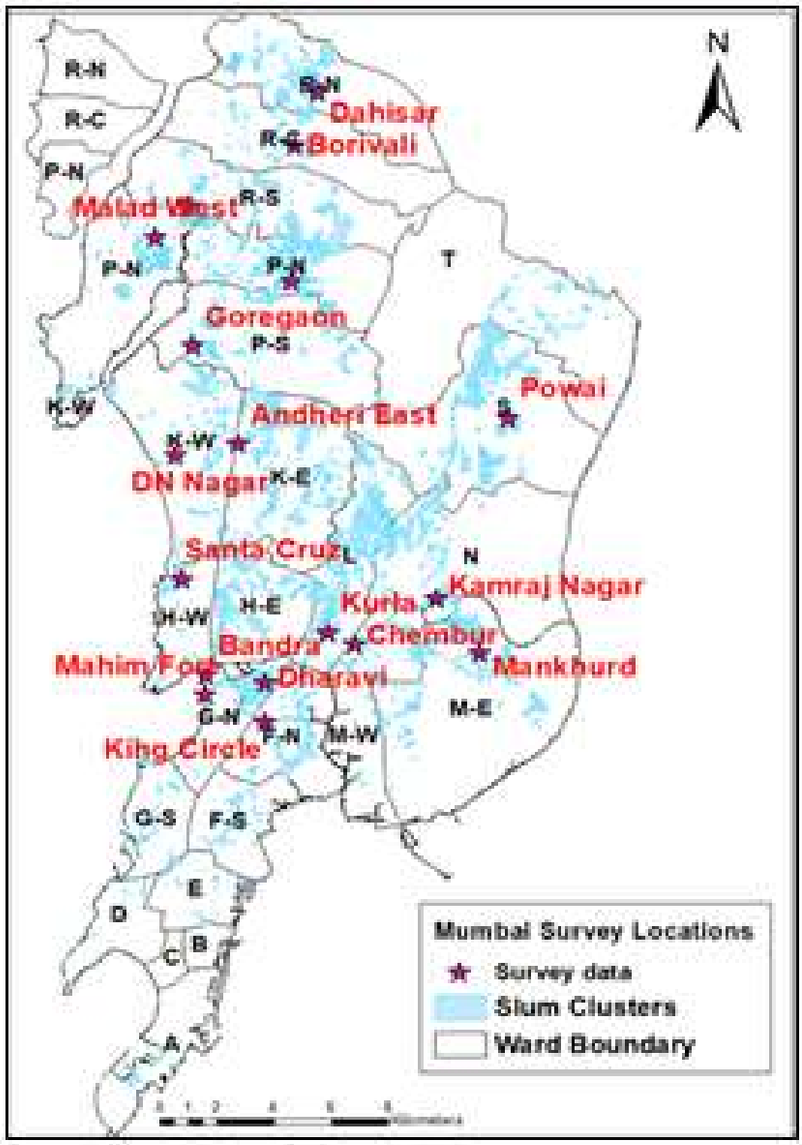
WHO has listed COVID-19 under the top seven contagious diseases which are directly or indirectly spread because of poor sanitation, hygiene facilities and lack of access to clean water. This literature also supports that good sanitation and hygiene facilities with access to clean water can control this virus. The slum communities are in a more risky and vulnerable situation in this pandemic because they do not have proper access to WASH facilities. The words social distancing, quarantine seem very incomprehensible when people do not have access to the minimum facilities. Dealing with this epidemic is not an easy task for a third-world country. India has a total population of over 1 billion, of which 20 million live in slums. This epidemic once again made it clear how much availability and access to clean water and sanitation is important. The slums of India spread across all the metro cities like Mumbai, Delhi, Kolkata, Hyderabad and other cities too. The government of India defines slums as, "Residential areas where dwellings are in any respect unfit for human habitation by reasons of dilapidation, overcrowding, faulty designs of buildings, narrowness or faulty arrangement of streets, lack of ventilation, light or sanitation facilities, or any combination of these factors which are detrimental to safety and health."

A case studies on Mumbai slums

Survey work has been done by TERI on Mumbai Slums to analyze the impact of COVID-19 on water and sanitation. The project was carried out on 18 slums which are both from island city and suburban districts of Mumbai.

Mumbai is the financial capital of India with a 12.48 million population as per Census 2011. In the past few decades, the city has become highly developed industrial and the increased job prospects have resulted in unabated migration from all over India even from neighboring countries like Bangladesh, Nepal, Bhutan, etc. Almost half of the total population lives in the slums of Mumbai due to a lack of affordable housing. So, they are forced to live in densely populated squatters even without basic facilities like proper toilets and access to clean water. The COVID-19 pandemic creates urgency for access to clean water and proper sanitation which is the first line of defense. Although most of the Mumbai slum has a good literacy rate (69%) lack of awareness among these slum communities leads to a vulnerable situation. The slums of

IMPACTS OF PANDEMIC ON WASH IN SLUMS



Mumbai are suffering due to a lack of clean toilet facilities. A survey report from ORF (Organizational Research Foundation) shows that only one toilet seat is available for 190 users which is against the WHO norms for health and sanitary practices. During the first wave of the pandemic Mumbai alone has recorded almost 60 % of the total positive cases all over India, out of which 40% affected people belong to these slum clusters. It is observed that water tanks from the municipality are not providing water daily to the slums. This pandemic has shut down many industries which cause a decline in water demand by the industrial sector. As a result, revenue from the water was affected by the water supply chain. In Mumbai slums, sanitation comes under the Maharashtra Housing and Area Development Authority (MHADA). Almost all slum clusters have closed drainage systems but in terms of maintenance of these drains, there is yet to be a functional system in place.

Mumbai slums mostly depend on community toilets and COVID-19 led these public facilities to be contagious places. Many factors are causing the rapid spreading of COVID-19 among slum dwellers like lack of education, lack of awareness, poor waste management systems, lack of drinking water and clean toilets etc. from the study It has been found that the slum cluster in the Malad West region scored 6.1 out of 10 in adaptive capacity ranking. Malad West has the worst waste management facility and poor drainage system. However, Asia's one of the largest slum Dharavi should be a true example for other states. This densely populated slum has shown the way how good hygiene practices can be the basic solution. Govt. has started a campaign "Testing, Tracing and Isolation". A COVID-19 affected person can be traced by her/his smartphone location. Moreover, a higher literacy rate, access to WASH facilities can be included as strengths.

IMPACTS OF PANDEMIC ON WASH IN SLUMS

COVID-19 pandemic has indeed created a buzz about 'the new normal but it is also a fact that we were not concerned enough about hygienic practices till the outbreak of COVID-19. However, this situation also changes the old perceptions about health & hygiene. This pandemic situation hits the backbone of our society. Even in the twentieth century we still do not have a clear solution to handle this. The main problem lies between our policies and interventions. It is high time that we considered this pandemic as a warning. We should reform our disaster and health-related policies and interventions. Hence, based on the perceptions survey data this study suggests a framework, especially for slums. The framework consists of six steps which are: Selection of areas, Define problems, Analyze the present situation, Control the situation, followed by Improvements and further decisions.

The world is seeking help and only we humans can help our mother earth by taking some sustainable steps. If we are still not convinced by this warning then we all face frequent similar disasters in the coming years. Indian govt. already started the urban sanitation efforts vis-a-vis Swachh Bharat Mission–Urban (SBM-U) and Atal Mission for Rejuvenation and Urban Transformation (AMRUT). I can share a verse from Bhagavad-Gita,

"मलनिर्मोचनं पुंसां
जलस्नानं दिनेदिने ।
सकृद्गीताम्भसि स्नानं
संसारमलनाशनम् ॥"

Bathing is associated with good hygiene practices. We use water to purify or cleanse our bodies. The verse saying the same thing that one can clean himself by using water but only positive approaches or mindsets can cleanse our thoughts and activities. Maybe tomorrow we will wake up and together we will make this earth more beautiful than before.

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SCIENTIFIC APPROACH AND EVIDENCE SHOWING DNA AS A GENETIC MATERIAL

BACKGROUND

Today we know that DNA is the hereditary material in humans and almost all other organisms, which transmit from one generation to another and keep maintaining the inheritance. The principle of inheritance was first discovered by Mendel. Based on his investigation, Mendel concluded that some 'factors' are transferred from one generation to another. Mendel's Law of Inheritance was the foundation to work on genetic material in scientific world. The search for genetic material began in the mid-nineteenth century among many scientists. There are two ways to prove DNA acting as a genetic material in most of living organism, Direct and Indirect. Initially direct method was used to prove DNA as a genetic material by Griffith on the basis of bacterial transformation (Streptococcus pneumoniae) in 1928. The plan of experiment and its outcome is summarise in fig.1. However, the biochemical nature of the genetic material was not defined until 1944 when Avery, McCarty and Macleod studied the isolated components of heat-killed S-strain bacteria in detail through series of experiments. He proved mice were died after the RNAase and proteinase enzyme proteinase enzyme treatment into the mixture of heat-killed S-cells and R-cells but not died after DNAase treatment. This was an extension of Griffith experiment to establish the biochemical nature of DNA.

GRIFFITH EXPERIMENT

Frederick Griffith experiment (1928) was conducted with the help of bacteria (Streptococcus pneumoniae) and mice. He cultured the bacteria which showed two types of growth. One culture plate consisted of smooth shiny colonies (virulent type III-S strain) while other consisted of rough colonies (non-virulent type II-R strain). The difference was due to the presence of mucous coat in (S) strain bacteria, whereas the (R) strain bacteria lacked of mucous coat.

Griffith injected both strains (S and R strain) to mice. Mice that were infected with (S) strain contracted pneumonia and died. Whereas mice were infected by the (R) strain. They stayed alive. In the second stage, Griffith took heat-killed the (S) strain bacteria and injected into mice, while the mice stayed alive. Then, he mixed the heat-killed (S) strains and live (R) strains. This mixture was injected into mice and they were died. He found that the living (S) strain bacteria were present in dead mice due to transformation.

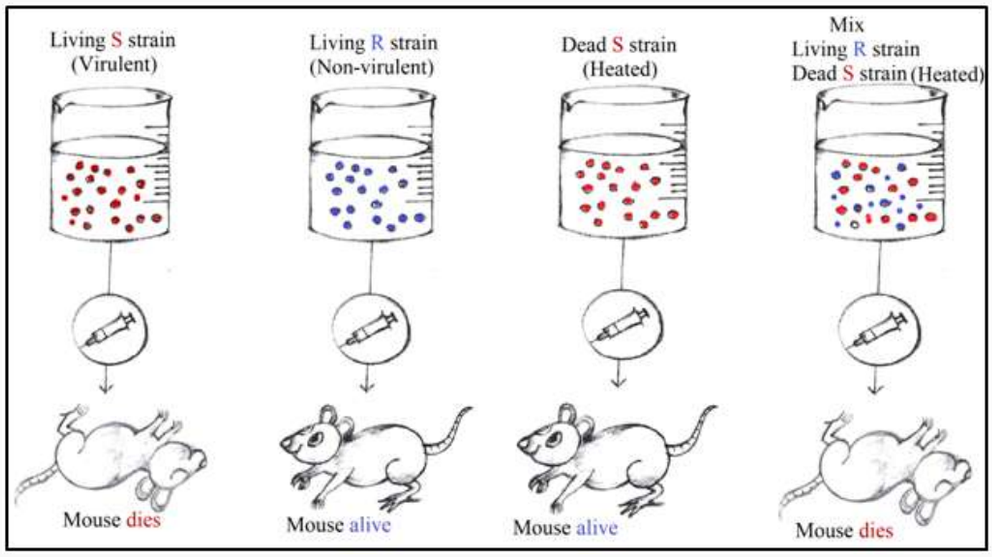


Fig. 1 Griffith's Experiment on bacterial Transformation (Streptococcus pneumoniae) which caused pneumonia in mammals.

CONCLUSION

Based on the observation, Frederick Griffith concluded that R (non-virulent type II-R) strain bacteria had been transformed into the lethal by S (virulent type III-S) strain bacteria. The R strain inherited some 'transforming principle' from the heat-killed S strain bacteria that was somehow part of the dead III-S strain bacteria which made them virulent. And he had proved this

SCIENTIFIC APPROACH AND EVIDENCE SHOWING DNA AS A GENETIC MATERIAL

transforming principle as genetic material which transformed from one generation to another. But he failed to explain that DNA is the genetic material.

Further, in 1952, Hershey and Chase experiment was a ground-breaking experiment for the discovery of genetic material.

HERSHEY AND CHASE EXPERIMENT

In 1952, Alfred Hershey and Martha Chase took an effort to find the genetic material in organisms. Their experiments led to a clear proof to DNA as genetic material. Bacteriophages (viruses that affect bacteria) were the key element for Hershey and Chase experiment.

EXPERIMENT

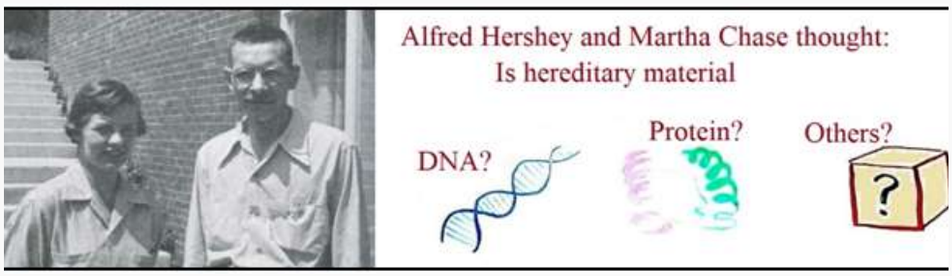
The experiment began with the culturing of viruses in two types of medium. One set of viruses was cultured in a medium of radioactive phosphorus whereas another set was cultured in a medium of radioactive sulphur. They observed that one set of viruses consisted of radioactive DNA but not radioactive proteins. This is because DNA is a phosphorus-based compound while protein is not. The latter set of viruses consisted of radioactive protein but not radioactive DNA.

The host for infection was ***E. coli*** bacteria. The viruses were allowed to infect bacteria by removing the viral coats through a number of blending and centrifugation.

E. coli bacteria which were infected by radioactive DNA viruses were radioactive but the ones that were infected by radioactive protein viruses were non-radioactive.

CONCLUSION

As a result, the radioactive and non-radioactive bacteria infer that the viruses that had radioactive DNA transferred their DNA to the bacteria but viruses that had radioactive protein didn't get transferred to the bacteria. Hence, we can say that DNA is the genetic material and not the protein.



INDIRECT EVIDENCE FOR DNA AS A GENETIC MATERIAL

1. Every cell contains nucleus which controls its morphology, physiology and heredity.
2. Friedrich Miescher (1869) and subsequent workers found out, nucleus possesses deoxyribose nucleic acid. DNA, therefore, occurs in all the cells.
3. DNA is capable of replication and involved in cell division, is equitably distributed in the daughter cells.
4. Parts of DNA can be repressed or depressed according to metabolic requirement.
5. DNA is capable of controlling the cell structure and cell functions through transcription and translation.
6. DNA can show infinite variations due to changes in its nucleotide type, sequence and length.
7. Differential activation of DNA segments or genes results in cell differentiation, tissue formation, organ formation and production of various components of a multicellular body.
8. It has an inbuilt clock for development.

SCIENTIFIC APPROACH AND EVIDENCE SHOWING DNA AS A GENETIC MATERIAL

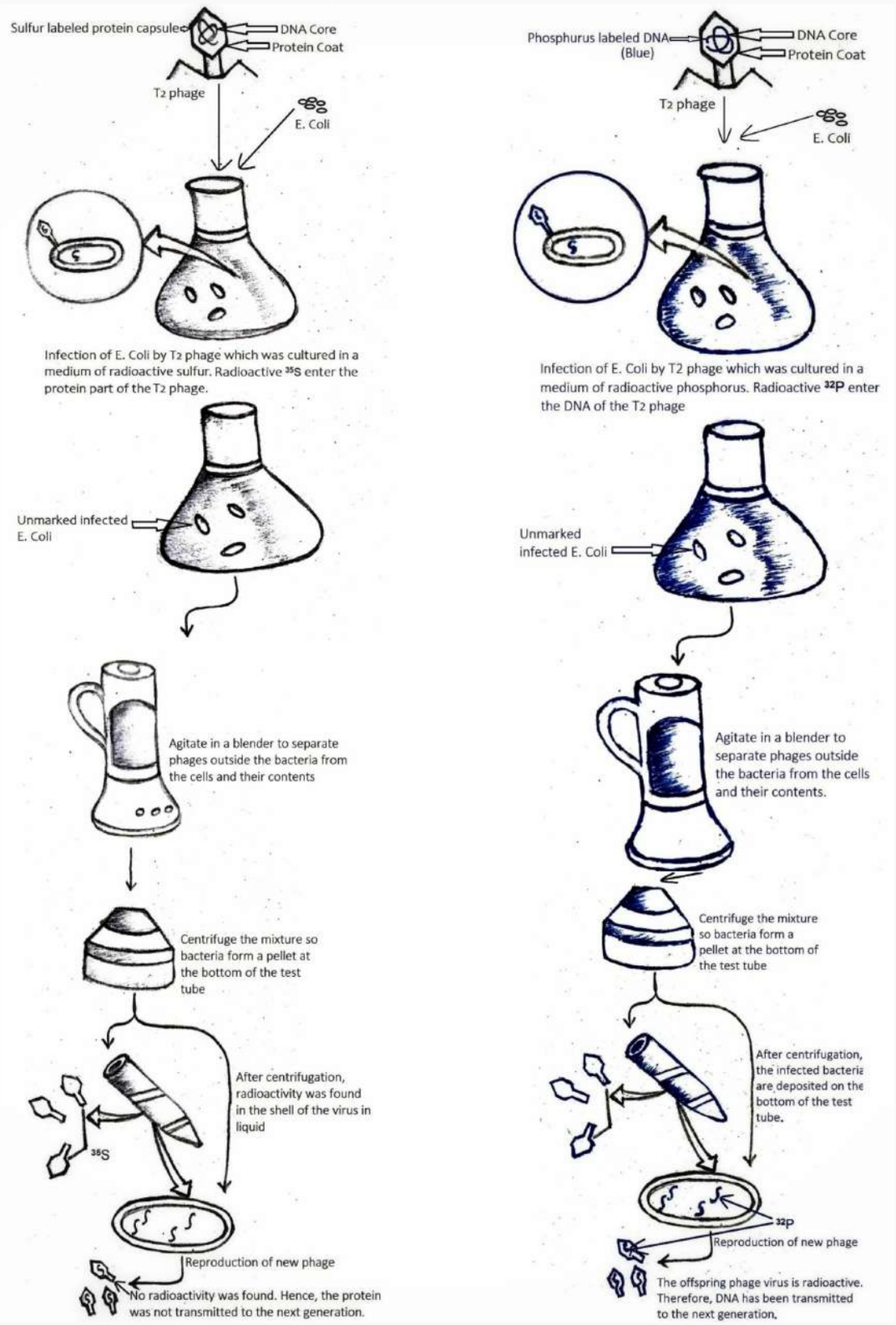


Figure 2. Hershey and Chase experiment using E.coli and Bacteriophage.

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AN APPROACH OF USING CRYPTOGRAPHY AMONG THE COMMUNITY WITH ENHANCING THE SECURITY ON KEY

The growing dependence of people on the utilities of online infrastructure and the expansion of the distributed and networked system due to global inter-connectivity for digital communication, draws the attention of bad actors with the intention of intrusion or eavesdropping. To deal with the security concerns in multi-party communication, authorization and authentication of the communicating users became a crucial part in setting up the communication. The problem of authorizing users for communication is addressed by generating and sharing one or more keys among each other via a non-secure channel. The concept forms the basis of key distribution methods. The simple idea behind the key distribution concepts is to use mathematical functions and techniques to have some kind of shared secret between the legitimate communicating parties and at the same time, it is computationally infeasible by an attacker to guess or brute-force the shared secret. However, with the growing computational capacity of commodity hardware, it becoming difficult to maintain the security of these shared secret. The modern day cryptography and key distribution protocols is heavily relied on the background of number theory and abstract algebra. With the increasing capacity of classical computer and active exploration in the domain of quantum computing, the feasibility of compromising such classical protocols and algorithms in increasing. To deal with such, other methods based on synchronization of neural networks, quantum mechanics and lattice theory are proposed.

Classical cryptography is based on the mathematics and it relies on the computational difficulty of factorizing large number. The security of classical cryptography is based on the high complexity of the mathematical problem for the instance factorization of large number. Classical cryptography involves an interesting combination of analytical reasoning, application of mathematical tools, pattern finding, patience, determination, and luck. In classical cryptography communicating parties need to share a secret sequence of random numbers, the key, that is exchanged by physical means and thus open to security loopholes. Classical cryptography technology divided into symmetric key cryptography algorithm and asymmetric key cryptography algorithm. In symmetric key encryption only one key is used to encrypt and decrypt data. The key should bedistributed before transmission between two parties. Key plays an important role in encryption and decryption. In asymmetric key encryption, two keys are used; private keys and public keys. Public key is used for encryption and private key is used for decryption. Public key is known to the public and private key is known only to the user.

Artificial Neural Networks are computational models that are made up of nonlinear computing units knows as neurons, which are inspired by human brains and intend to abstract the model of animal brain .Neural networks are trained on data using back propagation to learn the intrinsic patterns in the data. Neural networks are non-linear function approximation methods that have recently boosted its use in methods for speech recognition, Natural Language Processing, visual object recognition, object detection and other domains such as drug discovery and genomics. The networks forms a non-linear dynamical system that can demonstrate very complex behaviours such as synchronization in chaotic systems using a common signal link. The work in demonstrates the synchronization of the neural networks that are being trained by hebbian rule on their mutual output developsan equivalent state of their synaptic weights. The synchronized weights can lean to a secure transmission of secret keys. The novel phenomenon of synchronization of two neural networks with identical time

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dependent weights that are trained on mutual outputs, which can be applied to secret key exchange over public channels. They found that it was impossible for an opponent who knew the protocols and all the details of data transmission to decrypt the secret message. It was primarily because tracking the weight is a Hard problem compared to synchronization but also the complexity of the generation of the secure channel is linear with the size of the network.

Quantum Key Distribution (QKD) is an emerging technology in the quantum cryptography world. Unlike conventional cryptography algorithm which depends on complexity of mathematics for its security strength, the QKD uses quantum mechanics laws for its security strength. Theoretically it has been proven that QKD can provide uncompromising security by combining three factors namely, law of quantum mechanics, one-time-pad and hashing scheme. By using quantum mechanics law, QKD has developed new capabilities that is not present in the conventional cryptography techniques, on such ability is the ability to detect the presence of an eavesdropper.

With the increasing number of new computing platforms with a broad range of computing capabilities ranging from highperformance real time environment such as in cloud computing to highly resource constrained Internet of Thing (IoT). This varying computing capabilities poses a challenge to design and implement a standard cryptography methods. With the advancements in the quantum computing and quantum cryptography algorithms it becomes imperative to standardize post quantum cryptography methods and their protocols. The family of Lattice-Based Cryptography (LBC) has a wide range of application in security problems likes digital signature, key exchange, identity-based encryption. LBC methods can deployed and used across a wide range of devices with varying computing capabilities. For safety critical devices and critical infrastructure LBC shows enhanced security compared to other methods.

Primarily the cryptography functions that are in use today are based on number theory concepts and abstract algebra. However, the domain of cryptography are changing and adapting to the fast moving pace of technology. Key distribution protocols forms the first line of defense in securing a communication. The newly explored methods provide security based on hardness of various kinds of problems. Cryptography protocol starting with the bedrock concept of classical schemes, whose security is derived from the hardness of number theory problems. Going further, the method of quantum cryptography that are based on the principles of quantum physics, followed by neural cryptography particularly neural synchronization, that uses the tree parity machines and learning rule for key synchronization. Then, the method that uses lattice based problems for cryptography scheme is surveyed. One of the primary challenges in this field, is standardization of the methods. Every set of methods comes with its own set of shortcomings and advantages which must be accounted for, while implementing in real world scenario. The promising direction for the fields would be to investigate their use and implementation in end devices with limited computation power like IoT devices and so on.

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PAIN: GENES AND THEIR FUNCTION IN PERCEPTION OF ACUTE PAIN IN HUMANS AND ANIMALS

INTRODUCTION

Pain is something which many fear and most dislike. It causes too many emotions in each individual and has been seen like something bad by almost everyone from time immemorial. It is one of the most common reason for which a person seeks medical advice. But the question remains, what is pain? Pain is biologically adaptive and signals actual or potential tissue damage causing withdrawal and/or recuperative behaviours. Pain has been regarded as a misery which impacts productivity and utilization of resources. It is a process which is activated by certain adverse stimulus which can be mechanical, thermal, or chemical in nature. Any stimuli which can activate nociceptors can initiate pain. It has been seen that people are differentially affected by pain and it is subjective in nature. This subjective experience of pain is developed through a complex interaction of afferent sensory input and cognitive processing of the stimulus.

But is pain always bad? I don't think so. It has its own advantage and every species has been able to detect damaging or potentially damaging stimuli which have allowed them to protect themselves from injury. The mechanism of pain depends on specialized sensory neurons, called nociceptors, which detect harmful stimuli, such as noxious heat, cold and pressure. They convert those signals into messages which are then organized into a behavioural response by the organism.

Pain can be classified into many types but generally its either chronic of acute. Any short-term pain arising due to any reason is classified as acute pain which arises due to complex mix of chemicals mediators, inflammation, and nociceptors. The stimulus can be due to direct trauma or indirect due to the biochemicals released at site of tissue damage. If the pain receptors are up regulated by the mediators then additional surrounding nociceptors can be brought into activity which results in pain enhancement.

The perception of pain depends not only on the quantity of damage occurred but also on the individual who received the damage. The trait of pain is complex and is influenced by ethnicity, gender and the social context and interpretation of the pain experience. With development of genetics and proteomics the level of understanding of role played by genes in pain especially in acute pain is slowly being revealed. Earlier it was thought by few civilizations that pain is a trait present only in humans but with development of genetics and genome sequencing of different organisms we have been able to identify pain genes in almost all kind of animals.

Benefits of pain

Can pain have benefits? Yes, why not? Pain always has been a great teacher. Pain caused by injury makes organisms to avoid the condition which caused the injury in first place. It's the pain which had made survival of individual as well as species possible throughout the history of life on Earth. This can be understood by the fact that individuals with congenital insensitivity to pain have experienced high morbidity. It is not just humans who experience pain, but animals also are affected by it in similar manner even though they are not able to describe pain in language we understand.

Genes for pain or 'Pain Genes'

Acute pain is essential for survival of any organism as it leads to development of behavioural responses to avoid any noxious stimuli. The absence of nociceptors

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or a lack of function in these specialized neurons frequently leads to serious injury which can even cause loss of extremities. Pain causes unpleasant sensory and emotional experience but helps in providing a survival advantage. With various genome projects we are in a better position to understand pain at genetic level than ever before but are still a long way to finding all the answers. Technically when polymorphism in genes affect the expression or the functioning of their protein products in a way that affects pain response the genes are said to be pain genes. The study of such pain genes is done either through linkage analysis or association analysis. Study of pain behaviour in twins also provide a method to study pain genes as monozygotic twins have shown strong correlation to both experimental and musculoskeletal pain, compared to dizygotic twins, demonstrating a strong genetic component to pain heritability.

Genes involved in acute pain

It is frequently found that perception of pain is a factor of upregulation or dysregulation of gene(s). Upregulation or dysregulation of genes separately or in conjunction leads to change in perception of pain in the individual. In one study involving lower back pain, three genes (CCL2, PNOC, and CNR2) were found to be upregulated while seven (GCH1, CSF1, CALCA, PTGES, GDNF, and KCNQ2) were dysregulated. CCL2 which codes for chemokine-2 has been implicated for sensory perception of pain in many organisms and mutations at certain positions in the protein leads to slight reduction to complete loss of activity.

So, what causes pain? Various studies have thrown light on this have tried to provide some answers to this question. There are certain genes which cause the sensation of pain when they activated due to various types of stimulations. Also changes in other type of genes may lead to different perception of pain in individuals.

Pain genes can be divided on types of activity of the proteins, whether they are receptors or enzymes or behave like channels. We will now see what these genes are and how they cause or alter the sensation of pain in individuals.

Receptors

Opioid receptors have a major role in perception of pain. OPRD1 codes for Delta-type opioid receptor which functions as receptor for endogenous enkephalins and for a subset of other opioids. While mu-type opioid receptor coded by OPRM1 functions in regulation of perception of pain and its silencing leads to pain. MDB1 epigenetically silences OPRM1 along with KCNA2 which leads to acute and neuropathic pain in primary sensory neurons. The variation of the gene OPRM1 118G has been associated with decreased post operational pain relief.

If you ever felt pain due to being rejected in love or after losing a game, you can blame it on variation in OPRM1 118G as polymorphism is also involved in enhanced perception of social pain along with physical pain.

NTRK1 is a receptor which can recognise the pain induced by formalin and detect mechanical and temperature stimuli which can cause pain. Mutations in the gene can lead to with congenital insensitivity to pain, anhidrosis (absence of sweating), absence of

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reaction to noxious stimuli, and self-mutilating behaviour as the individual cant perceive pain.

Melanocyte-stimulating hormone receptor encoded by the gene MC1R is implicated in sensory perception of pain. Mice mutant C57BL/6-Mc1re/e and redheads of human species have non-functional MC1Rs and show reduced sensitivity to noxious stimuli and increased analgesic responsiveness to the μ-opioid selective morphine metabolite, M6G. It has been predicted that MC1R has a sex -specific role in acute noxious thermal responses and pain caused due to inflammation as it has been shown that female, MC1R mutant mice (MC1RE) have an altered response to noxious thermal stimuli, displaying an increased tolerance of noxious heat stimuli while male mice don't show such behaviour. So, females with this mutation will be able to show more tolerance to heat but you should never try to show off as even if you don't feel pain the damage is real. MC1R may be etiologically important in development of fear of pain and has been implicated in fear of dental pain.

D(2) dopamine receptor is coded by the gene DRD2 and its genetic variants are associated

with acute pain after a traumatic stressful event like motor vehicle collision (MVC). The pain you feel after that bone is broken is due to this receptor. DRD2 SNP rs6276 have shown a statistically significant main effect association with acute post-MVC pain severity. A study involving variation of the dopamine D2 receptor (DRD2) gene in contributing individual differences in thermal pain sensitivity found that patients with 957TT genotype reported more severe pain than patients with other genotypes. It has been understood now that dopamine is not only involved as award or pleasure molecule but is also involved in response to aversive stimuli showing a role of the mesolimbic dopamine system being involved in acute pain perception.

Cannabinoid receptor 2 encoded by CNR2 is heterotrimeric G protein-coupled receptor for endocannabinoid 2-arachidonoylglycerol mediating inhibition of adenylate cyclase. It may function in inflammatory response and nociceptive transmission along with other biological functions. It has been shown in different studies that mutations in the gene causes loss of ligand binding which causes changes. in agonist induced inhibitory effect on adenylyl cyclase Alpha-2A adrenergic receptor is coded by the gene ADRA2A and in its absence animals exhibit acute hyperalgesia (vs analgesia) following exposure to sound and footshock stressors. Studies have indicated that low levels of peripherally located α2A-AR receptors can lead to reduced feedback inhibition of norepinephrine release in response to stress. ADRA2A rs3750625 contributes to post-stress acute musculoskeletal pain severity after trauma by modulating miR-34a regulation. A recent study has shown that the mutation of the ADRA2A at the rs1800035, rs201376588 and rs775887911 loci can lead to reduction of the anaesthetic and analgesic effects on postoperative Chinese women and require more anaesthetics, but they do not affect drug safety.

Enzymes

The anaesthetic and analgesic effects on postoperative Chinese women and require more anaesthetics, but they do not affect drug safety.

PTGES codes for the protein prostaglandin E synthase which acts as the terminal enzyme in prostaglandin E2 biosynthetic pathway. It plays a key role

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in inflammation response, fever, and pain. Enough evidences have been provided by different studies for the fact that change in key amino acid residues leads to different level of enzymatic activities.

GTP cyclohydrolase 1 has many molecular and biological functions, and it may be involved in modification of pain sensitivity and persistence. GCH1 polymorphism has been implicated in pathophysiology of pain.

Catechol O-methyltransferase is coded by the COMT which helps in the inactivation of catecholamine neurotransmitters and catechol hormones and shortening of the biological half-lives of certain neuroactive drugs, like L-DOPA, alpha-methyl DOPA and isoproterenol. Many studies have shown the link of COMT and its variants with acute pain sensitivity in last few years. Nociception and risk of clinical pain have been associated with COMT genetic variants, and this association was shown to be mediated through adrenergic pathways. The effect of variations in COMT in breast cancer patients have shown that the SNPs have at least some association with heat pain and cold pain sensitivities. It has been shown in a recent study that isoforms of COMT can have different activities and can lead to difference in perception of pain. COMT has been implicated in post-operative pain perception and carriers of SNPs of the gene have higher probability of requiring analgesic interventions. In cases of MVC patients with COMT polymorphism they have shown variations in perception of pain.

It has been seen that COMT functional variants may predispose sickle cell disease patients to worse acute pain in women. COMT Val158/Met polymorphism has been implicated in pain response even though the initial response to the stimuli does not show any difference between carriers of polymorphisms which means that only on repeated challenge of pain defence system the difference become apparent. Certain SNPs in COMT predisposes the carrier to become less sensitive to pain as has been shown in the case of carrier of Val158Met consumes less opioid than the one carrying Met/Met for analgesia post operation. In certain cases, polymorphism in COMT may lead to more sensitivity to pain as has been seen in certain patients requiring more analgesic than others. In others COMT polymorphism and expression has been linked with acute cold sensitivity and risk of transition of LBP to chronic LBP.

Serine palmitoyltransferase 1 is product of the gene SPTLC1. The protein is specifically involved in sphingolipid metabolism and mutation in the gene can lead to autonomic sensory hereditary disease Hereditary sensory radicular neuropathy autosomal dominant type 1A which causes loss of pain sensation, among others. A mutation in V144D in SPTLC1 can cause painful as well as painless phenotypes in HSAN 1 which is an autosomal dominant disease.

Serine/threonine-protein kinase is coded by the gene WNK1 where mutations in the gene has been implicated in HSAN2A which is an autosomal recessive disorder characterised by impairment of sensation of pain among others.

Amine oxidase [flavin-containing] A is coded by the gene MAOA where genetic polymorphism in MAOA shows a weak association with acute post-surgical pain in humans.

Fatty-acid amide hydrolase 1 is encoded by FAAH and polymorphisms in the gene leads to difference in cold pain sensitivity. A microdeletion in a FAAH pseudogene and SNP in FAAH conferring reduced expression and

activity lead to a new pain insensitivity disorder in a female.

ATP-dependent translocase coded by the gene ABCB1 has been implicated with higher risk of developing postoperative pain in women. The polymorphism responsible for this is C3435T and has been implicated in differences in opioid sensitivity. Association between the ABCB1 polymorphism (C3435T) and interindividual variations in opioid consumption in the acute postoperative period after nephrectomy has been demonstrated. ABCB1 polymorphism can be utilized as an important genetic predictor to guide the acute pain therapy in postoperative patients.

Voltage Gated Channels

Sodium channel protein type 9 subunit alpha is coded by the gene SCN9A. It mediates the voltage-dependent sodium ion permeability of excitable membranes. Various SNPs of voltage gated SCN9A have been shown to be associated with pain settings. Such polymorphisms could play a role in acute pain perception. Opposite end of pain sensitivity is pain insensitivity and SCN9A has also been implicated in it. Pain insensitivity come under rare disorders as individuals with them become more vulnerable to physical injuries thereby increasing the morbidity and mortality rates. Pain insensitivity follows Mendelian inheritance and is autosomal recessive trait. It has been implicated in playing a role in pain mechanisms especially in development of inflammatory pain. SCN9A is inherited from Neanderthals and has been implicated in increased sensitivity of pain in present day humans. The gene has been involved in development of a phenotype where the individuals are completely insensitive to pain and otherwise remain healthy. Similar cases have also been found where missense and in-frame deletion mutation in SCN9A caused development of congenital insensitivity to pain. This has resulted in complete loss of function in activity of sodium channel. Mutations in SCN9A cause biallelic loss of function mutations resulting in Channelopathy-associated Insensitivity to Pain (CIP), and mutations here cause severe episodic pain in Paroxysmal Extreme Pain Disorder (PEPD) and Primary Erythermalgia (PE).

SCN11A codes for Sodium channel protein type 11 and has been implicated in regulation of sensory perception of pain. Mutations in the gene leading to gain of function can cause the development of neuropathic pain, cold aggravated pain or of hereditary sensory and autonomic neuropath 7 (HSNA7) which is characterized by congenital inability to experience pain resulting in self-mutilations, slow-healing wounds, and multiple painless fractures and mild muscle weakness among other problems. Variations in the gene also lead to the development of familial episodic pain syndrome 3 (FEPS3) which causes paroxysmal pain mainly affecting the distal lower extremities and occasionally the upper body, especially the joints of fingers and arms. The pain is exacerbated with fatigue.

Transient receptor potential cation channel subfamily V member 1 is coded by TRPV1 and is also known as capsaicin receptor. Mutation in the gene can lead to loss of sensitivity to capsaicin. SO if you are not able to feel the hotness of chillies then blame it to the mutation in this gene. It been demonstrated that gender, ethnicity, and temperament contribute to individual variation in thermal and cold pain sensitivity by interactions with TRPV1 and OPRD1 having single nucleotide polymorphisms. TRPV1 has been implicated as being the first line of defence protecting from acute non damaging heat.

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TRPM8 encodes the protein Transient receptor potential cation channel subfamily M member 8 which is involved in detection of temperatures below 25 degrees Celsius. Some studies have indicated that inactivation of TRPM8 is necessary for reduction for acute and chronic pain perception and some have reported that TRPM8 activation produces analgesia. Recently a study has shown that TRPM8 channels are strongly involved in pain modulation and acute and chronic pain are reduced by using selective antagonist. TRPM8 is required for neural and behaviour responses to acute noxious cold and cold mimetics in vivo.

Inhibitors of TRPM8 reduced pain in the cold pressor tests in humans which tells us that the channel has significant role in pain perception due to noxious cold. Importance of the gene TRPM8 in cold perception come from the study which showed that mice lacking TRPM8 neurons become insensitive to cold and cold mimetics.

Transient receptor potential cation channel subfamily A member 1 is a receptor activated non-selective cation channel involved in pain detection. A gain of function mutation in the gene leads to familial episodic pain syndrome in which period of intense pain is accompanied by other body stresses. TRPA1 is involved in perception of pain stimulated by various plant-based molecules and environmental toxins. Even in absence of N-terminal arkyrin repeat domain TRPA1 is intrinsically cold and chemosensitive which also proves that its cold and chemical sensing properties lies outside the domain. Polysulphide oxidised from hydrogen sulphide modulates various biological functions and is involved in evoking acute pain by selectively stimulating nociceptive TRPA1.

Voltage-dependent calcium channel subunit alpha-2/delta-3 is coded by CACNA2D3 gene which regulates calcium current density and activation/inactivation kinetics of the calcium channel. CACNA2D3 has been associated with pain sensitization and heat nociception in animal models. CACNA2D3 variants have been shown to be associated with reduced sensitivity to acute noxious stimuli. Whole-genome in-vivo RNAi screen for noxious heat in Drosophila lead to identification of straightjacket gene as a pain gene in the fly. Mammalian ortholog of the gene α2δ3 are also pain genes and its human ortholog CACNA2D3 has also been implicated in heat pain variance perception.

KCNQ2 codes for Potassium voltage-gated channel subfamily KQT member 2 which is a protein which forms K-channels along with KCNQ3. It has been implicated in pain and other neuronal hyper-excitability.

Potassium voltage-gated channel subfamily S member 1 is encoded by the gene KCNS1. It has been shown that mice lacking KCNS1 in peripheral neurons show slight increase in sensitivity of basal and neuropathic pain. It has also been found that deletion of KCNS1 from sensory neurons slightly increased the acute pain in mice. Val allele in KCNS1 show greater sensitivity to pain in homozygous condition while Ile allele showed greater insensitivity to pain in homozygous condition.

Potassium channel subfamily K member 18 is an outward rectifying protein channel encoded by the gene KCNK18. The gene has been implicated in pain pathways and it has shown in studies that it is responsible for familial migraine with aura. Recently a mutation in the gene has been shown to be linked with pain in head accompanied by vomiting. Genome-wide association studies have also implicated KCNK18 with migraine.

Piezo-type mechanosensitive ion channel component 2 is encoded by the gene PIEZO2. It has been .

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implicated in sensation of mechanical stimuli. Variants of the gene are not able to sense gentle stimuli applied to inflamed skin or were hypersensitive to normally pleasant stimuli as intensely painful.

Transcription Factors

PNOC stands for prepronociceptin and as the name suggests it may act as transmitter in the brain by modulating nociceptive and locomotor behaviour. It blocks nociceptin action in pain transmission by inhibiting nociceptin-induced hyperalgesia and allodynia and has potent analgesic activity.

Stimulating Factor

GDNF or Glial cell-line derived neurotrophic factor has been shown to increase the response of muscular Aδ-fibre afferents to mechanical stimuli, resulting in muscular mechanical hyperalgesia in mice. It has also been reported that GDNF plays a role as an endogenous mediator in acute and induction of chronic muscle pain, an effect likely to be produced by GDNF action at GFRα1 receptors located in IB4(+) nociceptors.

Brain-derived neurotrophin factor is coded by the gene BDNF has been shown to modulate fast excitatory (glutamatergic) and inhibitory (GABAergic/glycinergic) signals, as well as slow peptidergic neurotrasmission in spinal cord. Many studies implicate the pro-nociceptive role of BDNF in pain processes at peripheral and central nervous system. It is also suggested that BDNF derived from sensory neurons plays a critical role in mediating the transition from acute to chronic pain. It has been shown that both brain-derived neurotrophic factor (BDNF) and glial cell-derived neurotrophic factor (GDNF) levels are altered in pathological pain states, and exogenous BDNF and GDNF have multiple effects on pain behaviour, depending on the animal model (i.e. inflammatory vs. neuropathic). Both regulate the expression pattern and activity levels of TRPA1 and TRPV1 which leads to enhancing the neuronal sensitivity to painful stimuli and increased co-expression of thermo TRP channels.

CSF1 codes for Macrophage colony stimulating factor 1 which is a cytokine that plays an essential role in the regulation of survival, proliferation, and differentiation of hematopoietic precursor cells such as macrophages and monocytes. CSF-1 has an important role to play in inflammatory pain as it has been shown that when the driving inflammatory insults are acute or periodic CSF-1 becomes relevant.

Hormone

CALCA codes for calcitonin which is a small protein and has been implicated in response to heat and pain. Calcitonin has been used for treatment of acute pain and therefore any change which can alter its activity as analgesic could increase the pain in an individual.

Zinc Finger Protein

PR domain zinc finger protein 12 is coded by PRDM12 which implicated in detection of sensory stimuli of sensory perception of pain and sensory perception of pain. It is a transcriptional regulator which essential for human pain perception and pathogenic mutations can lead to congenital loss of pain perception. The congenital insensitivity to pain leads to severe injury in early childhood. Mutation is exon 5 of PRDM12 can lead to minimal response to pain which can even cause self-mutilations and mental retardation.

ZFHX2 codes for Zinc finger homeobox protein 2. It is a transcriptional regulator which is implicated in regulation of pain

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perception and processing of noxious stimuli and nociceptor expressed ZFHX2 gene is found to be important in regulating both mechanical and thermal acute pain thresholds in knockout mice. A point mutation in the gene can lead to development of pain insensitivity disorder.

Other molecules

Methyl-CpG-binding domain protein 1 is encoded by the gene MBD1 which acts as transcriptional repressor that binds CpG islands in promoters where the DNA is methylated at position 5 of cytosine within CpG dinucleotides. MBD1 is critical for genesis of acute pain and neuropathic pain. In mice deficient of MDB1 in dorsal root ganglion (DRG) showed reduced response to acute noxious stimuli and blunted neuropathic pain. On the other hand, overexpression of MBD1 in DRG produces hypersensitivities to noxious stimuli.

Beta-arrestin-2 is coded by gene ARRB2 which has been implicated in detection of temperature stimulus of sensory perception of pain. A study has highlighted the role of ARRB2 with low pain phenotype in Caucasian children in association with acute postoperative pain and morphine analgesia.

Pain genes in other animals

Pain has been studied in animals and different animals have been used as models for study of human pain. This clearly suggests that animals do experience pain. The level of the experience may be different but the response of any animal towards a predator is not different from human response therefore at some levels such things must have common origin. The DNA is the thing which is common among all organisms therefore the genetics of pain should not be different in animals even though the experience may be different. Many genes have been identified in different animals which certainly show some relation with perception of pain.

Drosophila

TRPA1 has been implicated in detection of chemical and temperature stimuli of pain in Drosophila. TRPA1 was confirmed as a bona fide “pain” gene in both adult and larval fly nociception paradigms to avoid noxious heat.

Allatostatin-C Receptor 2 in Drosophila has also been implicated in dampening heat nociception along with its immunological function against bacteria.

Tachykinin and Tachykinin like receptors i.e. DTKR have been implicated in systematic regulation of pain sensitization.

Hedgehog (Hh) is also implicated in systematic regulation of pain sensitization generally of thermal stimuli just like DTKR. TNF has also been implicated in thermal allodynia in the fly. Painless gene in the fly is involved in heat nociception by being activated by noxious temperature of 38 degrees Celsius. Knockdown of painless blocks DTKR-induced ectopic sensitization suggesting that thermal allodynia is mediated in part via this channel. Tachykinin/Hh activation can lead to increase in Painless expression, altered localization, or to post-translational modification increasing the probability of channel opening at lower temperatures. It has also been shown recently that fly gene Foraging is responsible for regulating nociceptive like escape behaviour through a developmentally plastic sensory circuit.

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Zebrafish

Zebrafish larvae have been studied for pain responses for extreme thermal stimuli and found that over-expression of specific genes in sensory tissues, are conserved from zebrafish to mammals. Transient receptor potential cation channel subfamily A member 1b is coded by TRPA1b in zebrafish. It has been implicated in detection of chemical stimulus involved in sensory perception of pain.

Rodents

Reg3b is upregulated in tissue or nerve injury given to study pain in rats and mice while CCL2 plays an important role in mediating peripheral nerve injury-induced neuropathic pain.

Hydrocephalus-inducing protein is encoded by Hydin. It has been implicated in biological processes relating to pain and inflammation, suggesting its relevance not only in acute thermal pain but also to inflammatory and central sensitization-mediated chronic pain through involvement of the CP–CSF system. Piezo-type mechanosensitive ion channel component 2 is longer than humans and is coded by the Piezo2. It has been implicated in mechanosensory detection of pain. It has been reported that Piezo2 ion channels are required for mechanical allodynia in mice.

Piezo2 channels mediates in mechanically-activated currents of different kinetics in corneal trigeminal neurons and contributes to transduction of mechanical forces by corneal nociceptors thereby mediating in perception of low threshold mechanically evoked pain in cornea.

Other Mammals

GDNF encodes Glial cell line-derived neurotrophic factor which has been implicated in insensitivity to pain in four sporting breeds of dog.

Melanocyte-stimulating hormone receptor, coded by MC1R where, gene mutation in human causes red hair and lower pain tolerance threshold. Similar thing is seen in horse, so it is also inferred that the gene mutation which cause red coat may also cause hypersensitivity to pain. In pigs around 185 genes responsible for inflammatory pain and neuropathic pain were identified after tail amputation using transcriptomic analysis in caudal dorsal root ganglia.

Epigenetics of pain

Epigenetics represents a mechanism by which the environment factors can directly modify the translation of the DNA information into RNA/proteins via stable and/or heritable changes in gene function that are not intrinsic to the genetic code, but affect gene expression in a tissue specific manner, resulting in a specific phenotype. Environmental factors alter gene expression and phenotype for painful disorders by inducing epigenetic modifications such as histone acetylation, DNA methylation, and RNA interference (RNAi).

Histone modification and DNA methylation are a factor of age of the subject. After injury, expression of transcription factors such as nuclear factor-kappa B (NF-κB) is increased, sodium channels in the injured axon are upregulated, μ-opioid receptors in the dorsal root ganglion are downregulated, substance P expression is altered, and the dorsal horn of the spinal cord is structurally reorganized through axonal sprouting. It has been shown that injury to increases dimethylation of Lys9 on histone H3 promoters of KCNA4, KCND2, KCNQ2 and KCNMA1 but did not affect levels

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of DNA methylation on these genes in dorsal root ganglions. It was also found that injury to nerve had increased activity of euchromatic histone-lysine N-methyltransferase-2 (G9a), histone deacetylases and enhancer of zeste homolog-2 (EZH2), but only G9a inhibition consistently restored K+ channel expression. Dnmt3a2 expression in the spinal cord dorsal horn, which is a DNA methyltransferase, not only blunts the induction of pain-induced genes including Ptgs2 but also decreases both thermal and mechanical hypersensitivity caused by the induction of persistent inflammatory pain.

Discussion

Pain is part and parcel of life on Earth. Organisms have developed various ways to avoid death and predators and sensation of pain is one of them. Pain helps organisms avoid conditions which can cause injury but also keep the injured part of the body from getting worse. In this context pain is an adaptive feature which ensures well-being of the organisms. The adaptive nature of pain is also seen in different types of genes been involved in perception of pain. The duration of wound healing and type of injury affects duration of pain. Genes affect how an organism perceives pain. The type and location of injury will eventually decide which genes will be activated for sensation of pain. The epigenetic affects also govern the activation or suppression of certain genes in the injured area. Environmental factors also play a crucial part in how pain is perceived by the organism through control of epigeneticeffects.

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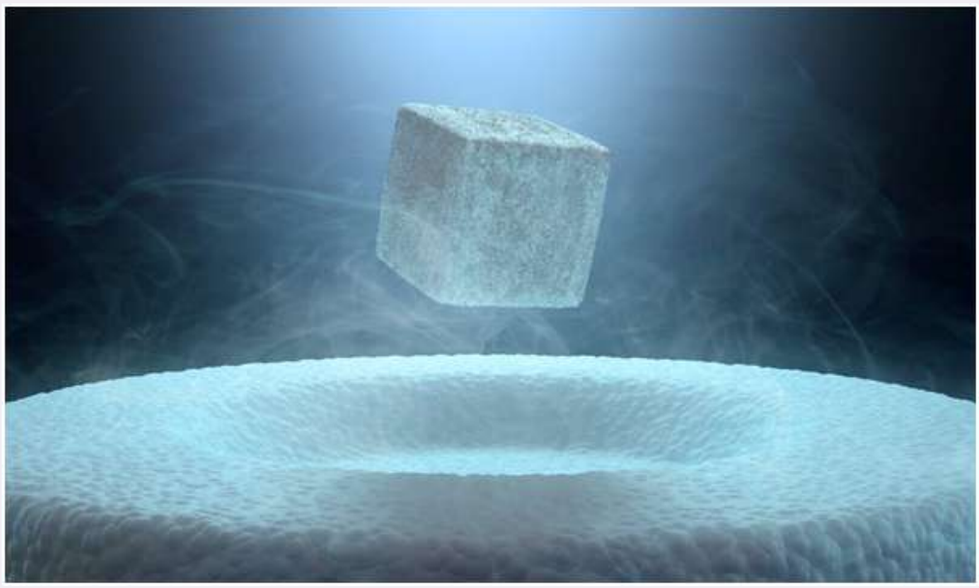
THE JOURNEY OF SUPERCONDUCTORS

ABSTRACT

Superconductivity is an anomaly of nature, which remained a mystery for the most part of the last century. This is an example of quantum behaviour which can be observed in a macroscopic level. It took more than half a century after the discovery of superconductivity, to understand the very origin of its peculiar nature. The quest of room temperature superconductor is still an ongoing topic of research and its fascinating applications attracted the science community since its discovery. Here lies the story of the discovery of superconductivity and my understanding about theory which is responsible for originating this behaviour.



(Acknowledgement: https://theconversation.com/explainer-what-is-a-superconductor-38122)

In today's scientific world, the term superconductivity has become very popular, but the rich history behind its discovery is an astonishing one. The theory and understanding of superconductivity bring together great minds from different fields. The word 'super' associated with this property is well justified, just the way superman could violate the laws of gravity, superconductors can also go against the laws of electricity in a way that was never been observed before. To understand the concept of superconductors, imagine that you have prepared a superconducting wire and somehow managed to pass an electrical current through it. Generally, in normal conductors once you switch off the battery the current will stop flowing, but in case of superconductors, once the current starts to flow, it will keep on going through the coil 'forever' and there is no need for external batteries to supply power. In normal conductors, when current pass through it for a very long time it generally become hot, an effect which is known as Joule heating developed in the system, because of the collision of electrons with surrounding atoms. This basically points towards the resistive power of the conductors. In case of superconductors, the Joule effect seems to be entirely absent. These materials behave, as if there is no friction of electrons with surrounding atoms. So, if we can operate a superconductor at room temperature, it will revolutionize the way we use electricity in our everyday life. We can have a constant supply of electricity without needing an external power supply ever. Kamerlingh Onnes, discoverer of superconductivity realised its application very early and imagined creating superconducting coils and use them as electromagnets. These electromagnets will be able to produce huge magnetic field without needing

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an external source to drive them. This dream has now become a reality as we see MRI scanners are being used in hospitals every day, whose source of power is the large magnetic field developed because of superconducting wires.

There is a catch associated with all these ingenious applications of superconductors. To observe superconductivity in a material we need to cool the sample to a very lower temperature. A material which shows superconductivity at room temperature is still an ongoing topic of research. Thus, the history of superconductivity is closely related with the development of low temperature physics, which revolutionize the concept of experimental physics. The story of low temperature physics started with liquification of gas. Johannes Diderik van der Waals of University of Amsterdam, published his famous law of corresponding state which is able to describe all the behaviour of real gases in 1880. In order to test these theories

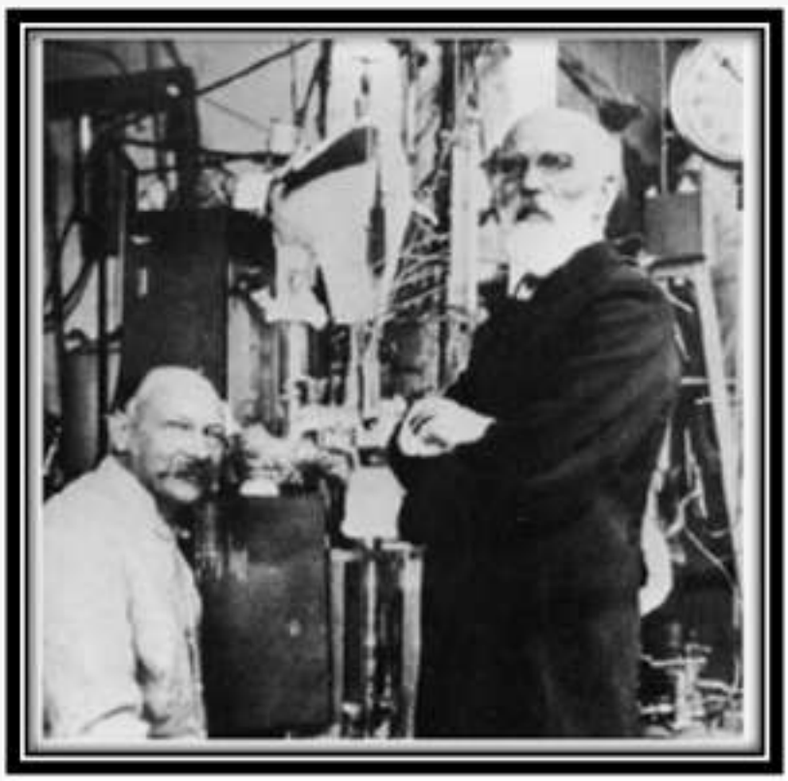

Fig.1: On the left (seated) Kamerlingh Onnes and on the right Johannes van der Waals (Acknowledgement: Superconductivity: A Very Short Introduction by Stephen J. Blundell, Oxford University Press, 10.1093/actrade/9780199540907.001.0001.)

for real gases at very low temperature Kamerlingh Onnes become committed to build his world-famous low temperature laboratory at Leiden in 1881. The motto of this laboratory was, '***Door meten tot Weten'*** which means ***'Through measurement to knowledge'.*** Onnes finally succeeded to produce liquid hydrogen in 1906. Even though he was not the first one to liquefy a gas, he produced it in a much larger quantity with more reliable apparatus. His previous experience became fruitful when he succeeded in making liquid helium for the first time by lowering the temperature of the helium gas up to 4.2K. For his contribution to investigation on the properties of matter he was awarded Nobel prize in 1913 and during his speech he said, ***'How happy I was to be able to show condensed helium to my distinguished friend van der Waals, whose theory had guided me to the end of my work on the liquefaction of gases.'*** So, how these events led to the discovery of superconductivity?

After achieving the liquification of gases, K. Onnes tried to understand what would happen to resistivity of a metal at low temperature. We know,

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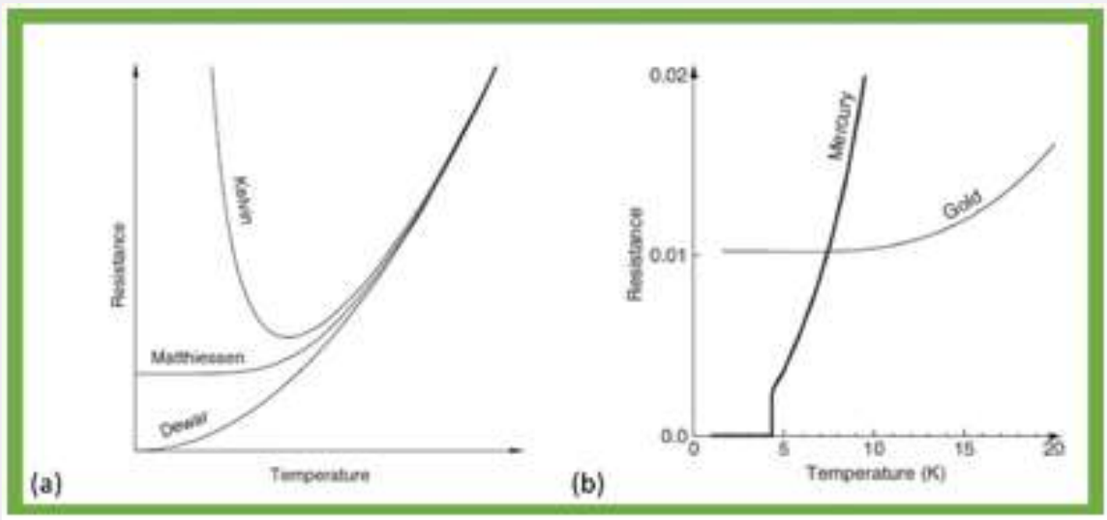

Fig.2: (a)Three popular theories about resistance of metal at low temperature at the turn of the 20th century. (b) The results of Onnes' experiments demonstrating superconductivity in case of mercury, which is not observed in case of gold.

(Acknowledgement: Superconductivity: A Very Short Introduction by Stephen J. Blundell, Oxford University Press, 10.1093/actrade/9780199540907.001.0001.)

because of thermal energy atoms in a metal behave like a ***'vibrating jelly'*** but their vibration become less when the temperature reaches to low temperature. This will minimise the collision of electrons with the atoms, creating less resistance to the flow of current at low temperature. In the first decade of the twenty first century, three vague theories were present which tried to explain the change in resistivity of a metal with temperature (Figure 2(a)) but to see which one would be most accurate with the experimental results, Onnes started measuring resistivity of different metals at low temperature.

Impurity of a metal always increases the resistivity, thus Onnes started his work with purest metal he could find which was mercury, a liquid metal. He cooled the metal with his newly discovered liquid helium. The experiment performed in 1911 demonstrated that, once the liquid mercury is cooled at 4.2 K, its resistivity dropped to zero (Fig.2(b)). Onnes and his team first thought it was because of some instrumental mishap. They performed the experiment many times but at one trial, one of his assistants nodded of in between the experiment and the temperature of the metal started to rise and with increasing temperature resistance reappeared in the mercury. They realised from the experiment that they have just found a new state of mercury. To see if this property is only exclusive to mercury or not, they repeated their experiment with another metal, gold and see that, resistivity of gold follows the path predicted by Matthiessen earlier (Figure 2(a)). This makes the resistance of mercury one of a kind. Onees named this property as ***'suprageleider'***, which translate to English as '***supraconductivity'*** and with time it became ***Superconductivity***.

Since its discovery there were other metals and alloys were discovered which showed similar behaviour as mercury. So, why superconductors are so different than the normal metals? It took decades, before anyone can come up with a suitable explanation of the theory of superconductivity. If

superconductors behave as perfect conductors, then there were some consequences associated with it. According to Faraday's theory of electromagnetic induction, if we have a current pass through a superconducting coil then, it will generate a magnetic field, which will remain in the metal forever in the exact state it was produced unless we increase the temperature of the superconducting metal. In another language superconductors might ***trap*** a magnetic field. Experiment also seems to support this behaviour. In 1933, Walther Meissner and Robert Ochsenfeld performed an experiment to observe the magnetic properties of a superconductors. They realised that, instead of trapping the magnetic field, these materials are actually, repelling the magnetic field from itself, which is now known as ***Meissner effect.*** Above the limiting temperature magnetic field can easily pass through the metal but once it reaches superconducting limit, magnetic field has to go around

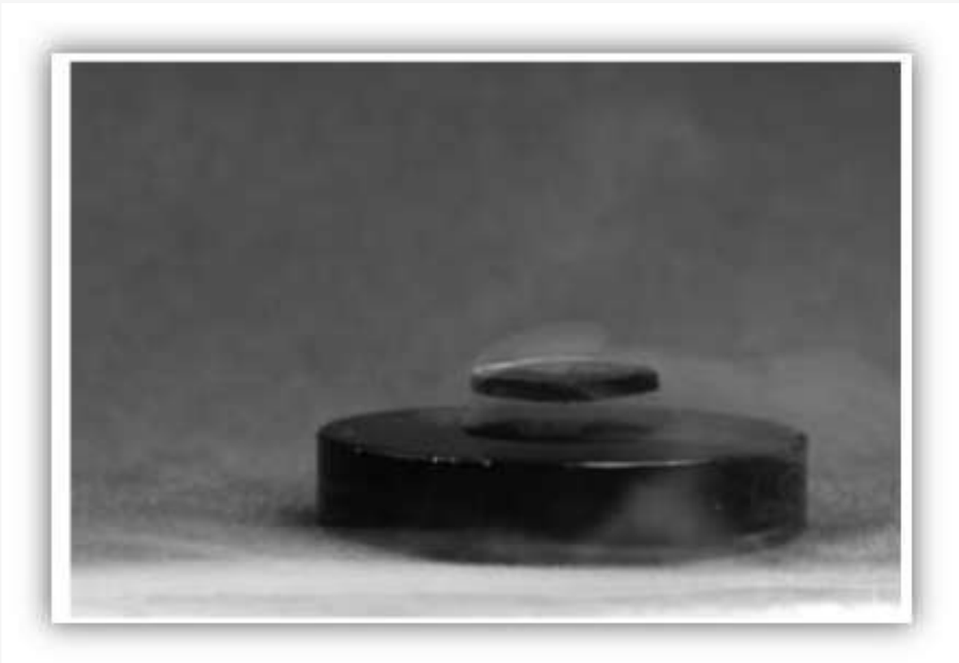

Fig.3: Levitation effect observed in superconductors.

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the metal. This led to the levitating effect observed in superconductors. This fascinating property is considered as a more fundamental property of superconductors then the zero-resistance behaviour and it make the then science community realize that, superconductivity is an ***'equilibrium states of matter'*** and its property is not dependent on the previous history of the metal. Accurate theory of ***Meissner effect*** was proposed by famous London brothers, Fritz London and Heinz London in 1935, who used quantum mechanics to describe this peculiar property of superconductors. In superconducting loop, currents seem to go on forever and they realize, this is rather similar to the motion of electrons in an atom. Quantum mechanics states that, electrons in an atom are in a state where their energy is fixed because of which it does not emit any radiation while rotating around the nucleus. London brothers consider that, the electrons in superconductor are also behaving in a similar manner, whose energy is fixed and remain same until we increase the temperature of the superconductor. They realized this behaviour is an example of quantum mechanics at a macroscopic level and associated superconductivity with a new term which is ***macroscopic quantum phenomenon***. In 1948 Fritz London realized that, as a consequence of this theory, magnetic flux penetrating the superconductor should also be

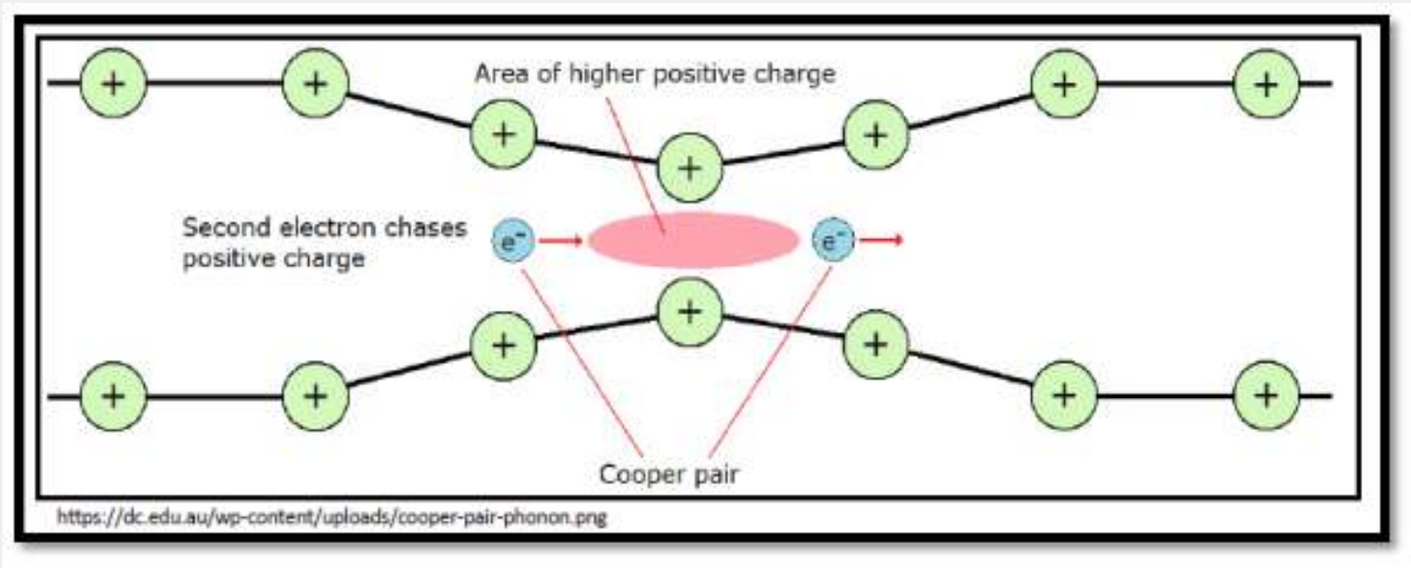

Fig. 4: Schematic representation of the idea of Cooper

quantized and must have a small value. It took another 12 years to experimentally proved the theory of magnetic flux quantization.

More generalised theory of superconductor was given by BCS theory from John Bardeen, Leon N. Cooper and Robert Schrieffer. The evolution of this theory started with isotope effect observed in superconductors. Tin is a material which shows superconducting behaviour and it has a number of isotopes with atomic weight ranging from 118.7 to 123.8 a.m.u. Experimenting with different isotope of Tin, Emanuel Maxwell and Bernard Serin independently proved that, superconducting transition temperature of tin isotopes is inversely proportional to their mass. From this time, the effect of lattice vibration caused by atoms could not be ignored while considering the theory of superconductivity. John Bardeen started working on the theory by attempting to understand how electrons are interacting with each other in a metal where both lattice vibration and effect of strong repulsion force is present in between the electrons. The first part of the theory was the origination of Cooper pair, developed by Leon N. Cooper who proposed that, electrons get paired up in a superconductor and these pairs remain rigid in the presence of electron-phonon vibration inside the lattice. In a superconductor, when an electron pass through the metal, it will attract other positive ion slightly towards them because of their negative charge, making a number of positive charges gather in a small region. This positive charge will then again attract another electron. At long distances, these two electrons will be paired up because of displaced ions, in spite the presence of coulomb repulsion force. The distance between two Cooper pair electrons is generally greater than the average inter-electron distance. Since electrons have half integer spins (), Cooper pairs now have zero spins, just like Bosons. As they are behaving like Bosons, multiple Cooper pairs are now allowed to stay in a same energy state creating a state of rigid electrons who is immune to the resistance due to lattice vibration and electron-phonon interaction. So why we are observing Cooper pairs in

superconductors below a particular threshold temperature? Since Cooper pairs are bound together, it takes a certain amount of energy to separate them and this energy gap is known as superconducting gap. When an energy equal to this gap energy is incident on this metal, only then the energy will be absorbed and the metal will lose its superconductivity. Any electromagnetic energy below this, will be scattered back from the metal, which generate the levitation effect observed in superconductors. So, the Cooper pair works, but it was difficult to understand the interaction between a large number of paired electrons which will lead to the superconducting effect, as the collision between phonons and electron pairs are inevitable. The solution to this problem was solved by Robert Schrieffer who consider the state of electrons in a superconductor, as a many-body problem in quantum mechanics exhibiting a coherent wavefunction. Here, when a pair of electrons is scattered by a phonon, they will

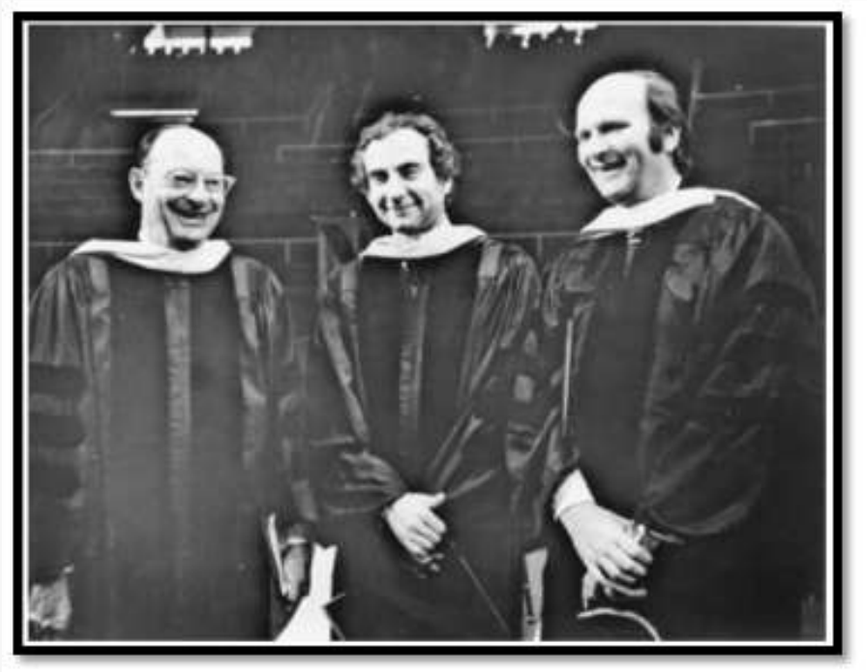

Fig. 5: John Bardeen, Leon Cooper, and Robert Schrieffer, inventors of BCS theory, standing in their correct order.

(Acknowledgement: Superconductivity: A Very Short Introduction by Stephen J. Blundell, Oxford University Press, 10.1093/actrade/9780199540907.001.0001.)

change their individual energy but the orientation of the pair along the current direction remains unaffected, just like a stream of water in river. One pair of electrons may change into another pair but their total giant collective movement of electrons (i.e., the flow of current) remain same in spite of their individual changes and hence once the current starts in a superconductor, it will remain same ***forever***. So why we do not see superconductivity in higher temperature, does cooper pairs vanished from the metals. At low temperature it takes large energy to break a Cooper pair but as the temperature increases the energy gap reduces to almost zero, they start to behave like any other metal. BCS theory is the result of three ingenious minds and for their contribution in theoretical physics they were awarded Nobel prize in 1973. Two years after the BCS theory, Lev Gor'kov published his theory based on the Ginzburg-Landau equations, which gave a solid foundation to the theory of superconductivity. This particular theory was able to describe a lot of phenomena related to superconductivity and even the London equation derived as a general consequence of G-L theory, which prove its diversity and importance. On the same year BCS theory came to be, another theoretical discovery was made by Russian physicist Alexei Alexeyevich Abrikosov. He demonstrated that, in case

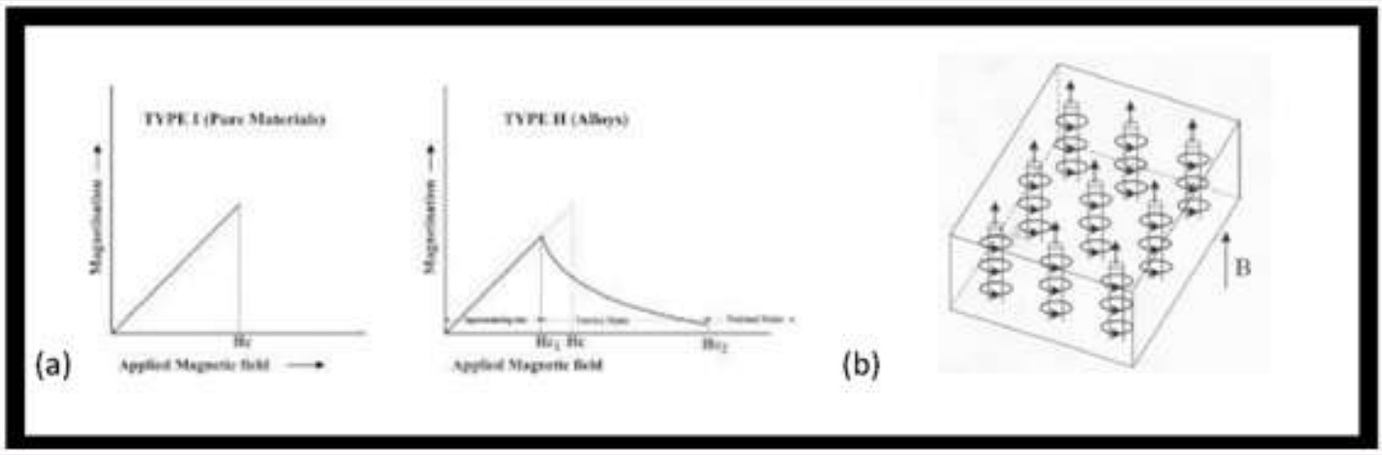

Fig.6: (a) Idea of Type I and type II superconductor. (b) Idea of vortex state observed in case of type II superconductor.

(**Acknowledgement: 3.The Abrikosov Vortex Lattice: Its Discovery and Impact by R. P. Huebener, Journal of Superconductivity and Novel Magnetism, https://doi.org/10.1007/s10948-018-4916-0.)**

of certain superconductors, it is possible to observe both superconductive and normal state together. He invented the concept of Type II superconductor where, the change from superconducting state to normal state happen gradually over an increase in magnetic field. Abrikosov found that, in Type-II superconductors it is possible, that magnetic flux quanta can be penetrated in the superconductors in the form of vortex (Abrikosov vortex lattice), which results into a new state called ***mixed state*** where both superconducting and normal domain structure can be observed. These vortices can interact with each other under the influence of external magnetic filed, thermal fluctuation and other defect and disorders. The theory remained unacceptable to large science community for more than ten years, until the existence of Abrikosov vortex was experimentally proved by small angle neutron diffraction data. This theory has immense impact on the technological purposes as most of the electromagnetic behaviour we observed in superconducting metals today are of Type-II superconductors, which remain superconductive even at high external magnetic field.

After the detail understanding of the theory, it seemed like the field of superconductivity had reached its potential, but in 1986 a new era begins. Swiss scientist Karl Alex Müller and German physicist Johannes Georg Bednorz, researchers at IBM reported that they have found superconductivity in a barium-doped compound of lanthanum and copper oxide where the critical temperature is 35 K, which was higher than the limiting temperature (≈ 30K) predicted by the BCS theory. Just like any other invention it was responded with criticism, but few other scientists also claimed to have higher transition temperature for superconductive alloys. In a way, this was the time when the research on high temperature superconductivity started. The highest transition temperature for superconductivity is reported by A. Schilling et al. in 1993 for HgBa2Ca2Cu3O8 compound, which still hold the record for highest critical temperature. With passing time more and more compounds are being discovered which shows high transition

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temperature under high pressure. The search for room temperature superconductor in normal condition is still an ongoing subject of research and succession of which will revolutionize the technology we see today.

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A LIMELIGHT ON THE TRADE-OFF BETWEEN DURGA PUJA AND COVID-19: A HARDHEADED LOOK ACROSS WEST BENGAL

"There are no solutions; there are only trade-off."
Thomas Sowell, Renowned Economist

If you give 2 options to a child, the child will select the option which will give them instant happiness, but when you are dealing with an entire nation the question of trade-off comes into the game. In layman's term, the trade-off can be defined as an exchange where you give up one thing to get something else that you also desire. In this article, we will try to put a limelight on the question of life and livelihood through the ongoing situation of trade-off in Bengal. The latest trend of the Covid-19 curve shows a dip in the number of active cases over a few days, along with that there is a remarkable dip in the R0 value across the nation. From the mathematical perspective, to define how much contagious a disease is we generally use the term R0, pronounced as R-naught. It's generally called as reproduction number. It's inferred as because the infection spreads among people and thus it's reproducing itself. R0 tells you the average number of people who will catch the disease from a contagious person. The basic parameter of its usage is on a population who didn't catch the infection earlier and they haven't been vaccinated for it before. For example, if R0 for infection is 4, then it means an average of 4 people will be affected until they have vaccinated.

There are mainly 3 classes of R0 value namely,
If (Ro less than 1): Each existing infection causes less than 1 infection, in this case, the disease will be declined eventually wiped out. If (R0 Equal to 1) : Each existing infection causes equal to 1 infection and in this case, the disease will stay and it will be stable but there won't be any kind of outbreak or epidemic.
If (R0 Greater than 1): Each existing infection causes more than 1 infection and in this case, there may be an outbreak and epidemic. In this pandemic situation John Hopkins University, USA published a public dataset for nCoV patients, containing vital information through which we can find out the approximate R0 for this epidemic using MLE (Maximum Likelihood Function). These dips came at a massive cost in terms of economic growth, and the advent of Durga Puja in Bengal again raises the question of life and livelihood. The current situation is such that the tourism industries have been blown away, along with small to medium businesses vanishing from the records and the big giants are laying away people. In the current situation, a huge section of people will either die of covid or without food. Certainly, Puja is not just a religious or social event. Its economic importance in this part of the world is simply too big to ignore. In contrast, ASSOCHAM had, in a 2013 report, estimated the size of the Durga Puja industry at 25,000 crores at an estimated compound annual growth rate (CAGR) of about 35 per cent. With that CAGR, the estimated size of the economy of Durga Puja in 2019 was nearly Rs 1.5 lakh crore, and that could be about Rs 2 lakh crore in 2020 under normal circumstances. And that's more than 10 per cent of West Bengal's GDP! These figures mainly account for the major industry, but there are lots of ancillary industries that sprung centring the puja. Countless people's yearly earning solely depend on the sale in these 6 days. Let's first look at the possible consequences of some of the festivals that took place amid the pandemic. New Orleans in the US pushed ahead with the Mardi Gras festival in April. And, thereafter, Louisiana has seen coronavirus cases skyrocket, particularly in New Orleans, the city at the centre of the state's outbreak. And with the second wave of Covid-19 on the cards it can turn Bengal into a slaughterhouse if people hit the roads like old normal time.

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Consequently, it must be a very delicate call to decide on the fate of the festivity of Puja in this pandemic year-one needs to balance the trade-off between economy and public health judiciously. Should the festivity officially be suspended for this year? Certainly, there are idol-makers, craftsmen, dhakis, small shopkeepers, and many others who earn major parts of their yearly income out of this festivity. And these people would prefer the festivity to roll on, even if it's restricted. Along with this the vaccine's are in the card the injecting rate should be increased in order to reach a substantial figure before the crowd roll. With high vaccination ratio the severity can be countered and the event can be carried out successfully. Another measure that can be taken is to isolate Kolkata from the neighboring districts during the major 4 days to put a check on the crowd mix until sufficient vaccination have been done across the state. In this delicate situation, the best policy which can be taken is to inject liquid cash into the market by the government so that the puja committees could go out and order the idols to and the money could roll over to the lower strata of the economic pyramid. Along with that, the wealthy section of the society should donate so those small pujas could be carried out and the money starts rolling in society. Along with this, there should be strict supervision on controlling the crowds so that the spread can be kept at the bay.

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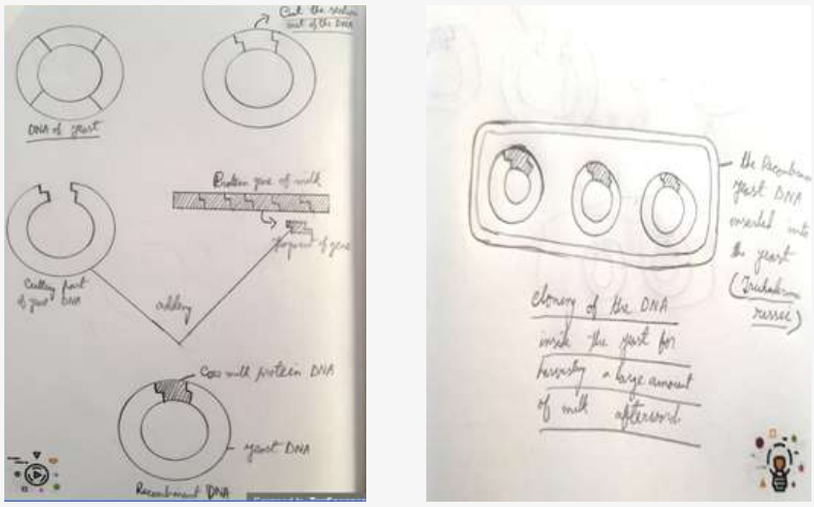
ARTIFICIAL OR LAB BASED MILK

We all know that milk is one of the most important foods in our daily life. We, more or less all drink milk as our regular supplement. Milk is a food which consists more or less all types of nutrients like proteins, carbohydrates, lipids, minerals, vitamins etc.

Earlier mainly the owners of the dairy animals like cow, goat etc. used these animals as milk donors. Then that milk was distributed to the household by the farmer on his own. But with the increase of population this manual process of production of milk was inadequate so many industries came into existence and the milking process were done by machines, so that it takes less time for larger yield that means more milk. But in industries they did not supply raw milk, because with the progress of science many microbial activities were observed and also some disease causing agents which could affect our health in various ways. So then they pasteurized the milk and added some other chemicals or detergents that increased the shelf life of the milk. In recent times this is the main process by which the milk is produced and marketed throughout the world. Mainly two processes are done one is pasteurization and another is homogenization. By pasteurization, all the microbes and the pathogens are fully removed and by homogenization the macromolecules of fat droplets are broken into micro molecules to avoid the separation of cream and milk.

Now this is all about the liquid milk, but after treatment with some chemicals, powdered milk is also available in the market at recent times. This milk is also produced from liquid milk with the help of some microbes or chemicals in powder format. If we mix it with hot water, the milk will be ready to drink with its all nutrients. But the amount of nutrients will be lesser than liquid milk.

So far we have discussed about the traditional industrial method of production of milk. Now we shall discuss something interesting, the milk which will be produced without a single dairy animal and does not take any space for production of the milk. With the help of a single cow gene, one can produce a large amount of milk which consists of same food nutrients as that of natural milk and is healthier than the natural milk. this is known as biotechnologically produced artificial or lab-based milk. Basically, lab milk is a type of milk which does not need any animals, feedlots, or farmland for the production. It is concocted inside the laboratories. It is not like the plant-based milk (soy milk, almond milk, coconut milk, oat milk, rice milk etc.) which is totally different in taste and flavour and the nutritional value. The nutritional values of these plant-based milks are very less, but lab milk is totally identical to the cow's milk in terms of taste and nutrients. This lab milk production is as same as the lab grown meat where the utilization of tissue grown harvested animal cells take place to produce lab grown meat instead of slaughtering the living animals. However, the lab based milk is not produced from any animal cells rather it is produced by the modification of yeast genetically or biotechnologically.



Recombinant DNA Technology for harvesting the Milk Protein (Whey and Casein)

ARTIFICIAL OR LAB BASED MILK

Now I will tell about the process of production of this artificial milk. The milk protein's replication is the key element of making lab milk dairy products which relies on fermentation. So first we have to take a microflora like yeast, bacteria, fungi etc. which can be modified genetically and that can convert the plant sugar into milk proteins. Mainly yeast is taken but we may take another microflora also. Here we take the ***Trichoderma reesei*** yeast to covert the plant sugar into whey and casein protein which are the main proteins present in milk. This process is as similar as when other yeasts ferment sugar into alcohol or leavened bread. To do so the companies genetically modify the yeast. They take the DNA of Yeast and add a fragment of milk protein genes with it to make recombinant DNA and then insert it again into the yeast for the growth and replication of the recombinant DNA. Next the proteins are separated from the yeast and the remaining sugar, then it is dried and filtered to make powder. Later this powder is mixed with water, vitamins, minerals, plant-based fats and sugars with right proportion of nutrients based on cow's milk. Here we can't say the product as a GMO product because the final product is separated from the yeast although the yeast is genetically modified. So, this lab milk is totally bacteria free, antibiotic free and lactose free which make the milk healthier than the natural cow's milk.

M U U f r i

Animal - Free

Milk

"Muufri" was the first company who started to make this lab milk in early 2014 at US. This start up was taken by two co-founders Ryan Pandya (CEO) and Perumal Gandhi who were the bioengineers in California. They were trying to perfect the artificial cow's milk with help of a special type of yeast that is genetically engineered to produce the milk proteins. They nicknamed this system of making artificial milk as a "out-of-body udder". Their main aim was to retain the taste and all the nutrients and health benefits into the artificial milk just like real milk, setting apart from soy, rice, almond plant based milk varieties which consists very less nutrients and also a different taste from the real milk. "If we want the world to change its diet from a product that isn't sustainable to something that is, it has to be identical [to], or better than, the original product," Gandhi told Linda Qui at National Geographic. "The world will not switch from milk from a cow to the plant-based milks. But if our cow-less milk is identical and priced right, they just might."

The two co-founders, Pandey and Gandhi were inspired to invent this artificial milk to reduce need for overcrowded dairy barns where cows are fed a constant cocktail of growth hormones and antibiotics and have their tails docked and horn removed for the higher production of milk from a cow in the milk industry. By doing that the quality reduces in the milk. They told that the dairy production is also responsible for emission of 4% greenhouse gas globally according to the FOOD AND AGRICULTURE ORGANISATION OF THE UNITED NATIONS.

ARTIFICIAL OR LAB BASED MILK

For them the synthesis of artificial milk is relatively an easier process. It has got less than 20 components and consists of 87% of water. The "Muufri" milk contains six proteins to help its structure and eight different fatty acids to give it its rich flavour.

The process of making this milk is similar to the process that pharmaceutical companies use to produce the insulin. To make this milk, at first DNA is extracted from the dairy cows and certain sequences are inserted into the yeast cell. Then the yeast culture grown in the industrial sized petri dishes at its right temperature and concentrations and within days the yeast is capable to produce enough milk for harvesting.

"Although the proteins in 'Muufri' milk come from yeast, the fats come from vegetables and are tweaked at the molecular level to mirror the structure and flavour of milk fats," says Qui at National Geographic. "Minerals, like calcium and potassium, and sugars are purchased separately and added to the mix. Once the composition is fine-tuned, the ingredients emulse naturally into milk."

According to Pandey and Gandhi this "Muufri" milk is better than the regular milk because it consists of all valuable nutrients like calcium, potassium, vitamins and moreover the milk is lactose free, which means the indigestion, or the lactose intolerance will not happen by having this milk. This milk is also bacteria free, antibiotics free, so healthier and no after effect. Because of not having the bacteria the shelf life is much longer than the regular milk, (about a week whereas for the regular milk it is 1 or 2 days). It was in market in mid of 2015. Initially the price was very high than the regular milk but afterwards when the production scaled up it became less.

In 2016 this "Muufri" is renamed as "The Perfect Day", and the number of partners increased, Isha Datar joined Ryan Pandya and Perumal Gandhi. On July 11, 2019, Perfect Day released the ice-cream which is made from non-animal whey protein and market value was initially 60$. From November 2020 the ice cream company "Graeter's" began to sell the vegan dairy ice cream based on perfect day products. In October 2020, Bob Iger,the chairman of The Walt Disney Company, joined the management with this company. They started their initial with only 30000$, and that raised to 61.5 million dollars, a huge in just 5 years between 2014-2019 years. But all these things are underdeveloped products. They are using the yeast Trichoderma reesei for the casein and whey protein synthesis.

So, this is all about the company "The Perfect Day (Muufri)" who are producing and marketing this lab milk or artificial milk.

Benefits of Artificial or lab milk:

- The milk is identical to the real milk in both taste and nutrients.
- The milk is synthesized with the help of yeast, so it is bacteria free.
- The yeast is genetically modified, so it is a GMO, but the product is not a GMO because the proteins are separated from the yeast, so the final product is antibiotic free.

ARTIFICIAL OR LAB BASED MILK

- The milk is lactose free so there will no chance of lactose intolerance or indigestion. We all know that real milk contains Lactose and in our body for that lactase is synthesized for the digestion but in some people or after a certain age this lactase production become less or stops in our body and the indigestion created in our body.

So, at the end of this discussion we can say that the lab milk is healthier than the real milk and safer to drink. But it is not available in India and if available the milk is so expensive, so we need to take an initiative to start the production of this milk in India and it will be more useful for us because due to high population in certain times the cow milk is not available and if available that will be not pure and not healthier. So, the lab milk or artificial milk production is a good choice for fulfilment of milk and all dairy products in our India.

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THE FUTURE OF WARFARE: MANNED, UNMANNED AND MORE

With conflict rising around day by day, the leaders of various nations have accelerated their program for building an "army of the future". It is evident that we are in the middle of a fifth-generation warfare where every day is just another tennis match of propaganda and misinformation, where the concerned parties involved, are busy pushing the ball to their opponent's court. To sum it up, the Word War III (if it ever happens) will not be a kinetic war with infantry, cavalry, air defenses and assets at the frontline, but a digital one with media houses turning into battlefields and journalists and news reporters into soldiers.

Infrastructure can be taken by a teenager sitting in his room by hacking the source code of these structures.

The Beginning

In 1981, the USAF requested for the development of an Advanced Tactical Fighter (ATF) that would eventually replace the already in-service F-15s. Two companies, Northrop Grumman and Lockheed Martin were participants in this tender. On 27 August 1990, the Northrop YF-23 had its first flight and the Lockheed Martin F-22 on 7 September 1997. The F-22 was selected by the USAF and finally inducted in 2005. Since then, countries around the world have been in a race to develop a fifth-generation stealth fighter.Russia's SU-57 and China's J-20 to name a few are claimed to be fifth-generation stealth fighters. The Americans on the other hand were able to take some of the features like stealth and minimum radar cross section and incorporate in their next advanced aircraft, the F-35. The F-35 is an edge above its predecessor (the F-22) with its capability of beyond visual range combat and electronic warfare. Let us see in details.

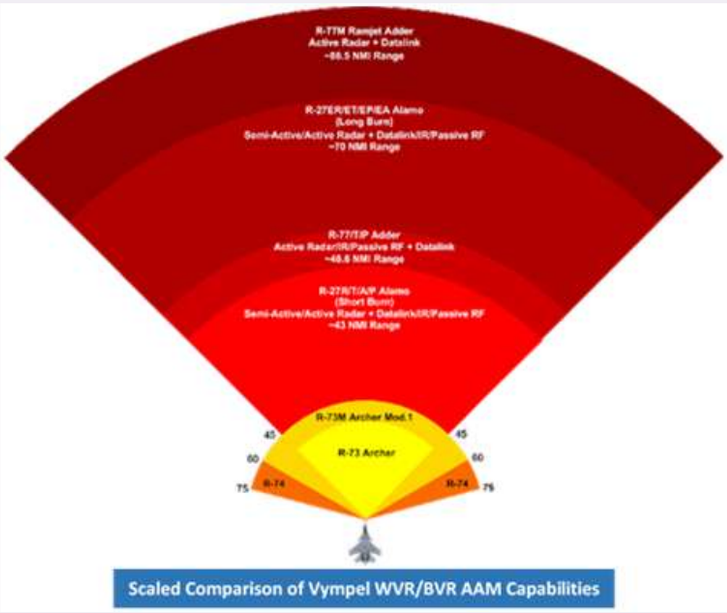
Beyond Visual Range Combat (BVR)

We all are familiar with the action-packed dogfight scenes in Top Gun where the pilots exhibited bone-chilling maneuvers that inspired many youngsters to become pilots around the globe. It was aesthetic to watch. But many would be disappointed to know that modern aerial combat isn't sporty anymore. Pilots don't want to engage in dogfights.

THE FUTURE OF WARFARE: MANNED, UNMANNED AND MORE

Modern aerospace engineers try to upgrade or develop aircrafts keeping in mind the non-visual detection aspect where the pilot can sense its adversary from a distance and take it down.

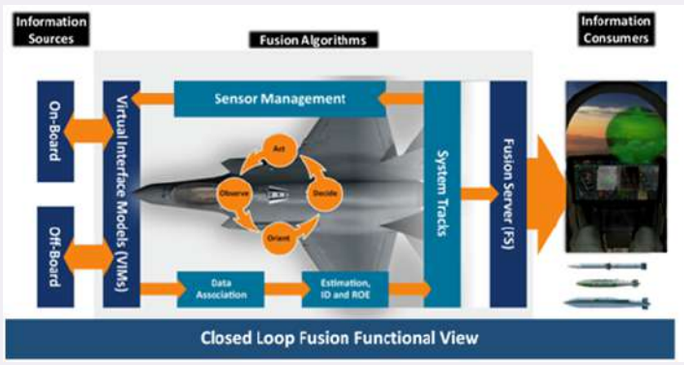
The distance between the two aircrafts must be more than 19km to ensure what is the forces is commonly called “first look, first shot, first kill”. The F-22 and the F-35 are some of the best examples of fighters that use this technology extensively.



Scaled Comparison of Vympel WVR/BVR AAM Capabilities

Sensor Fusion

Synergy is the key to winning any battle. The movements of data from the aircraft to the command to the drones (UAVs) flying in an area causes hindrance. With sensor fusion, the aircrafts can directly communicate and control the UAVs around and send them the radar images of the targets. Sensor fusion makes the life of a plot easy as it reduces the number of switches and controls on the dashboard. The main display has a panoramic touchscreen, which shows weather information, flight instruments, CNI information and integrated caution and warnings. Also, the pilot can customize the settings according to his needs.



Closed Loop Fusion Functional View


Display at the F –35 cockpit

Unmanned Combat

With AI and Machine Learning taking over a major chunk of activities in our daily life, there’s been a significant increase in productivity. The Americans have been using Predator drones for many years to eliminate precise targets at hostile territories here special forces can’t make way and for recon purposes.

In the coming years, militaries all around the world are planning to amplify the use of UAVs to the extent to which they can minimize human intervention. Apart from aerial vehicles, development of unmanned land and water vehicles. These are equipped with state-of-the-art technologies like heat signature detection and sensor fusion accompanied with artificial intelligence.

THE FUTURE OF WARFARE: MANNED, UNMANNED AND MORE

Exo-skeleton

Route marches are common in the army. Many soldiers look forward to it as it is a part and parcel of the job and they are trained for it. But, marching for miles carrying somewhat hundred kilos of weight in a hostile environment might be a tedious job for even the "iron-willed". This is where the exoskeletons come into play.

Exoskeletons are aimed to augment soldier strength and productivity, thus in the process reduce the risk of injury during lifting, loading, unloading and transporting. Experts are developing exoskeleton technologies that enable one soldier to lift more than 50 pounds.

Exoskeletons also should be able to help soldiers break down doors, carry out close-quarters battle maneuvers, dig and fill sandbags, carry injured warfighters who weigh as much as 270 pounds, load and unload pallets, maintain aircraft or vehicles at overhead heights, jump from high places, and recover quickly after parachuting.

Conclusion

Earlier in the ancient times, it was spears and bow and arrows that made The Romans fearsome and victorious. Then, with the invention of gunpowder, the Mongols became the largest land conquerors in the medieval times. Today a handful number of countries possess nuclear weapons. The weapons of annihilation. Modern day world is a tennis match of peace and conflict. Players are the governments; narrative is the ball. No one can anticipate which side the ball would land. Peace or Conflict?

One must understand that both go hand-in-hand. When there is peace, there will be some digging up plans for conflict. And when there is conflict, all will join hands for a resolution of peace.

War is catastrophic, it has to be dodged at all costs. But if the situation is unavoidable, it has to happen and the militaries around the world must be prepared to fight it.

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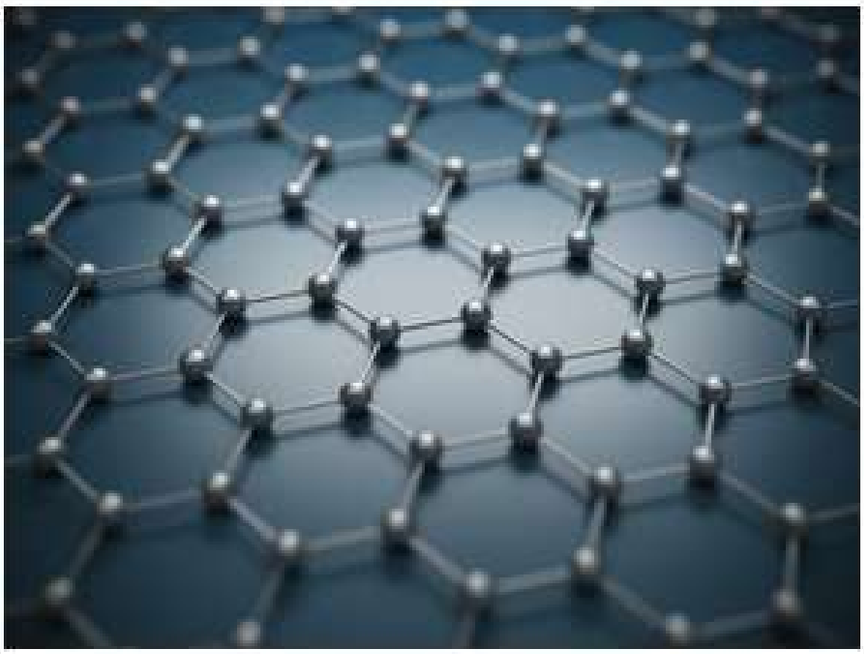
GRAPHENE BATTERIES: THE SUPERMAN OF BATTERIES

If I tell you about a battery which provides unlimited power, like you can use your smartphone at its full capacity and not charging it for a year, or a laptop that is never out of charge, or even an electric car which can travel miles without any juice, will you believe me?! you'll think that I am just kidding with you. Well my friend that time is not far our miracle material Graphene has made it possible. Now you guys are wondering that what this miracle material is. Is it even real?! Or just some made up stuff like Kryptonite or Vibranium. Graphene is an allotrope of carbon in the form of a single layer of atoms in a two dimensional hexagonal lattice in which one atom forms each vertex. Did I make it boring for you?! Yes I know I did a bit. Now if I tell you that you can extract this material at your home just using a pencil and a cello tape. How! Just make a mark on your copy with the pencil and start taking out layers from the mark using cello tape the last layer you are left with is graphene. See I told you it is a miracle material indeed.



In the field of batteries, conventional battery electrode materials (and prospective ones) are significantly improved when enhanced with graphene. A graphene battery can be light, durable and suitable for high capacity energy storage, as well as shorten charging times. It will extend the battery's life, which is negatively linked to the amount of carbon that is coated on the material or added to electrodes to achieve conductivity, and graphene adds conductivity without requiring the amounts of carbon that are used in conventional batteries.

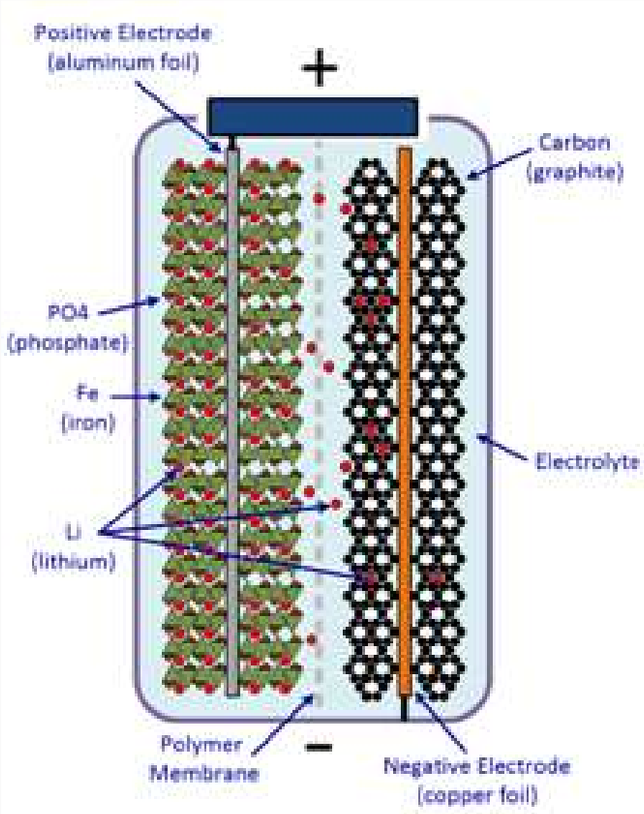
- Higher capacity
- Faster charging
- Light weight
- Flexibility
- High temperature range

Graphene can improve such battery attributes as energy density and form in various ways. Li-ion batteries (and other types of rechargeable batteries) can be enhanced by introducing graphene to the battery's anode and capitalizing on the material's conductivity and large surface area traits to achieve morphological optimization and performance.

GRAPHENE BATTERIES: THE SUPERMAN OF BATTERIES

It has also been discovered that creating hybrid materials can also be useful for achieving battery enhancement. A hybrid of Vanadium Oxide (VO2) and graphene, for example, can be used on Li-ion cathodes and grant quick charge and discharge as well as large charge cycle durability. In this case, VO2 offers high energy capacity but poor electrical conductivity, which can be solved by using graphene as a sort of a structural "backbone" on which to attach VO2 - creating a hybrid material that has both heightened capacity and excellent conductivity.

Another example is LFP (Lithium Iron Phosphate) batteries that is a kind of rechargeable Li-ion battery. It has a lower energy density than other Li-ion batteries but a higher power density (an indicator of the rate at which energy can be supplied by the battery). Enhancing LFP cathodes with graphene allowed the batteries to be lightweight, charge much faster than Li-ion batteries and have a greater capacity than conventional LFP batteries.



I hope you enjoyed the article as much as I enjoyed sharing the little facts about this miracle material :)

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CULTURED MEAT – A REMARKABLE DISCOVERY

Feeling Hungry? Want to eat a beef steak grown in laboratory or a burger patty made by a scientist. Yes , this is what we are going to hear and get as our food options in the upcoming future days hardly by 2040-2050.

The present global population of 7.3 billion is expected to surpass 9 billion by 2050. The Food and Agriculture Organization (FAO) has forecast that in 2050, 70% more food will be required to fulfill the daily demand of food for the sharp growing population, which is a great challenge due to resource and aerable land limitations. Moreover, with the increase in per capita income, meat consumption is increasing drastically across the globe, especially in developing countries, where even lower-middle class families are gradually opting for luxurious products like meat or other animal products.

This has brought a dire need for large production of high quality and affordable meat, milk , eggs by traditional livestock farming, which is a great challenge for the traditional livestock farming especially using environmentally sound and economically viable production systems.

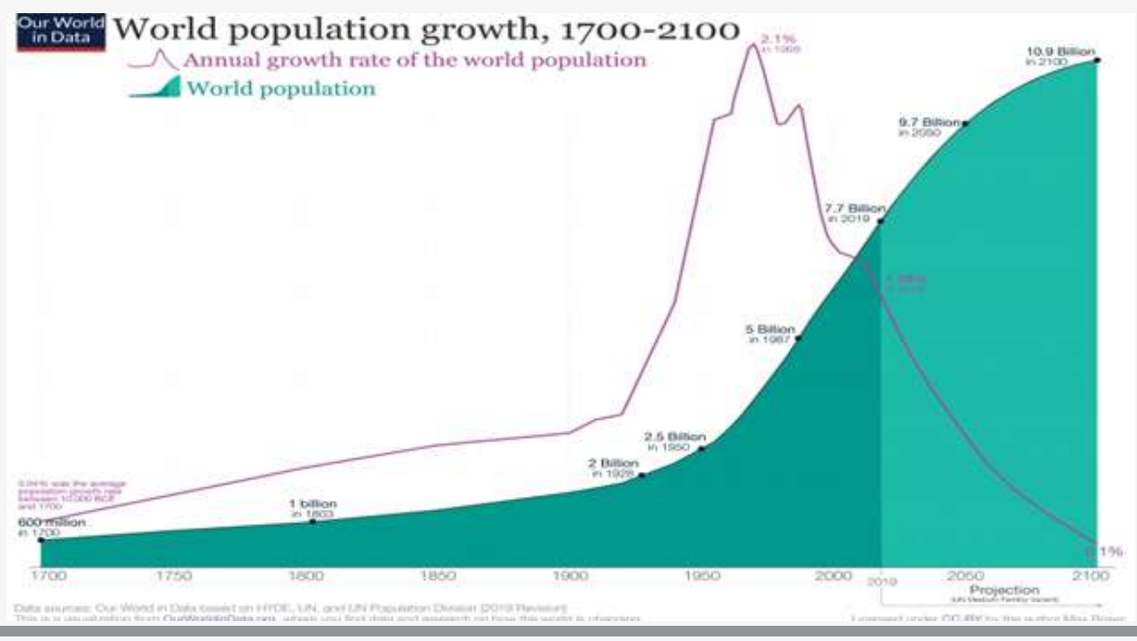
It is most likely that traditional livestock cultivation would well lack behind to cope up and fulfill the increased demand of meat across the globe even after maintaining all the sides. That is when, cultured meat

can come forward as a boon to the society and can help to fulfill the demand and supply of meat across the globe and can be the most preferable and suitable alternative protein source and will also be relief for all those who want to keep the amount of meat in their diet intact.

Now an obvious question comes to our mind – What is Cultured Meat? Cultured meat is artificial meat produced by in vitro cell culture of animal cells using Tissue Engineering techniques.

Cultured meat is a form of Cellular agriculture.

Cultured Meat though a recent discovery, has a very old history and it's also proving helpful in protecting nature by reducing amount of Green House Gas emissions caused by traditional livestock farming.



CULTURED MEAT – A REMARKABLE DISCOVERY

History

The history of Cultured Meat starts back to 1931. Winston Churchill in his 1931 essay 'Fifty Years Hence', wrote - "We shall escape the absurdity of growing a whole chicken to eat the breast or wings, by growing these parts separately under a suitable medium".

In the 1950s, Dutch scientist Willem Van Eelen independently came up with the idea for cultured meat.

In vitro cultivation of muscle fibres was first performed successfully in 1971, when pathology professor Russel Ross cultured smooth muscle derived from the inner media and intima of immature guinea pig aorta upto 8weeks in cell culture.

In 1991, Jon F. Vein of United States , filed for and ultimately secured patent for the production of tissue – cultured meat for human consumption.

In the early 2000s, the concept of cultured meat was popularized by Jason Matheny, when he co-authored a paper on cultured meat production and created 'New Harvest' the world's first non-profit organization dedicated to in-vitro meat research.

In 2001, University of Amsterdam dermatologist Wiete Westerhof, researcher and businesspersons William Van Eelen and William Van Kooten announced that they had filed for a worldwide patent on a process to produce cultured meat.

Public Trial

The first cultured beef burger patty was created by Mark Post at Maastricht University in 2013, from over 20,000 thin strands of muscle tissue costing over $300,000.

The burger was tested on live television in London on 5th August 2013, cooked by chef Richard Mc Geown of Couch's Great House Restaurant, Polperro, Cornwall and tested by critics Hanni Rutzler , food researcher from Future Studio and Josh Schonwald.

Making Process

1. Making of Cell Lines :- A scientist takes stem cells

from live animals and grow them in labs to permanently establish a culture called cell line.

2. Growth of cells

On establishment of good cell line, the sample is introduced to culture media, which provides basic nutrients for cell growth. Culture media is sometimes replaced by additives that supply additional growth factors (secreted proteins or steroids). Typical growth factors are added to the culture medium through the integration of Foetal Bovine Serum (FBS) or another animal based serum or by recombinant protein production. The sample along with growth medium is put in bioreactor where the cells grow and multiply and are then harvested into different forms according to need

3. Scaffolds or end products

The harvested and developed cells and muscle tissues from the growth medium are organised in a three – dimensional structure of different materials like sausage , wings and other forms using 3D printing technology or by using scaffold for getting the final end product.

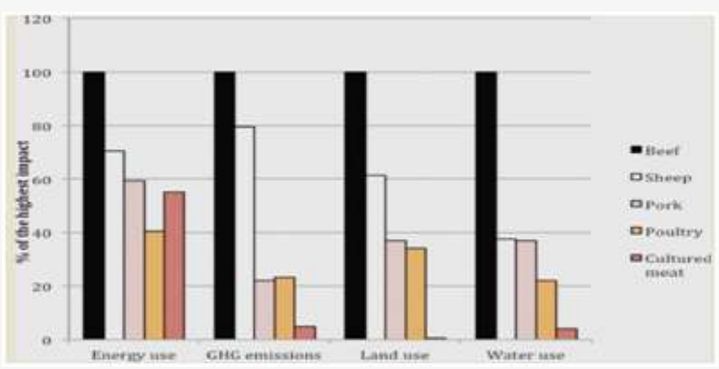
Scaffolds are molds meant to encourage the cells to organize into a larger structure. Scaffolds need to simulate the characteristics of ExtraCellular Matrix (ECM). ECM is the three- dimensional mesh of glycoproteins, collagen and enzymes responsible for transmitting mechanical and biochemical cues to the cell.

Environmental Impact (Traditional vs Cultured meat)

Traditional meat production is one of the major contributors to global environmental degradation. Currently, livestock raised for meat use 30% of global ice-free terrestrial land and 8% of global freshwater, while producing 18% of global greenhouse (GHG) emissions, which us more than the global transportation sector. Livestock production is also one of the major drivers of deforestation and degradation of wildlife habitats and it contributes to eutrophication of waterways. Globally 34% of the GHG emissions related to livestock are due to deforestation, 25% are methane emissions from enteric fermentation of ruminants and 31% of the emissions are related to manure management.

With increasing population, per capita global meat consumption is expected to double between 1999 to 2050. Such increase will also increase meat's impact on the environment unless more efficient meat production methods are adopted . One such effective method is growing only animal muscle tissue in-vitro instead of growing whole animal. The effective technology is called Cultured meat production .

Cultured meat is being developed in a potentially healthier and more efficient alternative to convential meat. Life Cycle Assessment (LCA) research method was used for assessing environmental impacts of large - scale cultured meat production. The result showed that production of 1000kg of cultured meat requires 26-33GJ energy, 367-521 m^3 water, 190-230 m^2 land and emits 1900-2240kg CO2 equivalent Greenhouse Gas emissions. In comparison to conventionally produced meat, cultured meat involves approximately 7-45% lower energy use, 78-96% lower GHG emissions, 99%lower land use and 82-96% lower water use depending on the product compared. Despite high uncertainty, it is concluded that the overall environmental impacts of cultured meat production are substantially lower than those of traditionally produced meat.



Pros and Cons of Cultured meat

Pros

i)The cultured meat is grown in-vitro in protected and sterilized lab environment. Which reduces the chance of meat getting affected by microbes especially intestinal pathogen like Escherichia coli, Salmonella typhi etc. Also the transfer of any disease from the meat of the animal which the animal might have been suffering from can be cut off.

ii)Lab grown meats are environment friendly and also involves very less use of antibiotic compared to traditional meat production for preventing any contamination and preservation for future use

iii)The nutritional content of cultured meat can be controlled by adjusting fat composites in medium of production. Moreover, Saturated fats can be replaced by healthy fats like Omega 3.

CULTURED MEAT – A REMARKABLE DISCOVERY

Cons

i)Cells are grown and multiplied in-vitro. According to sources, the cell growth can't be fully controlled which might result in the cultured meat to produce some unwanted biological consequences like faulty muscle structure and can have adverse effect bon human metabolism and health. It can also act as carcinogen due to not fully controlled cell growth.

ii)The growth medium contains Foetal Bovine Serum (FBS) extracted from the developing foetus of cows, which is a inhumane practice. Moreover, FBS contains a range of various hormones and growth factors and it is suspected by researchers that usage of the hormones and growth factors might cause adverse on human health causing hormonal imbalance in humans. But, these negative impacts are not yet proved by science but are just suspected and further researches are going on this and also to delete maximum of these negativities from cultured meat

Conclusion

In spite of all the pros and cons of cultured meat, it can become a handy and effective of protein source in our daily lives in very near future, depending upon how we the normal people welcome the cultured meat on our diet.

Currently, cultured meat is made available for common people in Singapore and several big farms like Mosa meats, Memphis meats, Aleph farms, Blue Nalu, Finless foods etc. are active around the globe in production of cultured meat.

Source: Several published articles , review papers .

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HYBRID PROPULSION: THE TRANSITION TO A ZERO-CARBON SHIPPING WORLD?

Sustainability, Eco- friendliness and Cost effectiveness are the main deciding factors for any new technological advancement right now. However, rapid climate change is a harsh reality that we face, and the actions we take now define the fate of future generations to come, so can we really afford to seek cost-effectiveness in such cases? Hence, IMO rules and regulations get stringent every year regarding each facet of Marine pollution. It has already set up goals of Decarbonization, i.e. reducing the carbon footprint of Shipping Industry and also reducing total annual GHG(greenhouse gas) Emissions by at least 50% (as compared to 2008) by 2050. Various advancements are being made in this field, and among them are the new generation of Marine propulsion systems, like Solar, Wind, Hybrid, Bio-fuel and Nuclear propulsion systems. Among them, Hybrid system is turning out to be very promising.

Hybrid propulsion is any vehicle propulsion system that includes two or more sources of propulsion in one design, usually which can be used either together or alternately. One of the most common of these systems in marine industry today combines a diesel engine with electric motors, at times operating purely on diesel power, at times operating purely on electrical power, and at times using a strategic mix of both. Such systems combine combustion engines with battery power to optimize engine operation while reducing emissions. These are ideal for vessels with flexible operation profiles and running hours with varying power demands. It optimizes the fuel efficiency of vessels that have a flexible power demand, such as fishing vessels, tugs, and RoPax.

Hybrid power has turned out to be much more than an efficiency-booster for existing technology. For the evolution beyond diesel, hybrid is an essential tool for electrification, fuel cell power and the transition to zero carbon shipping.

Advantages:

- Fewer NOX, SOX, and CO2 emissions
- Zero-emission operation possible.
- Silent operation possible.
- Optimum efficiency thanks to extra flexibility.

Disadvantages:

- A large room for storing the batteries is required, losing some space for cargo.
- Heavy and Expensive batteries.

However, the pros outweigh the cons because it helps in decarbonizing the supply chain, as a transition solution. The engines give enough range for transits to and from the site, and stored battery power can be used for station-keeping and loitering, saving fuel and reducing wear and tear.

This combination is an attractive solution for U.K.-based crew transfer vessel operator CWind, a division of Eidesvik began the hybrid OSV trend with the Viking Queen in 2015 and has converted seven vessels so far. Last year, Harvey Gulf retrofitted a Wärtsilä battery-power system onto its LNG dual-fuel OSV Harvey Energy, creating the world's first LNG battery-hybrid offshore vessel.

Battery-hybrid propulsion is also ideal for stop-and-go operating cycles, and ferries are strong candidates. Ferry operators in Europe, North America and Asia have been testing and deploying hybrid propulsion systems for nearly a decade, beginning with the Scottish ro/pax ferry "Hallaig" in 2013. The technology has caught on for passenger vessels of all sizes, all the way up to the 3,200-dwt Color Hybrid, a ro/pax ferry operated by Color Line between Norway and Sweden.

Rotor Sails is also a very promising marine Hybrid propulsion system.

HYBRID PROPULSION: THE TRANSITION TO A ZERO-CARBON SHIPPING WORLD?

Finnish company "Norsepower Rotor Sails" is one of the global companies that offer such technology, which is based on the Magnus effect.

When wind meets the spinning rotor sail, the air flow accelerates on one side and decelerates on the opposite side, according to Norsepower. The change in the speed of air flow results in a pressure difference and generates a lift force that is perpendicular to the wind flow direction. The same principle applies to all rotating spheres and cylinders. The thrust induced by the Magnus in ship effect can be utilized in propulsion by placing a cylinder on the open deck of the vessel and by rotating it around its vertical axis. A variable electric drive system, which is powered by the ship's low voltage network, is used for rotation of the rotor sail.

The essential parts of the Norsepower Rotor Sail Solution are:

- Rotor Sails, which deliver the forward thrust
- A control panel, which gives the captain full control of the operation and performance of the Rotor Sail Solution
- A fully automatic control system, which optimizes the forward thrust of the Rotor Sails
- A low-voltage electrical power supply to each Rotor Sail.

The ability to harness wind as an additional power source to enable a reduction in fuel consumption is a natural next step for the maritime transport industry as it is cost efficient and meets environmental regulations. Wind is one of the most freely available energy sources, making wind-assisted propulsion extremely viable. The wind capture provides a propulsion assist that is clean, abundant, and 100% carbon neutral.

As we can clearly see, "Hybrid" has an ever evolving significance, while playing an essential role in getting to zero emissions as a flexible transition technology for vessels on the working waterfront. If we could cope with the comparatively minor disadvantages, won't this be a great and efficient step towards a Zero-Carbon Shipping World??

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OUROBOROS STEAK (GROWN FROM HUMAN CELL) - NOT TECHNICALLY CANNIBALISM

ABSTRACT

Today we all know that a huge number of animals and birds are dying every day for feeding us. Ouroboros Steak is a new concept of biological research where isolated human cells are kept through certain culture medium to grow them. It enables human to cultivate their own cells. A group of US scientists and designers have developed this concept for grow-your-own meat kit using human cells and blood. Ouroboros Steak are small pieces of meat-protein, grown from human cells which poses a question to the cultured meat industry. This is a great thought where by studying your own cells, your own food will be satisfied. As result, no other animals will be harmed.

People think that eating oneself is cannibalism but eating Ouroboros Steak is not technically cannibalism.

What are problems we are facing with growing demand of animal meats?

If we continue at the rate at which we are killing animals, the day will come when these animals will become extinct on earth. The variety of life on earth is called biodiversity. As a result, the earth's biodiversity will be lost. And biodiversity is crucial for enabling us to live and stay healthy. If we reduce the amount of biodiversity there, leading many species to extinction, we cannot expect that nature will be able to provide these things for us.

The steak claims to reduce the need for other animal meat products. As a result, the animals we eat can be saved.

How the idea of the Ouroboros Steak came to the public?

The Ouroboros Steak was first shown at the Philadelphia Museum of Art in exhibition, created using human cell culture. To increase people's curiosity, the scientists and designers didn't taste this meat.

The exhibition was later exhibited at the London Museum also. The goal of placing steaks raised from human cells at the Design Museum in London was to criticize the growing use of living cells from animals in the meat industry. This sparked a brilliant debate about the harms of biotics and artistic criticism.

How does the concept actually work?

The ouroboros steak is a DIY meal kit designed by Andrew Pelling, Orkan Telhan and Grace knight. As part of the DIY kit, the team envisions users collecting cells from the inside of their own cheek using a cotton swab and depositing them into pre-grown scaffolds made from mushroom mycelium. These are then stored in a warm environment for around three months, while being fed with serum from old donated blood until fully grown.

Why the name Ouroboros?

According to Britannica, Ouroboros is emblematic serpent of ancient Egypt and Greece represented with its tail in its mouth, continually devouring itself and being reborn from itself. A gnostic and alchemical symbol, Ouroboros expresses the unity of all things, material and spiritual, which never disappear but perpetually change form in an eternal cycle of destruction and re-creation.

Here Ouroboros Steak (which, in a dark twist), named after the ancient symbol of the snake eating its own tail, reducing the need for other animals by drawing in human blood and cells in the same way.

OUROBOROS STEAK (GROWN FROM HUMAN CELL) - NOT TECHNICALLY CANNIBALISM

Feedback from prominent individuals and society

- According to Orkan Telhan, associate professor of fine arts at Penn's Weitzman School of Design, "our design is scientifically and economically feasible but also ironic in many ways. We are not actually promoting 'eating ourselves' as realistic solution that will fix humans protein needs.
- "As the lab-grown meat industry is developing rapidly, it is important to develop designs that expose some of its underlying constraints in order to see beyond the hype."
- Considering how climate change may affect food intake in the future, this is a great thought.
- Thinking of eating steak made from human cells is repulsive," said another Fox commenter.

Lastly, we rather ask a question: what would be the sacrifices we need to make to be able to keep consuming meat at the pace that we are? In the future, who will be able to afford animal meat and who may have no other option than culturing meat from themselves?

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LOCKDOWN AS A BLESSING IN DISGUISE FOR AIR QUALITY

"THE ONLY SOLUTION TO POLLUTION IS A PEOPLE'S HUMANE REVOLUTION! "
-BOBBY SEALE

Everything in this world is changing. Man lives within technology and technology is increasing gradually but still in this tech-savvy world the basic essential needs of a human life like air, water remains the same. As we know from the wise old saying that love is in the air but most pathetic thing is that air is polluted. So, it has to be ensured that pollution shouldn't be the price of development and prosperity and being a responsible citizen, it is our duty as well as responsibility to be a part of solution of the pollution. Pollutants are substance that instigate distasteful effects, or and hampers the natural resources of the environment. It has a long as well as short term ravaging effect to the environment and hampers as well as destroys human amenities, health etc. Among them some are biodegradable that means they gets decomposed into organic matters by bacteria, fungus etc and some are non-biodegradable (like plastic ,metal specially heavy, radioactive elements, medical waste, chemical) which means they are incapable or takes huge amount of time for decomposition and even cannot decompose at all in some cases. These non-biodegradable wastes has more adverse effect In the highly populated and fast developing countries in the world like India, the upswings and fluctuations in the economy led to environmental threats and the urbanisation as well as industrialisation paved the way to increase to air pollution leading to social instability. From the figure 1, a question can be raised that is the global growth promoting the growth of air pollution?

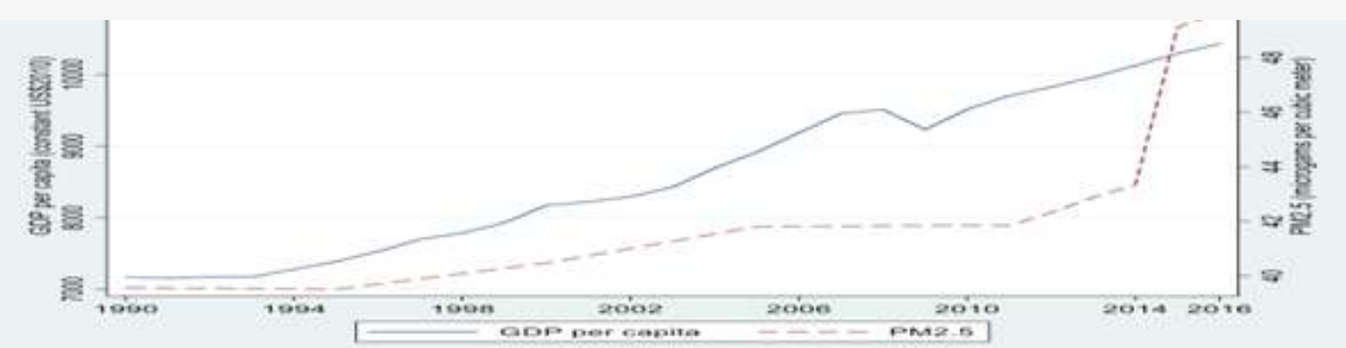

Figure 1: Representing Global GDP per Capital and increase in primary pollutant of air pollution
Source: world Bank data

LOCKDOWN AS A BLESSING IN DISGUISE FOR AIR QUALITY

As per reports and the facts published worldwide, more than 2 million premature deaths are due to adverse effect of the air pollution only and more than 4 million deaths are consequence to the household pollutions only. From the different results it is evident that 10% of total death in the world is only due to air pollution and so hence it is becoming a major threat to mankind and India is among top 5 countries having highest pollution. Air pollution can be said as the damaging and dangerous affect caused to the air due to release several toxic pollutants which is life-threatening and detrimental to mankind which may cause several chronic diseases and other problems like Lung cancer, asthma, anoxaemia ,corneal opacity, irritation etc.

The AQI value and concentration of other pollutants from June 2018 to June 2020 for Kolkata region is taken into account for understanding of the pollution index. Doing basic analysis, we can conclude that AQI value changes with the season as during festival time ie from September end to February end there is numerous numbers of festival and lighting of crackers promotes the rise in value of AQI and this value again gets down from March to August. Also, it is observed that AQI is directly proportional to the concentration of the pollutants but each pollutant has a different contributing factor. It is evident from figure 2.

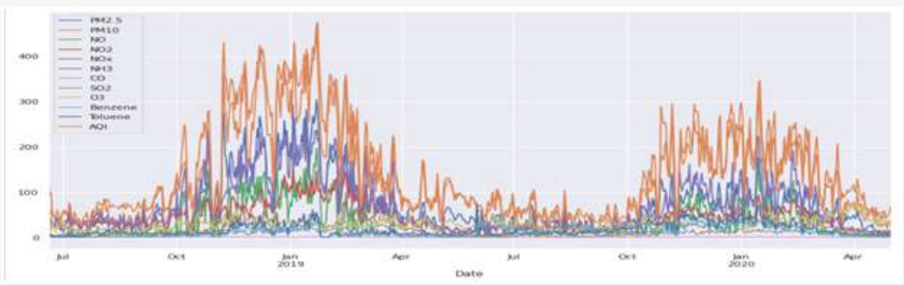

Figure 2: Different pollutants along with AQI over time

The world at present is facing a gravest health crisis due to a virus. This has culminated into a pandemic, also known as “corona virus pandemic”, which until months ago were unknown to the scientists. Corona virus is a large family of RNA viruses that cause mainly respiratory diseases ranging from the **common cold to more severe pneumonia in both mammals and birds. Viruses continue to emerge and challenge public health. The novel corona virus termed as COVID-19 by World Health Organization (WHO), first emerged in late December 2019 in Wuhan, China. In early March 2020, due to its rapid spread, the WHO declared COVID-19 as a pandemic. By July 8, 2020, it spread to more than 210 countries worldwide, infecting over 11 million people and causing 539,026 mortalities. India took unprecedented measures to contain the infection from across borders and within its territory. International travel and non-essential traveling visas were suspended on March 13, 2020. The Indian railways shut down its operations on March 23, 2020, for the first time in its history spanning over 167 years. A 21-day nationwide lockdown phase-1 was enforced from March 25 to April 14, which was extended further until May 31, 2020. Divided into different phases, the lockdown was marked by increasing relaxations in socio-economic activities in less infected regions. While the socio-economic devastation due to COVID-19 has been colossal around the world, which required "a wartime" plan from every corner of the world it has also come as the silver lining for the environment.**

LOCKDOWN AS A BLESSING IN DISGUISE FOR AIR QUALITY

Pollution level of air has drastically improvised due this. The COVID-19 lockdown has led to cleaner air. Lockdown resulted in a big improvement in the air quality, mainly for nitrogen dioxide (NO2) levels in major cities of India. As a result, as per the assessment of the Central Pollution Control Board of India, the air quality of Delhi-NCR, as well as all that of other metro cities of India, has improved drastically.

Due to the Lockdown, the industrial works, offices were stopped and due to this number of vehicles operating in the roads also decreased. So this lockdown become blessing to environment and pollution amount got reduced. The presence of smoke and carbon dioxide gases in the air has been drastically decreased. Due to this reason, the visibility range has increased. The sky is returning to its ancient glory with chirping birds and dazzling stars.AQI value decreased significantly which can be visualized using figure 3

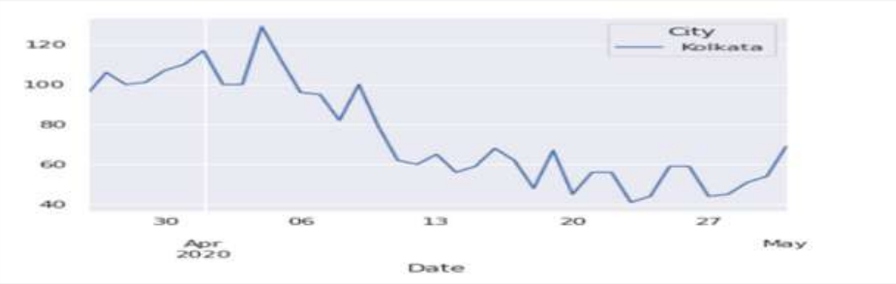

Figure 3 : Representing AQI during lockdown in Kolkata

Due to lockdown, the amount vechicles, industries operating were reduced and thus pollutant amount also dropped significantly and the concentration amount is very less than same time of last year which can be visualized using figures 4,5.

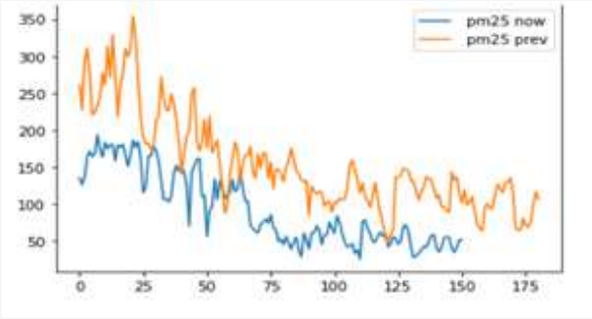

Figure 4: Comparison of pm 2.5 concentration

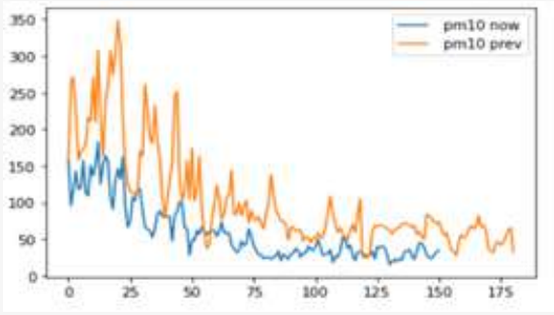

Figure 5: Comparison of pm 10 concentration

During early Lockdown, AQI value decreases to high extent resulting in pollution free environment which is plotted in figure 6

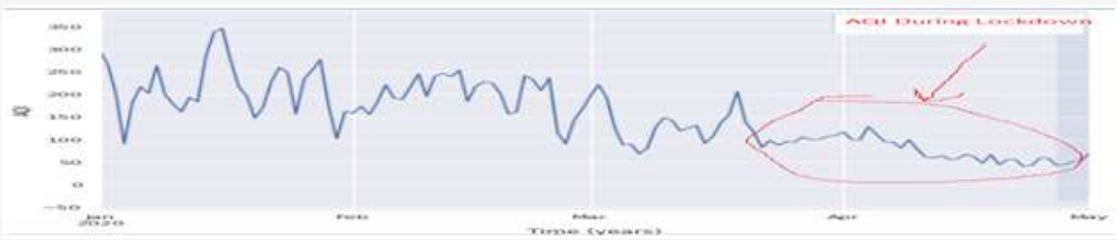

Figure 6: Showing AQI value decreasing

LOCKDOWN AS A BLESSING IN DISGUISE FOR AIR QUALITY

During the lockdown period, the polluted water of Yamuna, Ganga and other rivers of India became free from different pollutants and Pollution level in water is also drastically improved . Due to COVID–19-induced lockdown across the whole of India, vehicular traffic has been declined to almost zero. Industries billowing black smoke into the atmosphere is closed. Construction sites that are usually buzzing with activity, spewing dust, and dry cement particles into the air are eerily vacant and due to this reason drastic improvements in air and water quality, visibility of sky, etc. have taken place.

The lockdown has taught us a lesson to minimize our unnecessary activities as much as possible and also majorly contributed in restoring our nature. It may be inferred from this analysis lockdown did improve the air quality significantly. This may be concluded note that as a coin has two sides the negative impact on the health by COVID-19, healing of the earth took place. Among the selected pollutants PM10 and PM2.5 have witnessed maximum reduction followed by NO2, CO and NH3. In compare to the past three year average concentration of PM10 and PM2.5 has decreased by about –57% and –33% respectively. On a contrary there is a slight increase in O3 concentration which is expected to be primarily due to the decrease in the concentration of NOx and particulate matter. Moreover, as anticipated, a considerable reduction in NAQI is observed during the window period of lockdown throughout the megacity. Just after 1 day of the commencement of lockdown (i.e. 25th of March) there is about 40% improvement in air quality. Only on the 4th day of lockdown (March 27th) concentrations of PM10 and PM2.5 had come within the permissible limit and there were about 51% reductions in NAQI. During the entire 3 week of lockdown there was an about 43% decrease in NAQI in compare to the first three week of March this year. In order to implement short term (2–4 day) lockdown as an alternative policy measure for pollution reduction and its vis-à-vis effect on economy need to be study rigorously. Because cost effectiveness will be one of the key issue to the policy-makers while deciding such control measures. Moreover, with inter-seasonal disparity in the meteorological condition, concentrations of pollutants significantly differ in a region. Therefore, to facilitate fruitful implementation of this type of measures once or twice a year in a long-distance race in-depth analysis of the seasonal change in air quality in relation to regional meteorological condition is also required to be studied.

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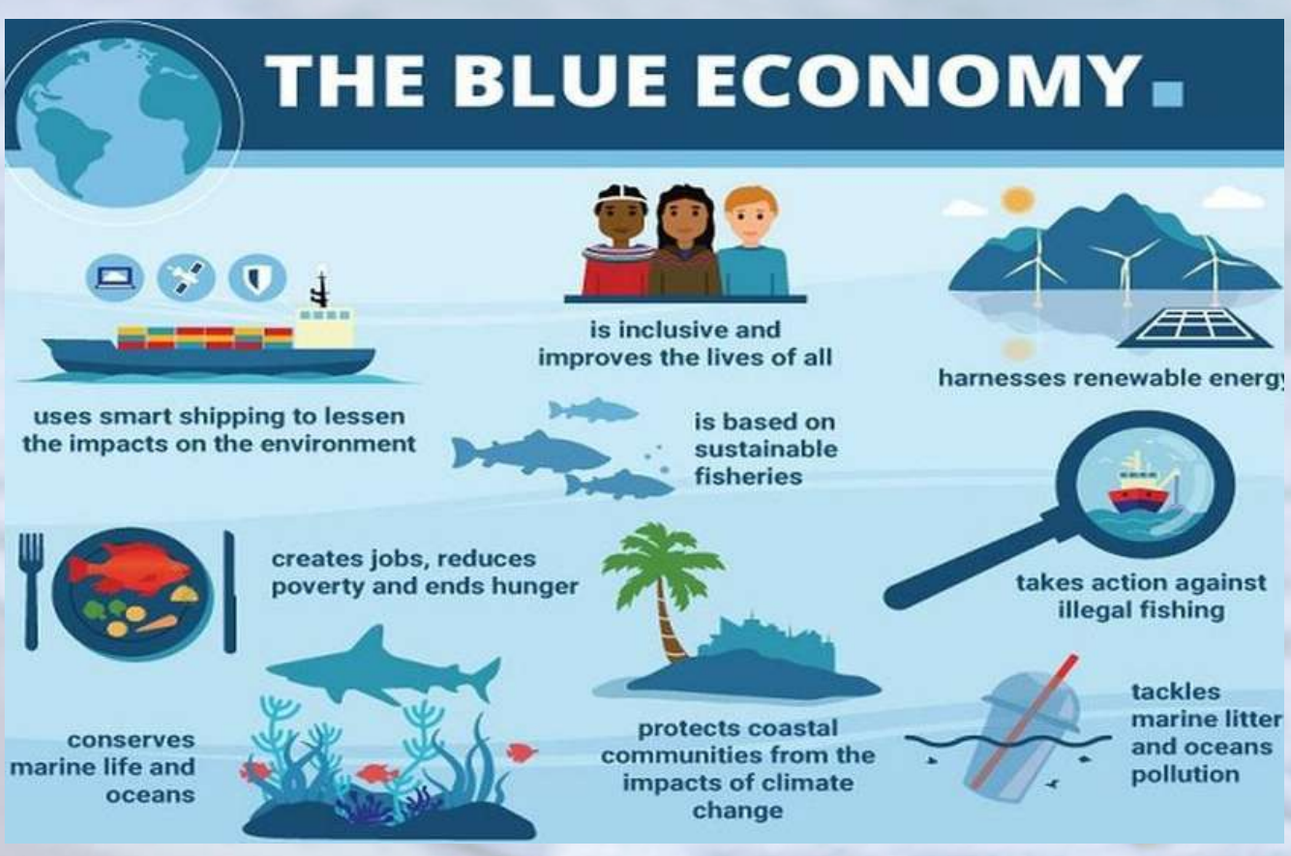
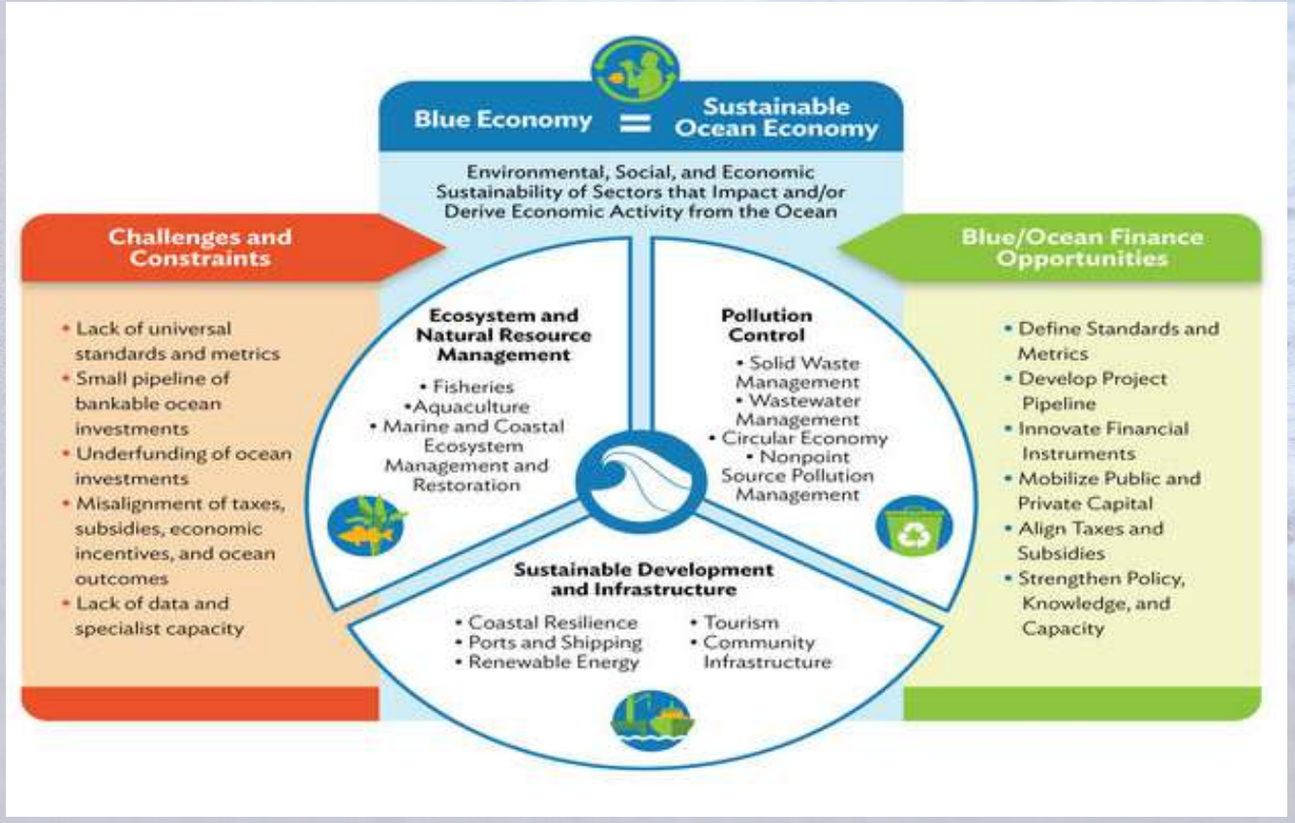

THE BLUE ECONOMY
is inclusive and improves the lives of all
harnesses renewable energy
uses smart shipping to lessen the impacts on the environment
is based on sustainable fisheries
creates jobs, reduces poverty and ends hunger
takes action against illegal fishing
conserves marine life and oceans
protects coastal communities from the impacts of climate change
tackles marine litter and oceans pollution


Blue Economy = Sustainable Ocean Economy
Environmental, Social, and Economic Sustainability of Sectors that Impact and/or Derive Economic Activity from the Ocean
Challenges and Constraints
• Lack of universal standards and metrics
• Small pipeline of bankable ocean investments
• Underfunding of ocean investments
• Misalignment of taxes, subsidies, economic incentives, and ocean outcomes
• Lack of data and specialist capacity
Ecosystem and Natural Resource Management
• Fisheries
• Aquaculture
• Marine and Coastal Ecosystem Management and Restoration
Pollution Control
• Solid Waste Management
• Wastewater Management
• Circular Economy
• Nonpoint Source Pollution Management
Sustainable Development and Infrastructure
• Coastal Resilience
• Ports and Shipping
• Renewable Energy
• Tourism
• Community Infrastructure
Blue/Ocean Finance Opportunities
• Define Standards and Metrics
• Develop Project Pipeline
• Innovate Financial Instruments
• Mobilize Public and Private Capital
• Align Taxes and Subsidies
• Strengthen Policy, Knowledge, and Capacity

Blue Economy in News

- Recently the first global conference on the Sustainable Blue Economy was held on 26-28 November, 2018 in Nairobi Kenya.
- Seychelles recently launched the sovereign Blue Bonds.

Blue Bond

- Seychelles became the first country in the world to launch sovereign Blue Bonds.
- It is a debt instrument issued by governments, development banks etc to raise capital from investors to finance marine and ocean-based projects.
- It will help in expansion of marine protected areas, improved governance of priority fisheries and the development of the Seychelles' blue economy.
- The blue bond is inspired by the green bond concept.

Blue Economy

- The concept was introduced by Gunter Pauli in his 2010 book- "The Blue Economy: 10 years, 100 innovations, 100 million jobs".
- It is the sustainable use of ocean resources for economic growth, improved livelihoods and jobs, and ocean ecosystem health.
- It advocates the greening of ocean development strategies for higher productivity and conservation of ocean's health.
- It encompasses–
- **Renewable Energy:** Sustainable marine energy can play a vital role in social and economic development.
- **Fisheries:** Sustainable fisheries can generate more revenue, more fish and help restore fish stocks.
- **Maritime Transport:** Over 80% of international goods traded are transported by sea.
- Tourism: Ocean and coastal tourism can bring jobs and economic growth.
- Climate Change: Oceans are an important carbon sink (blue carbon) and help mitigate climate change.
- **Waste Management:** Better waste management on land can help oceans recover.
- Blue Economy emphasizes on integration of development of ocean economy with social inclusion, environmental sustainability, combined with innovative business model.
- This is reflected in Sustainable Development Goal (SDG 14), which calls to conserve and sustainably use the oceans, seas and marine resources for sustainable development.

Need for Blue Economy

- Oceans cover three-quarters of the Earth's surface, contain 97% of the Earth's water, and represent 99% of the living area on the planet.
- Oceans protect biodiversity, keep the planet cool, and absorb about 30% of global CO2 emissions.
- At least 3-5% of global GDP is derived from oceans.
- Blue economy, through sustainable use of oceans, has great potential for boosting the economic growth by providing opportunities for income generation and jobs etc.
- It can support food security, and diversification to address new resources for energy, new drugs valuable chemicals, protein food, deep sea minerals, security etc.
- It is the next sunrise sector.

Challenges

- Threat of sea borne terror – piracy and armed robbery, maritime terrorism, illicit trade in crude oil, arms, drug and human trafficking and smuggling of contraband etc.
- Natural Disasters – every year tsunamis, cyclones, hurricanes typhoons etc leave thousands of people stranded and property worth millions destroyed.
- Man-Made problems – Oil spills, climate change continue to risk the stability of the maritime domain.
- Impact of climate change – changes in sea temperature, acidity, threaten marine life, habitats, and the communities that depend on them.
- Marine pollution – in form of excess nutrients from untreated sewerage, agricultural runoff, and marine debris such as plastics
- Overexploitation of marine resources – illegal, unreported, and unregulated extraction of marine resources.

Blue Economy in News

Developments Initiated by India

- The Sagarmala project is the strategic initiative for port-led development through the extensive use of IT enabled services for modernization of ports.
- **Sagarmala Project**
- Project aims at developing Inland waterways and coastal shipping which will revolutionize maritime logistics, creating million new jobs, reduce logistics costs etc.
- It focuses on the development of coastal communities and people in the sustainable use of ocean resources, modern fishing techniques and coastal tourism.
- India has an umbrella scheme by the name of O-SMART which aims at regulated use of oceans, marine resources for sustainable development.
- Integrated Coastal Zone Management focuses on conservation of coastal and marine resources, and improving livelihood opportunities for coastal communities etc.
- Development of Coastal Economic Zones (CEZ) under Sagarmala would become a microcosm of the blue economy, wherein industries and townships that depend on the sea will contribute to global trade.
- India has a National Fisheries policy for promoting 'Blue Growth Initiative' which focus on sustainable utilization of fisheries wealth from the marine and other aquatic resources.

Way Forward

- India should look to adopt the Gandhian approach of balancing economic benefits with sustainability for meeting the broader goals of growth, employment generation, equity and protection of environment.
- India must focus on marine ICTs, and transport (shipping) and communication services, and the creation of a knowledge hub for marine research and development.
- An effective response mechanism to address humanitarian crises and natural disasters should be made for the evolving Indian Ocean security strategy.
- India should not look at its oceans as just water bodies, but as global stage for continued economic, social, and cultural dialogue.

Rabi Paik

MRE, 3rd YEAR
SOMS

DATA LAKE CONCEPT

Stock all your data in one central storehouse at any measure.

What is a Data Lake?

The term "data lake" was introduced by James Dixon, Chief Technology Officer of Pentaho. Describing this type of data repository as a lake makes sense because it stores a pool of data in its natural state, like a body of water that hasn't been filtered or packaged. Data flows from multiple sources into the lake and is stored in its original format.

A data lake is a centralized repository that allows you to store all your structured and unstructured data at any scale. You can store your data as-is, without having to first structure the data, and run different types of analytics—from dashboards and visualizations to **big data processing, real-time analytics, and machine learning to guide better decisions**.

Data lakes allow users to access and explore data in their own way, without needing to move the data into another system. Insights and reporting obtained from a data lake typically occur on an ad hoc basis, instead of regularly pulling an analytics report from another platform or type of data repository. However, users could apply schema and automation to make it possible to duplicate a report if needed.

Why do you need a Data Lake?

Organizations that successfully **generate business value** from their data, will outperform their peers. The users will be able to do new types of analytics like **machine learning** over new sources like log files, data from click-streams, social media, and internet connected devices stored in the data lake.

This will help one to identify, and act upon **opportunities for business growth** faster by attracting and retaining customers, boosting productivity, proactively maintaining devices, and making informed decisions.

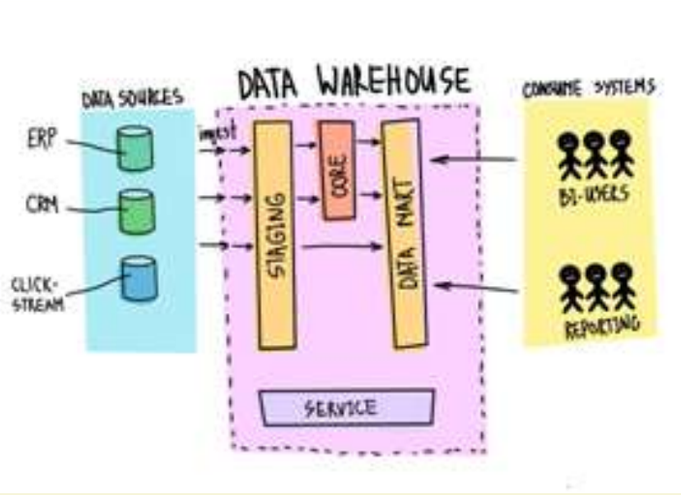
Data Lakes compared to Data Warehouses – two different approaches

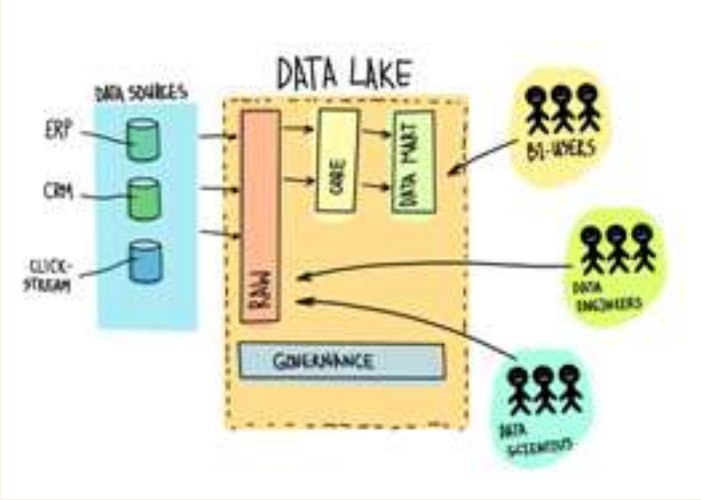
Key differences

- Different purposes. Data Warehouses are used by managers, analysts, and other business end-users, while Data Lakes are mainly used by Data Scientists and Data engineers
- Different processing methods Data Lakes, we use ELT (Extract, Load, Transform) but in Data Warehouse we use ETL (Extract, Transform, Load)
- Different levels of understanding of the data. In Data Lakes data is never rejected because it is stored in an unprocessed format and is useful in an environment with large data. The central database (implemented on RDBMS technology) is the foundation of the data warehousing environment.
- Different approaches to design. Data Warehouse design is based on relational data handling. Designing the data lake, the Big Data Architect and Data Engineer pay more attention to ETL processes, taking into account the diversity of sources and consumers of information.

DATA LAKE CONCEPT

Stock all your data in one central storehouse at any measure.





The essential elements of a Data Lake and Analytics solution

DATA MOVEMENT

Data Lakes allow you to import any amount of data that can come in real-time. Data is collected from multiple sources, and moved into the data lake in its original format.

SECURELY STORE, AND CATALOUGE

Allow you to store relational data like operational databases and data from line of business applications, and non-relational data like mobile apps, IoT devices, and social media.

ANALYTICS

Allow various roles in your organization like data scientists, data developers, and business analysts to access data with their choice of analytic tools and frameworks. Data Lakes allow you to run analytics without the need to move your data to a separate analytics system.

MACHINE LEARNING

Will allow organizations to generate different types of insights including reporting on historical data, and doing machine learning where models are built to forecast likely outcomes, and suggest a range of prescribed actions to achieve the optimal result.

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ENZYME TECHNOLOGY AND IT'S APPLICATIONS

INTRODUCTION

An enzyme is a substance that acts as a catalyst in living organisms, regulating the rate at which chemical reactions proceed without itself being altered in the process. Enzyme technology is primarily engaged in the production, isolation, purification and use of enzymes either in the soluble or immobilized form, for the benefit of humankind. With the advancements in, recombinant DNA technology, enzyme engineering produces more effective and diverse group of enzymes with useful applications in microbiology, biochemistry, diagnostics, therapeutics, biocatalysis, structural biology etc. The overall objective of this emerging technology is to produce unique sustainable products with specific function to fulfill the need of growing population.

SIGNIFICANCE OF ENZYME TECHNOLOGY:

Enzymes have a wide range of applications in modern world. These include their use in food production, food processing and preservation, textile manufacture, medical applications, and improvement of environment and in scientific research. The products of enzyme technology will be useful for chemicals, pharmaceuticals, fuel, food, or agricultural additives.

APPLICATIONS OF ENZYME TECHNOLOGY :

There are so many valuable applications of Enzyme technology in today's world, like

1. Pharmaceuticals Industries
2. Bio-fuels Industries
3. Paper Industries
4. Food and Beverage Industries
5. Agricultural

So here we explain a small informative note on the applications of Enzyme Technology.

1. Pharmaceuticals Industries

Enzymes used as drugs have two important characteristics, which are different from traditional drugs. Firstly, unlike drugs they bind and act on their targets with great affinity. Secondly, they are highly specific and act as catalyst to convert multiple target molecules to the desired products. These two features make enzymes specific drugs that can accomplish biochemistry in the body that small molecule cannot. The catalytic activity of enzymes is exploited in industrial manufacturing of drugs. Enzymes are also used as digestive aid where they are used to supplement digestive enzymes like amylase, lipase, and protease. Almost all enzyme therapies developed till date deal with the genetic disorders. Also the enzyme replacement therapy is used for relatively rare, inborn error of metabolism. Several enzymes are also used to prevent and treat common diseases like heart attack and stroke.

2. Bio-fuels Industries

Biofuels are defined as the combustible substances in the state of solid, liquid, or gas made up of biological derived resources in nature to be converted into a sufficient amount of energy. For biodiesel, the enzymes lipase and phospholipase are the major players. To the increased demand for biofuels, advanced biochemical processes using enzymes are being developed, which are gaining increased global attention. Research in this field aims at improving efficiency, and reducing negative environmental impacts, of production processes, in addition to enhancing the quality of the produced biofuels. Enzymes have been employed to overcome the drawbacks associated with the use of conventional chemical catalysts. For example, biodiesel production by enzymatic catalyzed processes is less energy intensive and more environmental friendly compared to its production

by conventional alkaline catalyzed processes. The research attention is also focused on genetic engineering in enzymes production. A few companies are commercializing biodiesel produced with enzymatic processes.

3. Paper Industries

In pulp and paper industry, the most important application of enzymes is in the rebleaching of kraft pulp. Xylanase enzymes have been found to be most effective for this purpose. Enzymes have also been used to increase pulp fibrillation and water retention and to reduce beating time in virgin pulps. With recycled fibers, enzymes have been used for dinking and to restore bonding. Specialized applications include the reduction of vessel picking in tropical hardwood pulps and the selective removal of xylam from dissolving pulp. Enzymes have also been investigated for removal of bark, shives, pitch, and slime and for retting of flax fibers.

4. Food and Beverage Industries

Food processing through the use of biological agents is historically a well-established approach. The earliest applications go back to 6,000 BC with the brewing of beer, bread baking, and cheese and winemaking, whereas the first purposeful microbial oxidation dates from 2,000 BC, with vinegar production. Early in the modern century Christian Hansen reported the use of a mixture of chymosin and pepsin for cheese making, and the production of bacterial amylases was started at Takamine. The enzymes used in large-scale applications, among them are those used in food and feed applications. These include enzymes used in baking, beverages, dairy, dietary supplements, as well as fats and oils, and they have typically been dominating one, only bested by the segment assigned to technical enzymes. The production of fruit and vegetable juices requires improved methods for extraction, clarification, and stabilization. Cellulases also has an important application as a part of macerating enzymes complex of cellulases, xylanases, and pectinases used for extraction and clarification of fruit and vegetable juices to increase the yield of juices. Enzyme mixtures containing pectinases, cellulases, and hemicellulases are also used for improved extraction of olive oil. Thus, the enzymes, composed of mainly cellulose, pectinase, play a key role in food biotechnology, and their demand will likely increase for the extraction of juice from a wide range of fruits and vegetables.

5. Agriculture Industries

Various enzyme preparations consisting of different combinations of cellulases, hemicellulases, and pectinases have potential applications in agriculture for enhancing the growth of crops and controlling plant diseases. Plant or fungal protoplasts produced using microbial hydrolases can be used to produce hybrid strains with desirable properties. Cellulases and related enzymes from certain fungi are capable of degrading the cell wall of plant pathogens in controlling plant disease. Many cellulolytic fungi including Trichoderma, Geocladium, Chaetomium, and Penicillium. are known to play a key role in agriculture by facilitating enhanced seed germination, rapid plant growth, and flowering, improved root system, and increased crop yields. Cellulases have also been used for the improvement of soil quality. Traditionally straw incorporation is considered an important strategy to improve soil quality and reduce dependence on mineral fertilizers. Therefore, using exogenous cellulase may be a potential means to accelerate straw decomposition and increase soil fertility.

CONCLUSION

Except all of these, Enzyme Technology has also may vital applications in many other industries, like Detergent industries, Textile industries, Bio-ethanol industries, and also in Waste managements. Cellulases are being commercially produced by

ENZYME TECHNOLOGY AND IT'S APPLICATIONS

several industries globally and are widely being used in food, animal feed, fermentation, agriculture, pulp and paper, and textile applications. With modern biotechnology tools, especially in the area of microbial genetics, new enzyme applications will become available for the various industries. Improvements in cellulase activities or imparting of desired features to enzymes by Enzyme Technology are probably other areas where cellulase research has to advance.

Reference:

All of these information are collected from internet sources and also from some reference books of biology.

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How will the world reinstate Normalcy as we face two pandemics Medical & Financial?

"Problems are not stop signs
They are Guidelines"
- Robert H. Schuller

Who doesn't face problems? Everyone! But as this pandemic is faced together, the solution will also be made if we work together. The current situation in no way is superior but a virus cannot break up the backbone of the most intelligent creatures of the world- Humans. The COVID 19 virus is one of those villains which cause harm not only to a specific person but chases the community as a whole. The situation was millions of people who are locked down at home are in no way advantageous. The world is under a serious crisis called the Medical and Economic Crisis. But what do we do?? The making up of a proper warrior in the name of Vaccine to defeat this villain will take up some time. But does that mean that we lose our hope in Science?

The country, as well as the world, is going through a major change both Economically and Medically.

Thousands of hospitals all around the globe are helpless as they cannot fight against the virus and in that way we are losing thousands of souls every day. Medical science has improved a lot in the years but hasn't matured to that level where the Coronavirus could be defeated. The lockdown imposed by the government is probably the best decision ever taken. But what about the thousands of people who earn every day and live every day? The lockdown has in a way pushed them to the verge of great danger and adversity. Praising the government and some NGOs I have said they are trying their best to reach every corner of the country and extend their helping hand. The main crisis that the virus got with it is of Social Distancing. But man is called a Social Animal! How can a virus change that genre of mankind to live, to stay, to laugh together? But it is doing the exact opposite. Mankind is pushed to a situation where he has to stay away from other people near him.

How will the world reinstate Normalcy as we face two pandemics Medical & Financial?

The schools, colleges, and the companies are all mere buildings now. The traffic and the hustle at the roads have vanished as it had never been so. But work from home is in a way is moving the cart slowly. The biggest economies of the world are in danger. Every day the points in the biggest markets are falling to a level which is heart breaking. Some economist fears that falling of the economy would be the biggest danger of all time.

"Economy fall" is indeed a very dangerous phrase to say. The economy of a country lifts the people. Retrospecting those days when people used to go to work and students enjoyed their classes, they were probably good old days. The standstill country fears a crisis in spheres which they were proud of once. Economic fall would also imply that many workers will lose their job. This is something that no one would like to think in his wildest dreams. But then again what should we do? Work amidst this virus infection? I would say no. Because the economy is a thing or a piece of work that is made by mankind and if it falls mankind will again be together, work together and build it up. I feel nothing is more important than life. If we stay here, when the virus is gone we'll be able to build the economy once again. Yes, it would take years but we will. But if no one stays, who will be responsible for the economy?

Medical has always been man's best friend and at this time too, it is being the same. Hospitals and our frontline workers like Doctors and Nurses and all those medical staves are trying their level best to give good news. I salute all those people who've worked and are working for us day and night. You are our superheroes! The crisis in the medical sphere is also very obvious. The total number of people in our country is 135.26 crore where the number of hospitals is 19,817. Isn't it frightening? It is! The hospitals are in full condition to admit the patients in crisis times. That's why Lockdown is so important. If we all go out, the virus will spread out more, and thus like Italy at one point in time we will be short of beds. That scenario will be worst and no one wants that!

How will the world reinstate Normalcy as we face two pandemics Medical & Financial?

I feel in such a locked situation it is the nature who is enjoying it's long lost freedom. And why wouldn't it enjoy it? We have never thought of mother earth and have devastated her like anything. This is how she is pressing the refresh button to refresh itself and be that mother who never leaves her children. The birds and animals are living a life with less fear. They are not fearing of poaching, fearing of injecting, and fearing of us! It tickled me that last day, what if COVID 19 is the rescue team from another planet who has come to rescue its friend, The Earth and we are the viruses?

The crosshair of two pandemics is very crucial indeed. But mankind can do anything, so if we think we will fight it together; guess what? no one can stop us to do so. So let's pledge that we stay home at least for all those Police persons, Doctors, and Nurses who are working just for us. Let's pledge to work together! Let's pledge to help others. Let's pledge to be more humane!

I'm ending my article with this beautiful song by the greatest Michael Jackson,

Heal the world
Make it a better place
For you and for me
And the entire human race
There are people dying
If you care enough for the living
Make it a better place
For you and for me

Shreya Ganguly

CSE, 3rd YEAR

NITMAS

AUTONOMOUS SHIPS: FICTION OR REALITY?

Our World has already entered into the era of technical advancement,where AI takes control over your basics to the highest of requirements of daily life. Special reference to Elon Musk and his breakthrough self operating Tesla cars and almost any other robot-operated devices, people want their life to be less problematic and are eagerly waiting for more such inventions that could ease up their lifestyle. With such a tremendous revolution in the coding market, the shipping industry couldn't resist itself and already a module for self-propelling ships is ready and about to hit the floor in few years as claimed by the company. Does this also mean that sailors will lose their job and sit back at home?

A new kind of ship is taking to the seas and mariners are not sure what to make of it. Is it safe? How will it get along with other vessels in the vicinity? Will it shake up the maritime transportation business? What impact will it have on the seafaring profession? These are some of the main questions being asked about autonomous shipping.

For the time being, all we know is that ROLLS ROYCE has initiated a joint industry project in Finland called **Advanced Autonomous Waterborne Applications (AAWA)** and **YARA BIRKELAND** is expected to be the world's first fully autonomous container ship with zero-emission. As claimed by ROLLS ROYCE, the vessel was supposed to be touching waters in 2019 for trails and by 2020 to enter into the logistic market for full-scale operation. But since we are at the midway of 2021 and still there is no information regarding the further development of the project, the experts believe we won't be witnessing the rise of the automatic shipping industry by 2035. Well, this might be a relief for the mariners as they get to keep their jobs for the time being!

However, people must fully understand that the autonomous shipping industry comes with some pros and cons. According to the veteran mariner's way of looking at the pros and cons of the shipping industry as a whole, the cons of autonomous shipping at this time could outnumber the pros.

Looking at the pros of autonomous or smart ships or unmanned ships, they are expected to be safer, more efficient, and cheaper to run. According to the reports, 75% to 96% of marine accidents are a result of human error, often due to fatigue of the crew members. Remotely controlled ships are expected to reduce the risk of such human errors. Another advantage perceived by the developers is that they can be designed with a larger carrying capacity and lower wind resistance

AUTONOMOUS SHIPS: FICTION OR REALITY?

due to the accommodation of the crew. This will reduce fuel consumption, its operational cost and facilitate designs for more space for cargo. This scheme surely attracts a lot of marine corporations to invest in smart ships to cut down their expense, but looking on the other side of the coin they might change their mind.

It will not be roses, roses all the way for autonomous shipping. While every building block is in place to control smart ships, what could prove to be more challenging? To answer this we first must consider the regulatory board laws and legislation. We already know that to enforce a single law it takes a lot of time and might even take decades to pass, this is one of the huge challenges to face. Moreover the risk of cyber attacks and piracy will always be there in shipping. As regards to cyber-attacks, an autonomous ship is vulnerable to such attacks as any computerized system in a shore-based establishment is. All the computerized and network shipboard systems are potential targets for cyber attacks, which can lead to disastrous consequences. Moreover, without the presence of a single soul on the fleet, there can be a high risk of cargo loss and vessel damage during emergencies as shore-based systems cannot handle the on-going situations in the high seas and might lead to huge losses.

Considering all facts and claims autonomous ships with no crew onboard are a distinct possibility in the not too distant future. But to reach this destination a few more milestones need to be crossed in order to make autonomous shipping absolutely safe, secure, reliable, and legal.

Once the legendary poet of the 19th century John Masefield said:

"I MUST GO DOWN TO THE SEAS AGAIN,
TO THE LONELY SEA AND SKY
AND ALL I ASK IS A TALL SHIP, AND A
STAR TO STEER HER BY"

Now if autonomous ships become a reality and Josh Masefield was alive, he could see his tall ship turning into an autonomous ship and the satellites replacing his star!

Before ending, it is worth pondering over this point - If man himself is imperfect then can man-made devices be perfect?

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IMPACT OF LOCKDOWN-1 ON INDIAN RAILWAYS

"Be like a train; go in the rain, go in the sun, go in the storm, go in the dark tunnels! Be like a train; concentrate on your road and go with no hesitation!"

- Mehmet Murat ildan

The transportation and freight service is the backbone of every nation. It circulates the economy with the movement of workforce and material. The transport system circulates and broadens the reach of the market through the length and breadth of the country. In India, the railway network is owned by Ministry of Railways and all the activities have been carried out through them.To make a nation stand we need the basic formulation of transportation. Railways are the backbone of the transportation system of a country. It is also a pillar of the Indian Economy. The efficient transport system provides socio-economic opportunities. The use of the railway system is best understood for mass communications at a middle-range travels due to its availability and indistinctive time efficiency by connecting more platforms than airdromes. Also, for land-locked regions, it is the most essential medium for trade and increase the productivity of the country. Our country is having the largest railway connection in Asia, making thousands of people reach their destination daily needs a lot of effort to be made behind it. Having started its journey during the time of East India Company, Indian railways had made remarkable progress over the years. Importance of railways can be visualized by analyzing the data for the past few years. It is evident from analysis of data of few years that the number of passengers is increasing at a high rate and railways is also railways is also trying to give better passenger service by increasing the number of trains.

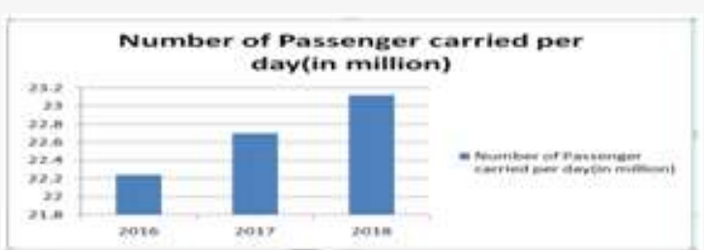

Figure 1: Representing daily no of passenger

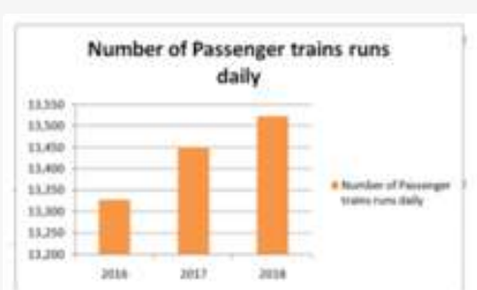

Figure 2: Representing daily no of passenger train

Also, the number of accidents is decreasing which means railways are becoming cautious which is evident from the Indian Government records. If we look at the financial condition, it is evident that the revenue is an increasing function i.e. with the increase in time, it is increasing which can be visualized from the figure 3 which is scaled and the Y-axis represent the revenue receipt (in trillion)

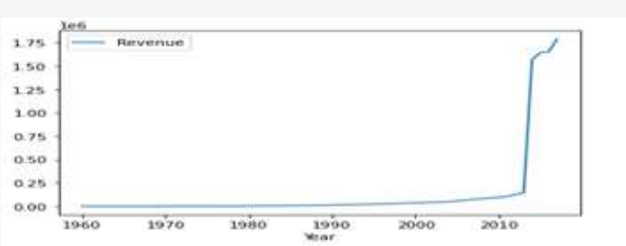

Figure 3: Increasing trend of revenue

From the reports and details it is evident that the lion's share of GDP is in the transport sector especially in the railway sector of India's and the change affects the total GDP. The different reports says that during the high growth of railways worldwide, per-capita income was increased 31% .From the reports and published papers of eminent research scholars ,it is proved that there is more than 15% improvement in the agricultural sector, another pillar of economy and the productivity of factory was also increased and the it brought a great revolution in the markets where well-connected local markets were set up instead of segmented market with high transportation cost. So it is obvious that the economic growth is directly proportional the railway development and its density network of the country.

IMPACT OF LOCKDOWN-1 ON INDIAN RAILWAYS

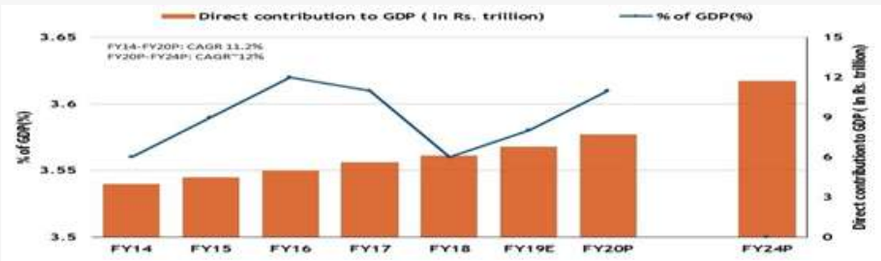

Figure 4: Percentage contribution of railway sector into GDP

Mainly the urbanization, industrialization, investment in public share promotes the growth of passenger as well as freight traffic and so Indian Govt is ready to invest a percentage of FDI to this sector. It is estimated that Indian railways will be accounting a high percentage of global share of the railway sector nearly 35% by the end 2040.

The current ongoing situation of Covid-19 have put a halt on the entire railway network of the India for a good long 7 months, which have crushed the established revenue model of the country. In the history of 167 years old Indian Railway that the trains were utterly empty and would not carry passengers all over the nation. "Never in the history, there has been such long interruption of services. Not during the World wars, not during the 1974 railway strike, or any other national calamity or natural disaster," a railway spokesperson said.

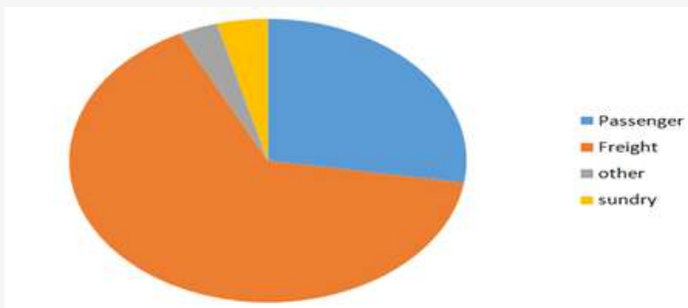

Figure 5: Main components on income of IR

The economic set back started as soon as the outbreak of corona virus took place in India as train ticket cancellations peaked causing losses even before the lockdown was knocked. Several services were cancelled and the occupancy rates grew very poor to avoid the spread of the novel corona virus. The Lockdown breaks the whole revenue model and multi-layered model has been broken. Almost 80% of the trains all over India were cancelled and as soon as the lockdown was announced the whole passenger transporting wing was stopped by the Indian Railway authority. With this suspension, a great logistical challenge to meet the massive demand in supply gaps emerged.

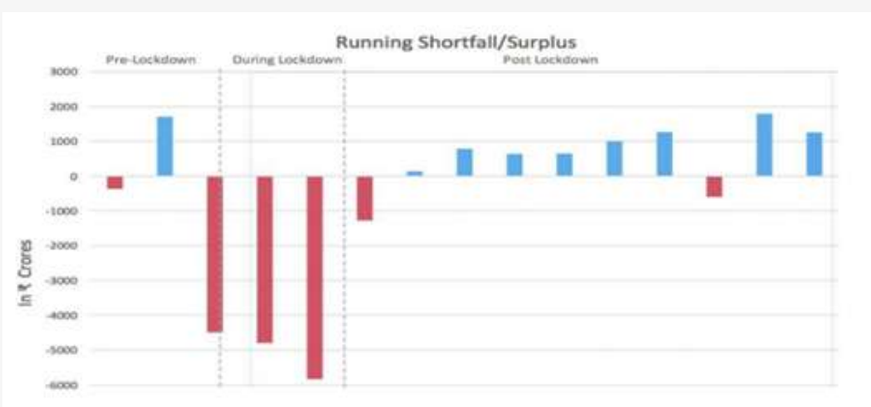

Figure 6: The economic set back of Indian Railways

In this pandemic situation, railways had taken several initiatives in welfare of mankind. From 25 March to 17 April, under the aegis of the Ministry of Railways, special parcel trains have been instrumental in transporting 5.2 million tonnes of food grains across the country. In addition, the supply of fuel stocks, medical equipment and supplies, Personal Protective Equipment (PPE) and general goods are being made available in cities and villages through the Indian Railways.

IMPACT OF LOCKDOWN-1 ON INDIAN RAILWAYS

Between 1 May 2020 and 26 June 2020, Indian Railways carried approximately 6.3 million migrants across the country on 4,594 Shramik trains. The trains were diverted dynamically by analyzing congestion on the routes due to increased freight movement. Also Indian Railways has deployed nearly 5,600 isolation coaches with more than 70,000 beds. With minor modifications to a conventional coach carried out at Indian Railways' coach factories, these coaches are being used to treat mild, non-intensive care patients and are being managed by sufficiently trained medical staff. These mobile hospital units have been a big help in treating patients in remote areas of the country where many hospitals are not available.

It is expected a loss of Rs 35,000-40,000 core. 40% of the share is hold by freight revenue. So the main target is to augment freight revenue. So at the current time of pandemic it is necessary to appraise passenger segment from different respect and so zero-base analysis is required and the re-modeling of the freight and the other sectors of the railways has to be done because the passenger sector also is one of the determinant in determination of cost function of freight traffic. Also IR has to increase their wages in the other sectors along with diversification of the capital and investing it in different freight services. So the increase in volume in this sector may increase the earnings of the Indian Railways.

Public response to the Indian Railway's exemplary work during the COVID-19 crisis has been extremely positive. Some social media users have hailed the Railways deeming their efforts, "systematic, organized and sensitive to public needs." In this manner, the Indian Railways had incurred a huge amount of loss and the revenue model is crushed but inspite of that innovated consistently to provide much-needed relief material during the Covid-19 crisis in India.

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HOW PROGRAMMING/CODING IS RELATED TO BIOTECHNOLOGY

INTRODUCTION

As artificial intelligence and computers are becoming an important part of our lives, having knowledge only about biology theory is not going to help out. Skills should be combined with experimental design and interpretation that also requires an understanding of the analytical approach. While academic knowledge can aid in the implementation, computational literacy seems non-replaceable.

WHEN PROGRAMMING (CODING) MEETS BIOLOGY:

Bioinformatics, as a new emerging discipline, combines mathematics, information science, and biology and helps answer biological questions. The word 'bioinformatics' was first used in 1968 and its definition was first given in 1978. Bioinformatics has also been referred to as 'computational biology'. However, strictly speaking, computational biology deals mainly with modeling of biological systems. The main components of bioinformatics are (1) the development of software tools and algorithms and (2) the analysis and interpretation of biological data by using a variety of software tools and particular algorithms.

WHAT IS BIOINFORMATICS?

Bioinformatics is the use of computers for the acquisition, management, and analysis of biological information. Bioinformatics is clearly a multi-disciplinary field including computer systems management networking, database design, computer programming, molecular biology

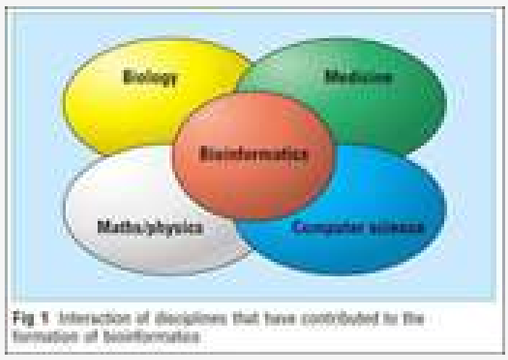


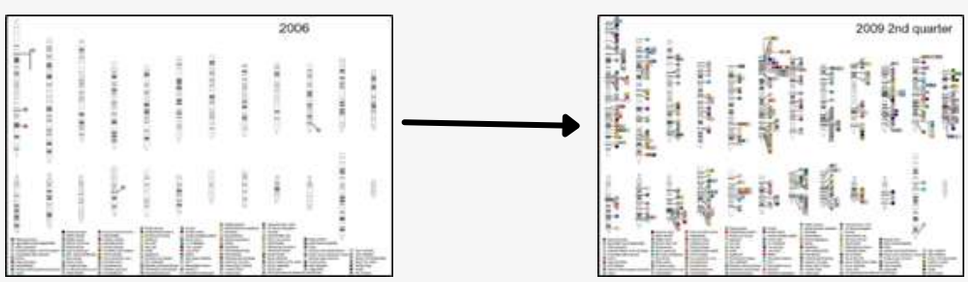
Fig 1 Interaction of disciplines that have contributed to the formation of bioinformatics

By definition: Bioinformatics can be defined as 'the application of computational tools to organize, analyze, understand, visualize and store information associated with biological macromolecules.

IS PROGRAMMING KNOWLEDGE NECESSARY FOR BIOINFORMATICS?

Biology is the study of living beings, starting from the interaction between species and population to the structural and functional organization of cells and tissues in an individual organism. Biologists collect and interpret huge amounts of data during a study. For example, we have vast volumes of DNA sequence data, but how do we understand which parts of that DNA control the various life processes? How do we determine the function of new proteins that we came across during a study? And how do we predict the structure of a protein, based on the available information of its sequence? Bioinformatics is a tool that helps us to answer these questions.

GENE MAPPING IS NOW MORE EASY AND LESS TIME CONSUMING BY USING OF PROGRAMMING LANGUAGE & AI BASED COMPUTATIONAL INTERFACE.



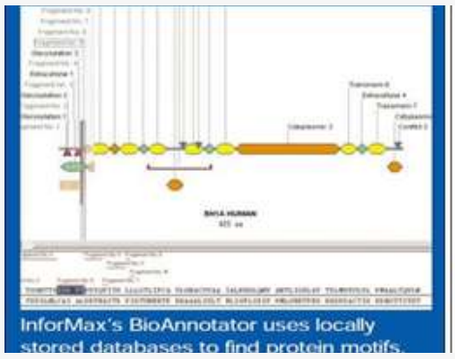
Evolution in Gene Mapping through Bioinformatics

HOW PROGRAMMING/CODING IS RELATED TO BIOTECHNOLOGY

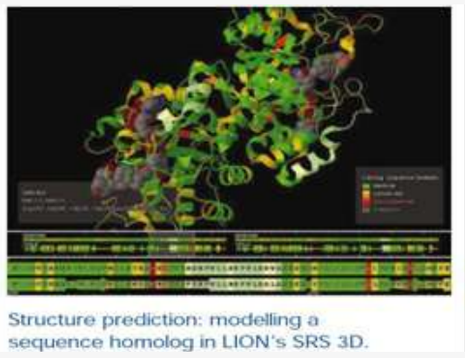
COMPUTER LANGUAGES NEEDED IN BIOINFORMATICS:

Proficiency in computer languages is important. We need to know basic programming languages like C++, Python, R, Java, PHP, and MySQL. Most bioinformatics programming utilizes PERL.

BIOINFORMATICS : TOOLS



InforMax's BioAnnotator uses locally stored databases to find protein motifs.



Structure prediction: modelling a sequence homolog in LION's SRS 3D.

HOW PROGRAMMING IS NOW HELPING US IN BIOTECHNOLOGY:

Experience with bioinformatics tools, such as Blast, BLAT, molecular modeling, drug design, sequence analysis algorithms, and clustering tools helps us to improve the way of workings. Experience in using bioinformatics resources, such as the UCSC genome browser and Entrez is very important and easy to operate Genomic Database. We'll need to be familiar with the National Center for Bioinformatics (NCBI) and the database and analysis tools available on their website.

GENOMIC DATA SCIENCE:

It is the field that applies data science and statistics to the genome. As we know, genomics produces large volumes of data and each human genome has 20,000-25,000 genes made up of 3 million base pairs. To analyze and understand data from upcoming generation segmenting experiments, the expertise of genetics is important to cover the concepts and tools.

CAREER OPPORTUNITIES:

Sequence Assembly: This involves the use of sophisticated computer-based methods to assemble the thousands of fragments that make up the genome of an organism.

Genomic Sequence Analysis: This involves mapping out the regions of a genome that code for a particular protein's production.

EMPLOYERS FOR BIOINFORMATICIANS:

The pharmaceutical industry tends to be the major employer of bioinformaticians, although biotech companies, especially those involved in personal care products, industrial organisms and agriculture have seen bioinformatics play a more important role in their industry.

CONCLUSION:

In general, we are well aware that the quest for unraveling the molecular processes of a disease to an extent that affords the effective development and selection of drug therapies is a great challenge. However, we are encouraged by promising recent developments that incremental progress will be made along this route and that important intermediate results will find their way into pharmaceutical and medical practice not only in the long term but also in the more immediate future.

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Todays pandemic world taught u what?

I will give my introduction at the end. U can say I am a teacher but I lack the quality of being a well wisher of pupils. Still I have taught u a lot of valuable things in yourlives .I made u forget what is war, what is terrorism, what is hate, selfishness, jealousy, self-centredness. I have taught u how to unite and work hand in hand. Due to me people of all castes , all religions, all states, all nations i.e entire world learnt what actually unityand harmony is.

I have taught u how to lead a peaceful happy joyful life with an urge of fulfilling only your needs and sacrificing your wants. I have made you learn how simplicity can be yourlife partner. Days after days, u have bought excessive daily food items and cooked too much quantity of food and you just have thrown it in dustbins for being unable to have it. Today I have taught u the pain of hunger and the value of your wasted food. You are having money in your pocket but not able to buy it due to shortage of food items in your locality. I have taught how to have a minimum square meal to sustain your livelihood.Hoping that you will not waste food in future. I have made you acknowledge that like outer world which is endowed with adorable and luxurious things, our inner world our home is equally filled with mystery, love, eye catchy memorable moments with our dear family members. This is going to be a golden incredible moment in the album of your life.

It didn't took 1 year for me to pacify the busy hustle and bustle of the world and to gift it with a tranquil mild relaxed serene world. I have made all Indians realise their fault of leaving their mother India, where they have brought up with lovable memories, and getting settled in abroad in search of better opportunities and better lifestyle. Now they are lamenting for their deeds and desire to come back in the lap of mother India. Hoping that you all will not repeat the mistake in future. I have made you feel the beauty of nature with clear pollution free air in the environment. As we see the birds flapping their wings and moving independently in air, we wish to live with same freedom stepping out in the outer world Just think what an inhumanity and pain u all gave to birds caught in cage for your own happiness and self-interest.

I have taught you to stretch your helping hands to the needy and poor unemployed people. Sonu Sood is a great example of it who have mostly played villain role in cinema but have become a real hero in life through his heavenly work for the welfare of people. I have made you recognise that doctors and nurses are real gods who have saved lakhs and lakhs of life selflessly inspite of knowing their life is at risk. The sacrifice of these humanly gods is

priceless. A great salute to police and others who have served mankind without thinking about their own lives. All teachers of our society have got connected to each of their students through online teaching mode and didn't step back from making a better educated world through their tedious diligent hard work. With all advanced mode of teaching, teachers have reached door to door of your homes seeing you all in video in your homes which was previously sub-centred to school only.

Todays pandemic world taught u what?

I have urged you to reminisce your traditional ethics of welcoming people by joining hands, keeping surroundings clean and tidy and more importantly becoming self-reliance self-dependent self-employed. I have made you realise that doing household activities on your own is not a matter of embarrassment. From celebrities to common people, everyone is carrying out their own household work in proper hygienic manner. I have enabled you to acknowledge the importance of oxygen . Someone correctly said people don't worth the free things at all. Your heinous act of felling down trees for a well organised urbanism resulted in oxygen insufficiency and thus the need of oxygen cylinder is emerging. I am helpless as my presence in your body results in oxygen deficiency and widely emerging of mine has contributed to scarcity of oxygen cylinder and hospital beds in the society.

How powerful I am , you have perceived that. Still you are ignoring the consequences of my habit and carrying out unwarily your deeds , carelessly going out in market. Crowd is the only fuel for me to grow big. Lock down, sanitizer, social distancing, masks, cap lead to reduction of my size. Face to face interaction without masks is also a cause of my inhibition.

People say I have born in WUHAN in CHINA. After my birth, I didn't take much time to rule the world and become a guest of your house. Today I am the biggest celeb in the news and internet in the world. I have been growing up at a faster rate. Netisians are completely engaged in my deeds all over the world. As I have born, I will die one day. But when my demise is going to happen is unknown to everyone. I have only one question--------

"What I have taught you,

Will you remember it for ever ..."

Yes your guess is correct I am CORONA VIRUS DISEASE whose nickname is COVID-19.

Shreya Kayal
CSE, 3rd YEAR
NITMAS

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POTENTIAL ROLE OF FRUIT COMPOUNDS TO PREVENT AND TREAT PARKINSON'S DISEASE:

Research Evidences have found that the compound **Farnesol**, found naturally in herbs, and berries and other fruits, prevents and reverses brain damage linked to Parkinson's disease in mouse studies.

WHAT IS (PD)?

Parkinson's disease (PD) is a neurodegenerative disorder that affects predominately dopamine-producing ("dopaminergic") neurons in a specific area of the brain called substantia nigra.

Symptoms generally develop slowly over years. The progression of symptoms is often a bit different from one person to another due to the diversity of the disease. People with PD may experience symptoms like:

·Tremor, mainly at rest and described as pill rolling tremor in hands. Other forms of tremor are possible

·Bradykinesia

·Limb rigidity

·Gait and balance problems

The cause remains largely unknown. Although there is **no cure**, treatment options vary and include medications and surgery. While Parkinson's itself is not fatal, disease complications can be serious.

Parkinson's disease (PD) affects 1-2 per 1000 of the population at any time. PD prevalence is i increasing with age and PD affects 1% of the population above 60 years.

In a review by de Lau and Breteler in 2006, it was reported that an estimated 10 million people in the world (i.e., approximately 0.3% of the world population) and 1% of those above 60 years are found to be affected with PD. There are very few population-based studies determining the exact incidence and prevalence of PD in India. But the knowledge about this disease has been present in India since ancient times. Though the prevalence of PD in India is less compared to other countries, the total burden of PD is much higher as a result of large population.

FARNESOL AS A BLESSING:

The compound, used in flavorings and perfume-making, can prevent the loss of neurons that produce dopamine in the brains of mice by deactivating PARIS, a key protein involved in the disease's progression. Loss of such neurons affects movement and cognition, leading to notable symptoms of Parkinson's disease such as Tremors, Muscle Rigidity, Confusion and Dementia. Farnesol's ability to block PARIS, say the researchers, could guide development of new Parkinson's disease interventions that specifically target this protein.

POTENTIAL ROLE OF FRUIT COMPOUNDS TO PREVENT AND TREAT PARKINSON'S DISEASE:

WHAT IS PARIS?

In the brains of people with Parkinson's disease, a buildup of (PARIS) Parkin-interacting Substrate slows down the manufacture of the protective protein PGC-1alpha. The protein shields brain cells from damaging reactive oxygen molecules that accumulate in the brain. Without **PGC-1alpha**, dopamine neurons die off, leading to the cognitive and physical changes associated with Parkinson's disease.

[Our experiments showed that Farnesol both significantly prevented the loss of dopamine neurons and reversed behavioral deficits in mice, indicating its promise as a potential drug treatment to prevent Parkinson's disease,"- says Ted Dawson, M.D., Ph.D., director of the Johns Hopkins Institute for Cell Engineering and professor of neurology at the Johns Hopkins University School of Medicine.]

EXPERIMENT

The researchers fed mice either a farnesol-supplemented diet and a regular mouse with normal diet for one week. Then, the researchers administered pre-formed fibrils of the protein alpha-synuclein, which is associated with the effects of Parkinson's disease in the brain.

OBSERVATION

The researchers found that the mice fed with the farnesol diet performed better on a strength and coordination test designed to detect advancement of Parkinson's disease symptoms. On average, the mice performed 100% better than mice injected with alpha-synuclein, but fed with a regular diet.When the researchers later studied brain tissue of mice in the two groups, they found that the mice fed a farnesol-supplemented diet had twice as many healthy dopamine neurons than mice not fed the farnesol-enriched diet. The farnesol-fed mice also had approximately 55% more of the protective protein PGC-1alpha in their brains than the untreated mice.

RESULTS

In chemical experiments, the researchers confirmed that farnesol binds to PARIS, changing the protein's shape so that it can no longer interfere with PGC-1alpha production.

INFERENCE:

While farnesol is naturally produced, synthetic versions are used in commerce, and the amounts people get through diet is unclear. The researchers caution that safe doses of Farnesol for humans have not yet been determined, and that only carefully controlled clinical trials can do so.

POTENTIAL ROLE OF FRUIT COMPOUNDS TO PREVENT AND TREAT PARKINSON'S DISEASE:

Though more research is needed, Dawson and his team hope farnesol can someday be used to create treatments that prevent or reverse brain damage caused by Parkinson's disease.

Date: July 29, 2021

Source: Johns Hopkins Medicine

Collected from: *https://www.sciencedaily.com/*

ORIGINAL JOURNAL REFERENCE

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DOI: 10.1126/scitranslmed.aax8891

LINK: https://stm.sciencemag.org/content/13/604/eaax8891

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INDIA TO LAUNCH DEEP OCEAN MISSION

DEEP OCEAN MISSION

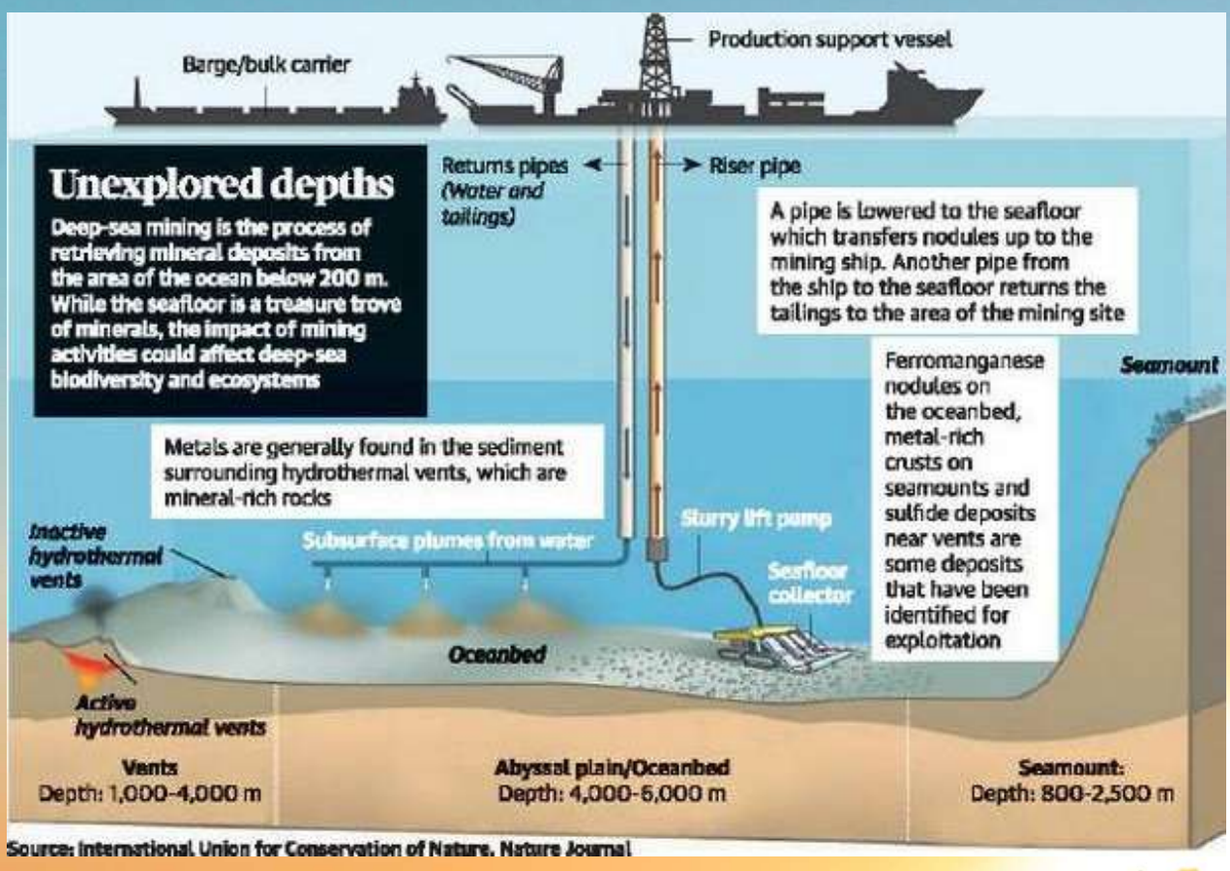
- Deep Sea Mining through 'Underwater Vehicles' and 'Underwater Robotics'
- Asserting exclusive rights to explore polymetallic nodules from seabed **over 75,000 sq km of areas in international water**
- Estimated polymetallic nodules resource potential: **380 million tonnes (MT)**

THESE POLYMETALLIC NODULES CONTAIN

Manganese	92.6 MT
Nickel	4.7
Copper	4.3
Cobalt	1

(*figures are rounded off)

- Development of ocean climate change advisory services
- Technology for sustainable utilisation of marine bio-resources
- Deep ocean survey and exploration
- Energy from the ocean and offshore-based desalination
- Krill fishery from southern ocean

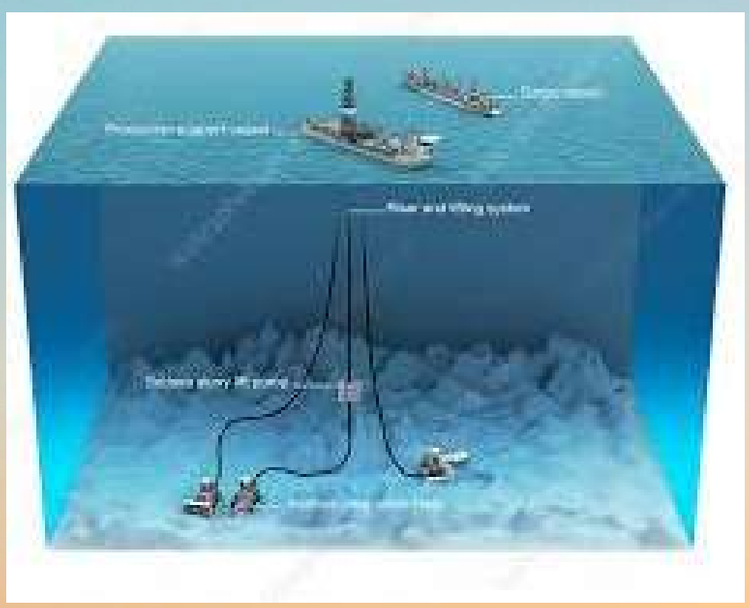


Source: International Union for Conservation of Nature, Nature Journal

INDIA TO LAUNCH DEEP OCEAN MISSION

Deep Ocean Mission (DOM)

- Nodal Agency: Ministry of Earth Sciences (MoES)
- The mission proposes to explore the deep ocean similar to the space exploration started by ISRO.
- Underwater robotics and 'manned' submersibles are key components of the Mission which will help India harness various living and non-living (water, mineral and energy) resources from the seabed and deep water.
- The tasks that will be undertaken over this period include deep-sea mining, survey, energy exploration and the offshore-based desalination.
- These technological developments are funded under an umbrella scheme of the government – called Ocean Services, Technology, Observations, Resources Modelling and Science (O-SMART)



A) FIVE major components

1) Development of Technologies for Deep Sea Mining, and Manned Submersible:

- A manned submersible will be developed to carry three people to a depth of 6000 metres in the ocean with suite of scientific sensors and tools.
- Only a very few countries have acquired this capability.
- An Integrated Mining System will be also developed for mining Polymetallic Nodules from 6000 m depth in the central Indian Ocean.

(2) Development of Ocean Climate Change Advisory Services:

- A suite of observations and models will be developed to understand and provide future projections of important climate variables on seasonal to decadal time scales under this proof of concept component.
- This component will support the Blue Economy priority area of coastal tourism

INDIA TO LAUNCH DEEP OCEAN MISSION

(3) Technological innovations for exploration and conservation of deep-sea biodiversity:

- Bio-prospecting of deep-sea flora and fauna including microbes and studies on sustainable utilization of deep-sea bio-resources will be the main focus.
- This component will support the Blue Economy priority area of Marine Fisheries and allied services.

(4) Deep Ocean Survey and Exploration:

- The primary objective of this component is to explore and identify potential sites of multi-metal Hydrothermal Sulphides mineralization along the Indian Ocean mid-oceanic ridges.
- This component will additionally support the Blue Economy priority area of deep-sea exploration of ocean resources.

(5) Energy and freshwater from the Ocean:

- Studies and detailed engineering design for offshore Ocean Thermal Energy Conversion (OTEC) powered desalination plant are envisaged in this proof of concept proposal.
- This component will support the Blue Economy priority area of offshore energy development.

Why need such a mission?

- Oceans, which cover 70 per cent of the globe, remain a key part of our life. About 95 percent of the Deep Ocean remains unexplored.
- For India, with its three sides surrounded by the oceans and around 30 per cent of the country's population living in coastal areas.
- The ocean is a major economic factor supporting fisheries and aquaculture, tourism, livelihoods and blue trade.
- Oceans are also a storehouse of food, energy, minerals, medicines, modulator of weather and climate and underpin life on Earth.

Pre-requisites to this mission

India has been allotted a site of 75,000 square kilometres in the Central Indian Ocean Basin (CIOB) by the UN International Sea Bed Authority for the exploitation of polymetallic nodules (PMN).

Hunt for PMNs

- These are rocks scattered on the seabed containing iron, manganese, nickel and cobalt.
- Being able to lay hands on a fraction of that reserve can meet the energy requirement of India for the next 100 years.
- It has been estimated that 380 million metric tonnes of polymetallic nodules are available at the bottom of the seas in the Central Indian Ocean.
- India's Exclusive Economic Zone spreads over 2.2 million square kilometers.

Rabi paik

MRE, 3rd YEAR

SOMS

GENOME EDITING

Genome editing is the technology which gives the scientists the ability to **alter the DNA** of an organism. By these technologies genetic material can be added, removed or replaced at particular location in the genome. Several Genome editing approaches have been developed. The most recent one is **CRISPR-Cas9**.

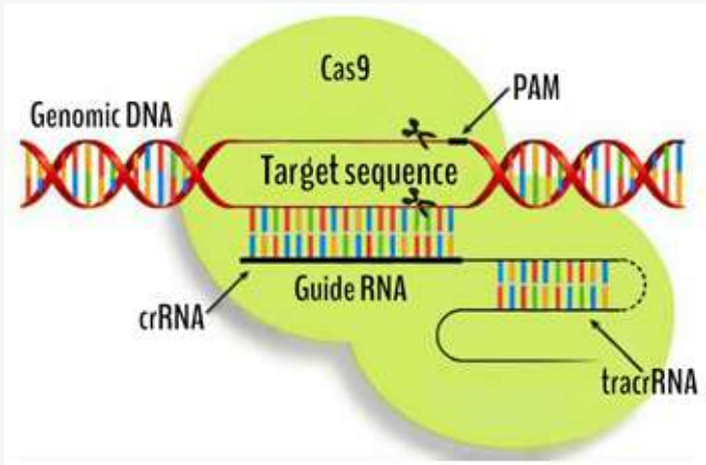
CRISPR-Cas9

Developing an efficient and reliable way to make precise, targeted changes in the genome of any living cells have been a long-standing goal for the biomedical researchers. The discovery of **CRISPR-Cas9** system has paved a huge achievement. **CRISPR-Cas9** is a method of genome editing in which genetic materials can be added, deleted or changed. This system mainly consists of two molecules which are the factors of transformation in DNA. This tool is used by scientists to cut DNA in specific locations.

Cas9 is an enzyme used in this method, which acts as a molecular scissors. It cuts the strand of the DNA from a specific location in the genome to convert the desired DNA.

The function of guide RNA is also important in this technique with **Cas9**. It is a part of the RNA sequence whose function is to find and bind to a specific sequence of DNA. The guide RNA contains an RNA base that complements the targeted DNA sequence of the genome.

The CRISPR-Cas9 system is based on an antiviral defence mechanism in bacteria in which the Cas9 enzyme recognizes the viral DNA sequences of previous infections and cuts up invading DNA during re-infection. Researchers have engineered the



CRISPR-Cas9 system to not only locate and cut specific sequences of DNA, but to also turn on or off the expression of targeted genes without making permanent changes to the DNA coding sequence.

While this **CRISPR-Cas9** repressor technique has emerged as a robust tool for disrupting gene regulation in cell culture models, it had not yet been adapted for delivery to adult animals for applications such as gene therapy.

C - Clustered
R - regulatory
I - interspaced
S - short
P - palindromic
R - repeats

Applications of CRISPR-Cas9

There are several successful applications of CRISPR-Cas9 in today's world, such as

1. Regulation of Endogenous gene expression
2. Epigenome editing
3. Live-cell labelling of chromosomal loci
4. Edition of single-stranded RNA
5. High-throughput gene screening

GENOME EDITING

Some recent works with CRISPR-Cas9

∅ CRISPR-Cas9 for preventing Fuchs' corneal dystrophy in mice.

In recent study, researchers at the University of Oregon's Phil and Penny Knight Campus for Accelerating Scientific Impact used start codon disruption with **CRISPR-Cas9** gene editing to prevent Fuchs' corneal dystrophy in mice. It is the first demonstrated use of the technique, called start codon disruption, to treat a genetic disorder in post-mitotic tissue, and has potential to revolutionize treatment of Fuchs' dystrophy by replacing the need for corneal transplant. It could also lead to new treatments for other genetic diseases, even disorders affecting non-reproducing cells. The paper details the results of an 8-year study that addresses a disease affecting roughly one in 2,000 people globally. Fuchs' corneal dystrophy causes corneal endothelial cells to die off, causing swelling that can lead to decreased vision, pain, visual impairment and blindness.

Researchers sought to test whether knockdown of the protein could offer a new therapeutic strategy for the disease. They turned to CRISPR-Cas9 gene editing to target the pathogenic protein in adult mutant mice but faced the challenge of using the technology on post-mitotic cells.

Ø CRISPR enzymes as covid-diagnostic

A research team led by scientists in the labs of Jennifer Doudna, David Savage and Patrick Hsu at the University of California, Berkeley, is aiming to develop a diagnostic test that is much faster and easier to deploy than qRT-PCR. It has now combined two different types of CRISPR enzymes to create an assay that can detect small amounts of viral RNA in less than an hour. Doudna shared the 2020 Nobel Prize in Chemistry for invention of CRISPR-Cas9 genome editing.

While the new technique is not yet at the stage where it rivals the sensitivity of qRT-PCR, which can detect just a few copies of the virus per microliter of liquid, it is already able to pick up levels of viral RNA —about 30 copies per microliter—sufficient to be used to surveil the population and limit the spread of infections.

Prime Editing

A newer version of the CRISPR-Cas9 technique has been developed known as 'Prime Editing'. CRISPR-Cas9 cuts the daily before correcting it. Although this corrects the mutated piece of DNA, it also leaves behind a damage in other regions of the same genome. Whereas, the Prime Editing can be in a new piece of DNA without causing damage elsewhere in the DNA. Hence, it is considered safer than the CRISPR-Cas9 technique.

Reference

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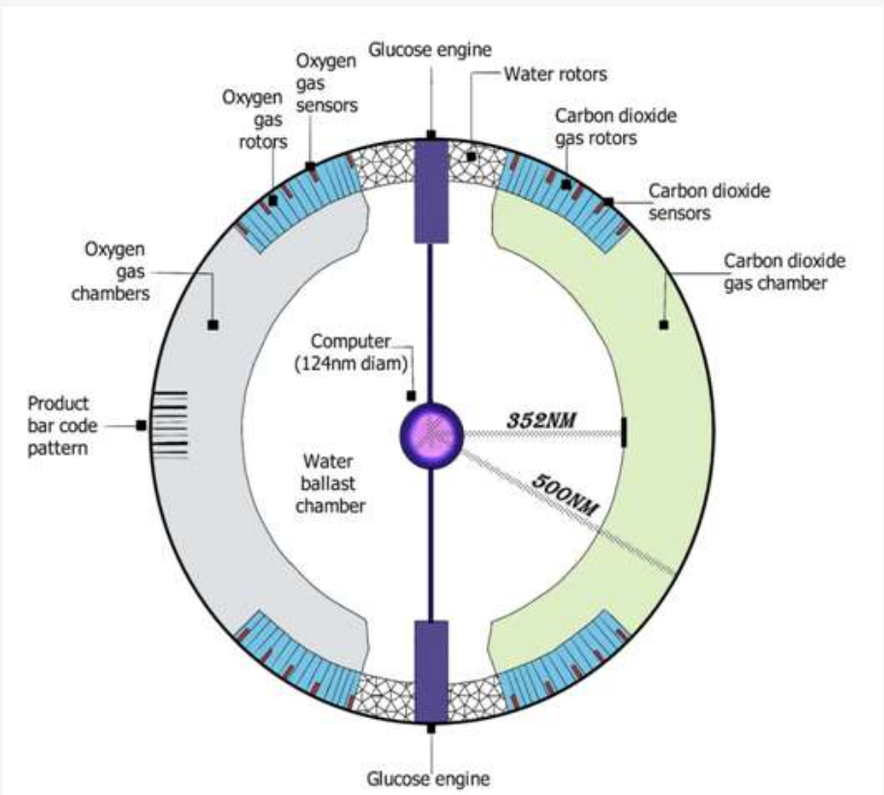
USE OF NANOTECHNOLOGY FOR SYNTHESIS OF SYNTHETIC ERYTHROCYTES (RBC) OR ARTIFICIAL RESPIROCYTES

We all have a brief idea about the wonders that biology and technology together can bring forth. Therefore nanotechnology is defined as the ***fabrication of devices with precision to the scale of 1 to 100 nm***. This scale yields perfection or precision on the molecular or even at the atomic level. Its reference can also be traced to "***molecular manufacturing***".

Nanotechnology has potentially limitless or infinite number of applications in a wide range of fields such as ***physics, biology, engineering, biochemistry, chemistry, computer science and in our proposed case this shows a beautiful wonder due to the association of biology with technology or biotechnology can bring forth***. Now we come to the concept of ***Respirocytes***.



Artificial respirocyte(Synthetic RBC)
[Diagrammatic representation and inner working components]

[Parichaya Chowdhury ; BSc Hons Biotechnology, 3rd sem]

- A synthetic RBC is called a "respirocyte".
- It is actually a bioengineered, blood borne, spherical, 1micron diamondoid 1000 ATM pressure vessel.
- This is controlled by a chief nanocomputed core and numerous chemical and pressure sensors which is remotely programmed by a medical professional or a physician via externally applied acoustic signals.
- With active pumping , powered by endogenous serum glucose, these respirocytes are able to deliver 236 times more oxygen to the tissues and cells of the body per unit volume than natural RBC and to manage carbonic acidity.

USE OF NANOTECHNOLOGY FOR SYNTHESIS OF SYNTHETIC ERYTHROCYTES (RBC) OR ARTIFICIAL RESPIROCYTES

- There are 3 major storage tanks – 1 for oxygen, another for carbon dioxide and a 3rd ballast tank for water.
- ·An onboard chemo mechanical turbine or fuel cell generates power by combining glucose drawn from the bloodstream and oxygen drawn from internal storage.
- ·This is converted to mechanical power which drives molecular sorting rotors and other subsystems such as in bacterial flagella.
- ·Its complex structure has power plants, each of which develops 0.3 pico watts of power, which is enough to fill the oxygen storage tank from empty in just 10 seconds at a pumping rate of 100 million molecules per second.
- ·The average male human body has 28.5 trillion rvc each containing 270 million haemoglobin molecules binding four oxygen molecules per haemoglobin. However, since haemoglobin normally operates between 95% saturation (arterial) and 70% saturation (venous), only 25% of stored oxygen is accessible to the tissues.
- ·Now each respirocyte stores up to 1.51 billion oxygen molecules, 100% of which are accessible to the tissues.
- · And roughly we have to deploy 5.36 trillion devices to fully duplicate human blood capacity.
- ·One litre of 50% respirocyte suspension, which puts 954 trillion devices Into our blood stream. This sums up as, we could then hold our breath for 3.8 hours, at the normal resting metabolic rate.

Respirocytes can provide for a temporary replacement for natural RBC in the case of an emergency and can also act as an alternate source to natural oxygen supply.

So to conclude we can say that,

Respirocytes can bring about radical changes an improvement in the field of biotechnology. Respirocytes are a potential alternative or even a permanent solution to symptomatic treatment for anaemia. Respirocytes can deliver oxygen to muscle tissues faster than lungs.

In other words, respirocytes have the potential to radically improve the metabolism in human beings and have a great possibility in changing our lives in the near future. It has numerous applications in the field of medicine and can radically improve the state of curing chronic blood related disorders and can drastically improve the metabolism and in turn amp up or boost up the total bodily capacity of a human being. In other words **RESPIROCYTES HAVE THE PROSPECT OF POTENTIALLY CHANGING THE FACE OF THE FUTURE AND CAN DEFINITELY BRING ABOUT A NEW ERA IN THE FIELD OF MEDICINE AND BIOTECHNOLOGY.**

Reference

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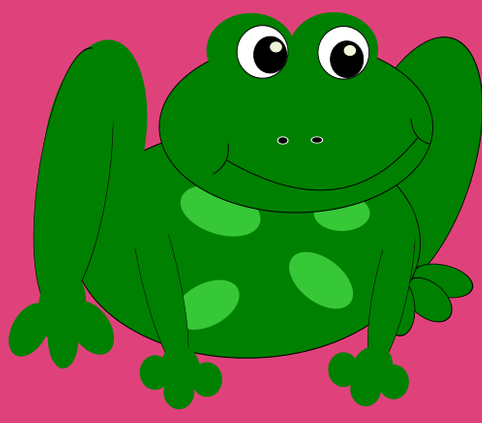


FUN PAGES

BBQ Chemistry!!!

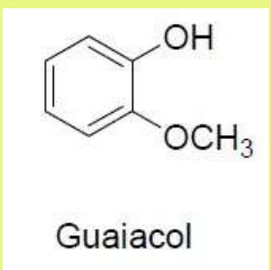
Barbecue or *Barbeque* or *BBQ* *is the mouth watering term for every food lover. Though there are various methods available for the preparation of delicious barbecued foods, but the amazing taste is only due to formation of some basic chemical compounds. Let's try to find reasons behind Smoky smell, taste and flavor ...*

Burning of charcoals produce Phenolic compounds:

Syringol

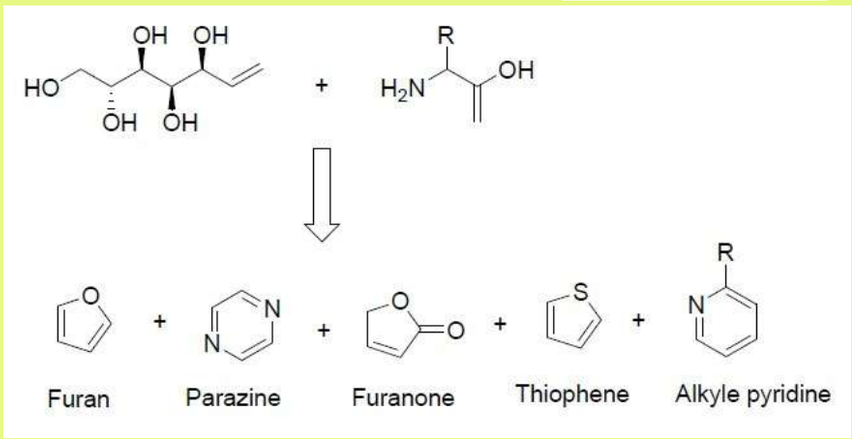
Syringol: Responsible for smoky smell.

Guaiacol: Responsible for smoky taste



Guaiacol

The delicious flavor of Barbeque is due to Millard Reaction. Here the amino acids and reducing sugars that are present inside the meat or fish are turned brown in colour and gave a brownish shade to the barbecued food and presented a distinctive flavor. The compounds which are generally responsible for this flavor are:



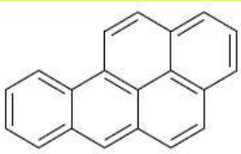
Furan Parazine Furanone Thiophene Alkyle pyridine

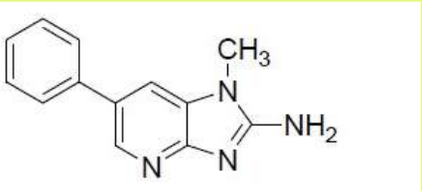
These compounds may be different depending on the characteristics of materials used and its pH.

Caution

Sometimes, few black parts are found due to over burning, it creates other carcinogenic compound **Heterocyclic amines (HCAs)**. In recent scientific research, it has been reported that formation of these carcinogenic compounds are less if meats marinate with beer.

If the meat or chicken pieces are fatty, then fats melt due to heat and directly fall into hot charcoals. This produces different **Polyaromatic hydrocarbons (PAHs)**, in which **Benzopyrine** is carcinogenic.

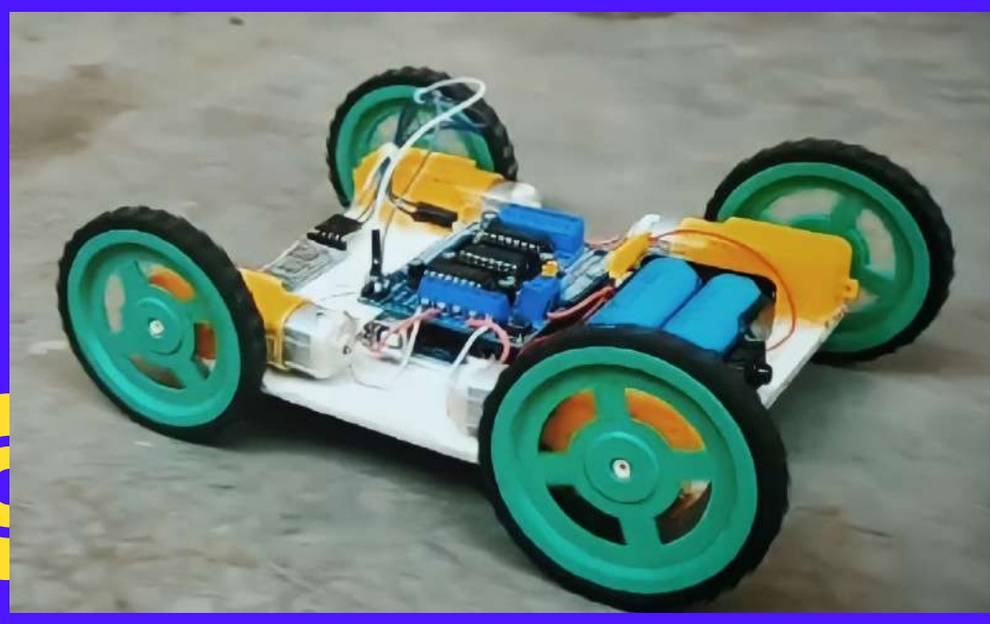

Polyaromatic Hydrocarbons (PAHs)



Heterocyclic Amine (HCA)

Dr. Abhijit Samanta, School of Science & Technology

Bluetooth Control Arduino Car



In this project I made a Wireless Bluetooth Controlled Robot Car Using Arduino. The robotic car can be controlled wirelessly via a Smartphone. The Smartphone has an Android app through which the user can send commands directly to Robot. The robot can move forward, backward, left, and right and can also be stopped. The Arduino's Bluetooth-controlled robotcar is interfaced with a Bluetooth module HC-05. We can give specific voice commands to the robot through an Android app installed on the phone. At the receiving side, a Bluetooth transceiver module receives the commands and forwards them to the Arduino, and thus the robotic car is controlled.

I used in this car one Arduino UNO, HC-05 Bluetooth Module, L293D motor driver, 4 pies 5V DC motors, 2 pies 3.7V battery, 4 pies while and some jumper wires for connection. The Arduino is an open source device that hasbeen the brain for numerous projects. With the combination of Arduino and Bluetooth shield we can control over many other things. It was such a great experience for me and especially I want to thank The Neotia University for stick out the technology source of my mind.

Joy Basak, 2nd Year
Robotics and Automation Engineering

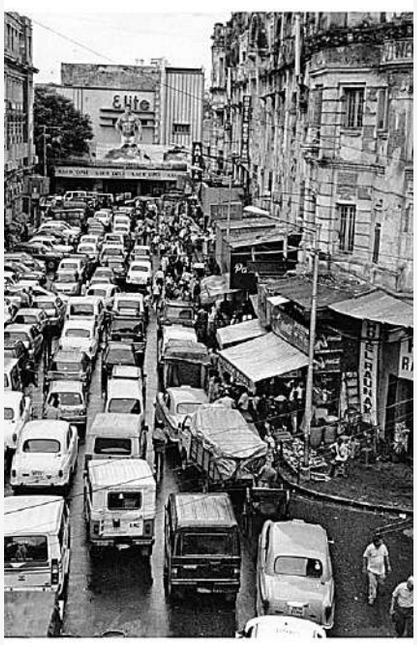
DRAWING

KUNTAL DHENKI
E.E 4TH YEAR 7TH SEM

SUBHAM JANA
E.E 3RD YEAR 5TH SEM

KUNTAL DHENKI
E.E 4TH YEAR 7TH SEM

SUBHAM JANA
E.E 3RD YEAR 5TH SEM



মা – এর জাত

রজত চ্যাটার্জ্জী

অ্যাসিস্ট্যান্ট প্রফেসর, মেকানিক্যাল ইঞ্জিনিয়ারিং

মাছের বড় পিসটা প্রায়ই সুবীরের পাতে পড়ে। মানে নেতাই, সুবীরদের মেসের রাঁধুনি, সুবীরকে একটু অন্য চোখে দেখে। কোলকাতায় হাজরা রোডের মেস বাড়িতে সুবীর ছাড়া আরও পাঁচজন থাকে। আতীন ছাড়া বাকি সবাই চাকরীজীবী। আর মেসের মালিক কৌশিক ব্যানার্জ্জী। পরিবার নিয়ে উপরতলাতেই থাকেন। খুব সাত্ত্বিক মানুষ। পুজো আচ্ছার কোনও কামাই নেই। এহেন বাড়িতে যখন আগের রান্নার লোক মাইনে নিয়েই সরে পড়েছিলো তখন সবার মাথায় আকাশ ভেঙে পড়ে ছিলো। তখন হটাৎ করেই নেতাই অর্থাৎ নিতাই রায় সামনে এসে দাঁড়ালো। সে কাজ খুঁজছে। কৌশিক বাবু প্রথমে রাজী হননি। ব্রাহ্মণ ছাড়া তিনি লোক রাখবেন না। শেষে নিতাই তার পৈতে দেখিয়ে যখন বলল যে সেও ব্রাহ্মণের ছেলে তখনও কৌশিক বাবু না না করতে লাগলেন। রায় আবার কিরকম ব্রাহ্মণ? তখন সুবীর এসে বলল তারাও রায় এবং তারাও ব্রাহ্মণ। তখন সুবীরই জোরাজুরি করে নেতাই কে রাখল। সেই থেকে নেতাই সুবীরের কাছে কৃতজ্ঞ। লেখাপড়া শেখেনি। পাথর প্রতিমায় গ্রামে বাড়ি। মাঠে ঘাটে কাজ করে আর সংসার চলেনা। একটা ছেলে, বউ ও মা নিয়ে তার সংসার। ছেলেটাকে লেখাপড়া শেখাতে চায়। তাই চাকরীর আসায় কোলকাতায় আসা। সুবীরের আর একটা কাজ ছিল প্রতিমাসে নেতাই এর বাড়ী থেকে চিঠি আসলে সেগুলো নেতাই কে পড়ে শোনানো এবং তার এক দুলাইনে উত্তর লিখে দেওয়া। চিঠি গুলো ওর বউ লিখত। প্রতি চিঠিতে এক অশিক্ষিত, দরিদ্র গ্রামের বধূ তার স্বামীর জন্য দুশ্চিন্তার প্রতিটা লাইনে ধরা থাকতো। তা অবিবাহিত সুবির কে নাড়া দিত। অথচ এই বিয়ে নিয়েই মায়ের সঙ্গে ঝগড়া। সে কথা মনে পরতেই এবার দিন তিনেকের ছুটি নিয়ে বাড়ি গেছিলো সুবীর। ফিরে এসে দেখে নেতাই তার পুঁটলি নিয়ে বাইরে বসে আছে। চোখে জল। কাঁদছে বোঝা যাচ্ছে। সুবীর কাছে আসতেই কান্নায় ভেঙে পড়লো নেতাই। সুবীর জিজ্ঞেস করতে বলে, “বাবু জবাব দিয়েছেন”। সুবীর কেন’র উত্তর খুঁজতে ভিতরে যেতেই কৌশিক বাবু যেন ঝাঁপিয়ে পড়লেন সুবীরের উপর। সবাই চুপ। নেতাই নাকি তার পরিচয় লুকিয়ে চাকরী করছে, সে নাকি মুসলমানের ছেলে। সুবীর কিছু বলার আগেই কৌশিকবাবু একটা পোস্টকার্ড সুবীরের হাতে ধরিয়ে দিলো। বাড়ির সব কুশল লিখে চিঠি। তার বউয়ের সবজী কাটতে গিয়ে আঙ্গুলে কেটেছে বলে তার মা চিঠি লিখেছে। শেষ লাইনে এসে চোখটা আটকে গেলো সুবীরের। “আল্লা তোমাকে ভালো রাখুন”। কৌসিক বাবুর চিৎকার। “পৈতে পড়ে বামুন হয়েছে মুসলমানের পো”। সুবীর কি করবে কিছু বুঝতে পারলো না। অসীম কে জিজ্ঞেস করলো, নেতাই কে এই ব্যাপারে কিছু জিজ্ঞাসা করা হয়েছিলো কিনা। অসীমও ঝাঁজিয়ে উঠলো, “এটা আর জিজ্ঞাসা করার কি আছে। চিঠিতে তো স্পষ্ট। এখন মনে হচ্ছে, তুইও জানতিস আগে থেকে”। সুবীর বলল, “না। কারন এতদিন ওর বৌ চিঠি লিখত। এই প্রথম ওর মায়ের চিঠি পেলাম”। সুবীর আরও বলল, “তাও, ওকে একবার বলবার সুযোগ দেওয়া হোক”। কৌশিক বাবু তাকে ঘরের ভিতর ঢুকতে দিতে নারাজ। তাই সিধান্ত হল সবাই বাইরে যাবে। সুবীর আগে বেড়িয়ে গেলো, পেছনে সবাই। বাইরের ঘরে নেতাই কে ডাকল সুবীর। চিঠি দেখিয়ে বলল, “তুই কি মুসলমান”? নিতাই মাথা নাড়ল। “না”। কৌশিক বাবু গর্জন করে উঠলেন, “আবার মিথ্যা কথা। মা মুসলমান আর ছেলে হিন্দু ব্রাহ্মণ”? সুবীর নিতাইএর কাঁধে হাত রেখে বলল, আসল ব্যাপারটা কি বুঝিয়ে বলতে। তারা কিছু বুঝতে পারছে না। নেতাই তারপর কাঁদতে কাঁদতে যা বলল তা হল, আয়লায় নেতাই এর ঘরদোর যখন ভেসে গেছিলো তখন তার সাথে ওর বাবা মাও ভেসে গেছিলো, সেই সময় এই ভাসমান নেতাইকে উদ্ধার করেছিলো ওই পাশের পাড়ার রাবেয়া আম্মি। ছোটবেলা থেকেই ওই নামেই ডাকতে শিখেছিল নেতাই। তারও একমাত্র মেয়ে রুবীনাও ভেসে গেছিলো আয়লায়। তখন নেতাই এর বয়স কত হবে, চার কি পাঁচ। সেই রাবেয়া আম্মিই নেতাই কে বুকে টেনে নিয়েছিলো। তাকে ভেসে যেতে দেয়নি। এতটুকু থেকে এতবড় করেছে। তার বিয়ে দিয়েছে। কিন্তু তার পৈতৃক পরিচয়টুকুও যত্ন করে রেখে দিয়েছিলো ওই আম্মি। বিয়ে দিয়েছিলো গ্রামের মেয়ে লক্ষীর সাথে, হিন্দু। শেষে নেতাই কাঁদতে কাঁদতে বলল, “বাবু, ‘মা’ তো ‘মা’ ই হয়। তার জাত কি কোনোদিন জানতে আছে বাবু? না জানাতে আছে। তাদের মুখে দুটো অন্য তুলে দেওয়ার জন্যই তো এত দূর আসা। না হলে একা আমার কি দরকার ছিল বলুন তো দাদাবাবুরা। মা’র বয়স হয়েছে। এখন আমি কি করি বলুন। মুসলমান বলে আমার মা টা কে আমি ভাসিয়ে দেবো। তাহলে তো কোনও ধর্মই আমার থাকবে না বাবু। আমি তো একটা অমানুষ হয়ে যাবো। আর বাবু, মা কে তো মা বলে জানি। মায়ের কি কোনও আলাদা ধর্ম হয় বাবু? আমি জানিনা, আপনারাই বলুন”।

কারোর মুখে আর কথা নেই। সুবীরের চোখ ছলছল করে উঠলো। সেও তো মায়ের সঙ্গে ঝগড়া করে থাকতে পাড়েনি। দৌড়ে চলে গেছিলো সে। এবার সবার দিকে তাকাল উত্তরের আশায়। সবাই চুপ। কৌশিক বাবুর চোখে জল। এগিয়ে এসে সেই নেতাই কে বুকে জড়িয়ে ধরলেন। বললেন, “তুই ঠিক বলেছিস নেতাই, ‘মা’, ‘মা’ই হয়। আমরই ভুল। মায়ের জাত খুঁজতে গেছিলাম, আচ্ছা শিক্ষা দিলি তুই। আয় আয়। তোর হাতে খেয়েই আমি পরপারের কড়ি গুনবো আজ থেকে”।

SOCIAL MEDIA'S IMPACT ON MENTAL HEALTH DURING COVID 19

Introduction

- Human civilizations have experienced various severe health problems because of climate change which unfavourably affected health and human wellbeing in different societies worldwide.This COVID-19affected almost every country. The WHO declared the COVID-19 pandemic as the "International Concern" on January 30 ,2020. Based on the statistical facts, the mortality rate among patients with infectious disease (SARS-CoV-2) ranges between 2% to 3% worldwide and this infectious disease (COVID-19) remains an abnormally transmitted chronic disease globally.
- According to Health experts, sitting is as dangerous as smoking. Sitting all day is one of the worst things for our health. And covid 19 outbreak forced us to stay at home.With lockdowns imposed, many children and young people are spending all their time at home. Most of them may be online on social media, and often they will spend more time online than usual.

Lives of young people in the physical world get affected through social media. Young people will encounter bad behaviour be it directed at them or at someone or something else. How they respond to bad behaviour is an opportunity for them to learn important life skills.

The Pew Research study determines that one in six teenagers have experienced at least one of six different forms of abusive behaviour online like:

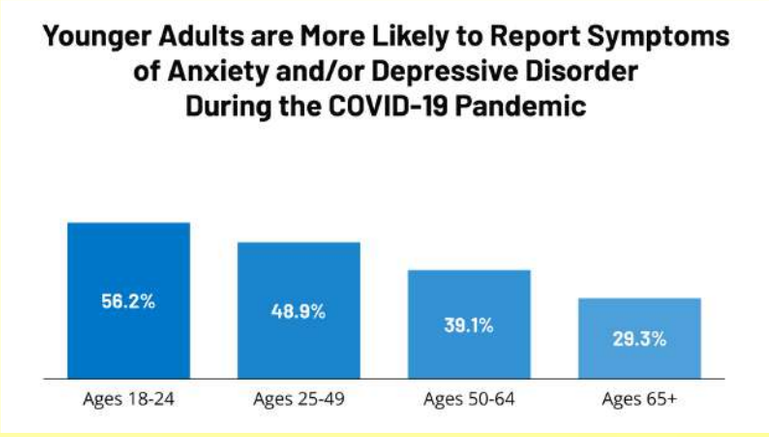
- Name-calling
- Spreading false rumours
- Receiving unsolicited explicit images
- Having their activities tracked by someone unknown
- Someone making physical threats
- Sharing explicit images of them without their permission

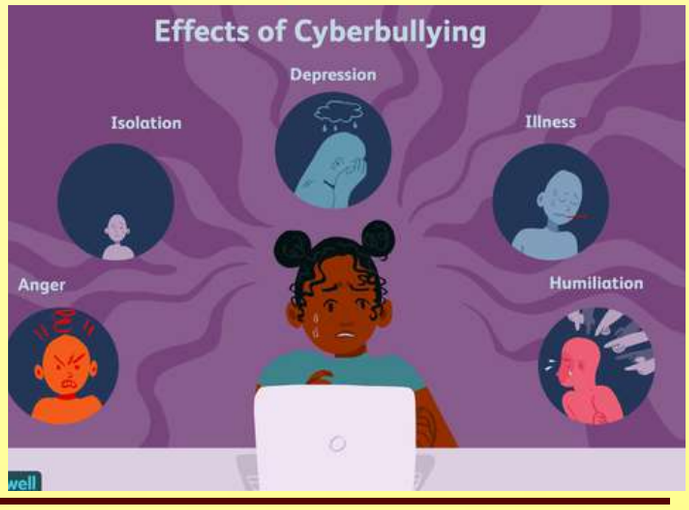
The survey found that 91% of teenagers believe online harassment is a problem for people their age, and 64% identify it as a "serious problem."

SOCIAL MEDIA'S IMPACT ON MENTAL HEALTH DURING COVID 19

Why is the young generation facing the bad impacts of social media ???

It can be a long discussion. There are too many black sides of social media that can easily affect a human being. The first side is 'it's Addictive' . Different studies have confirmed that people experienced the psychological symptoms of withdrawal when they stopped using (this went for all internet use, not just social media). Their recent study found that when people stop using, they also face small but measurable physiological effects. Although social media is to be used for recreation purposes, yet children get easily addicted to these platforms. And for this social media is negatively affecting mental health.





- **Cyberbullying'is the second dark side of internet.**
- Research said that many may receive or be the subject of mean comments, messages and posts. This can be a reason of stress and feelings of isolation. It has become more common nowadays due to the technology that children have access to. The most common apps like Instagram, Twitter, Snapchat, Facebook etc that teenagers use to cyberbully. Due to the lack of knowledge of when and where it is happening, Cyberbullying has become much harder to stop. Teens will say awful things to one another online and what they do not realize is that once it is said and published online it will remain same for long period of time. Home used to be a safe place for teens, but now a child is still within reach of becoming a victim of cyberbullying through text messages or phone calls. According to Pew Research study, eight out of ten teens who use social media now share more information about themselves than they have in the past. This includes their images, location, contact information and their posts also.In order to protect children, it is important that personal information such as age, birthday, school/church, phone number, etc. be keptprivate.

Ankita Ghosh

CSE, 3rd YEAR
NITMAS

Ankan Sarkar

CSE, 3rd YEAR

School of Science & Technology

Ranit Bhowmick

RE, 2nd YEAR

School of Science & Technology

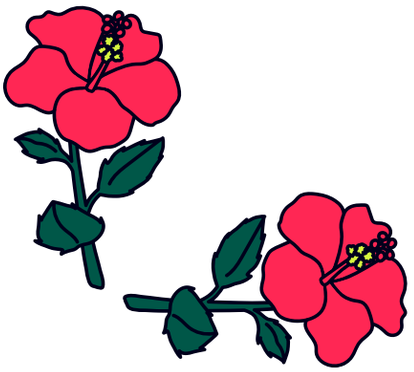
মনে প্রশ্ন জমে

মনে প্রশ্ন জাগে
এক পিঁপড়ে কিভাবে বাঁচে?
হ্যাঁ সেও বাঁচে
জীবন সংগ্রামে জয়ী হয়ে
মানুষের দুটো আঙুলের চাপে সে চাপা পড়ে।
এই আশঙ্কা পূর্ণ জীবনে , সে
কী করে ?.....

মনে প্রশ্ন জাগে
বীজ কীভাবে প্রাণ ফিরে পায় ?
পারিপার্শ্বিক অবস্থা তাকে মেরে ফেলতে চায়,
কিন্তু সে কি মরে ?
না .....
সেও বাঁচে ,
কঠোর সংগ্রামের মধ্য দিয়ে
সেও জীবনে বড়ো হয় ।
বিশ্বকে বাঁচিয়ে রাখার কাজে সামিল হয় ।
আর মানুষকে শান্তি প্রদান করে ।
শুধু তাই কী ?

মনে প্রশ্ন জাগে
ছোটো পাখির ছানা কী ভাবে বড়ো হয় ?
সেদিন এক পাখিকে দেখেছিলাম
সাত সমুদ্র তেরো নদীর এপারে
সেছিল অসুস্থ , জীর্ণ
সে যেতে চেয়েছিল ওপারে ।
সে পারেনি ।
তার পর চলে হাজার চেষ্টা
সে মেটায় জীবনের তেষ্টা ।
মানব জীবন কী এই নিয়ম ব্যতীত ?
না

SOUMYADIP ADAK
CSE, 2nd Year
NITMAS)



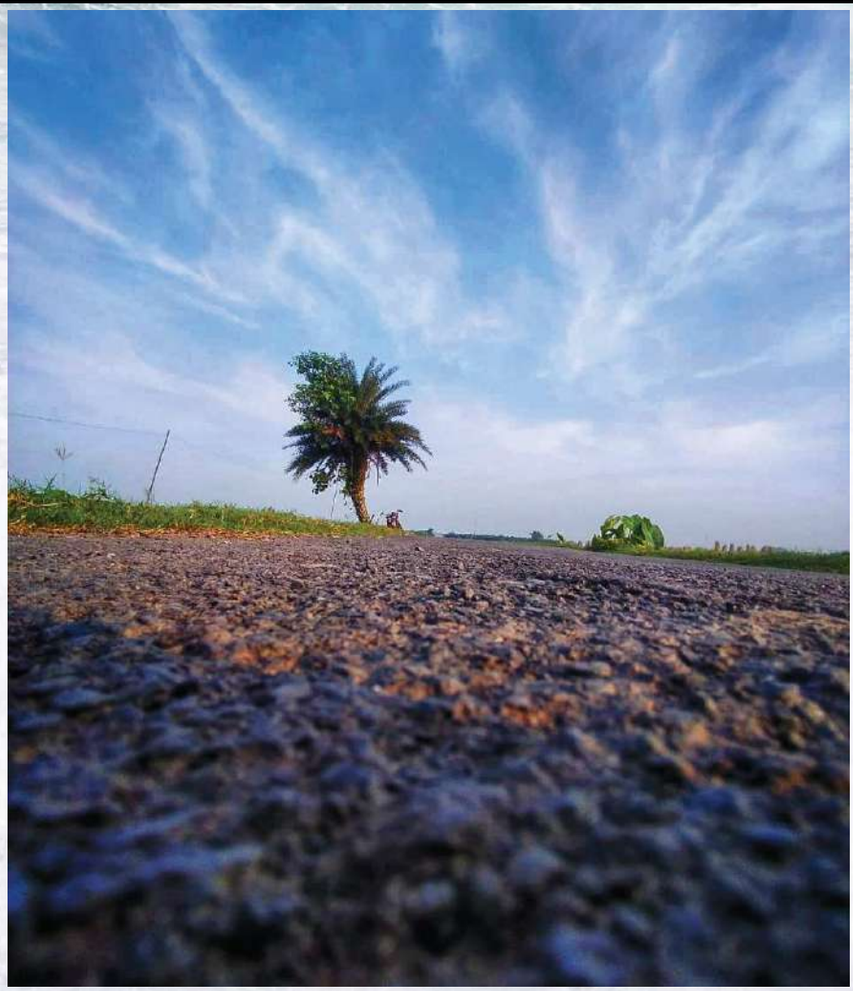
RANIT BHOWMICK
-RE 2ND YEAR

WE ARE MARINERS

When clouds make their home in the sky
When the dancing water is passing by...
We, Mariners, stand to do fly
The ship, when the water gets high.

When the storm are getting near
When the ocean gives them a pair
We, Mariners, stand with a hand upon gear
To move forward without any fear.

Yes, we stand and fight saying family bye
To bring a smile on their face and eye.



Nilimesh Roy
MRE, 3rd YEAR
SOMS

LIFE AT SEA AS A MERCHANT NAVY OFFICER

Life at sea in the merchant navy can be very different when compared to that on land.

- Odd working hours. Ship works 24/7 and hence people work round the clock in shifts, i work in the afternoon from 12 to 4 and in the mid night from 12 to 4.
- Changing weather. Once we started from saudiarabia ,the temperature there was 43 deg celcius and we went to alaska,the temperature there was 2 deg celcius. Thats how temperature changes are on a ship, they can be drastic.
- Strong winds, heavy waves. They make the ship roll and pitch making even simple things like walking, sleeping, cooking difficult. I remember eating only bread and kitchidi for a week as cooking other foods was deemed too risky(the utensil simply wont stay on the stove due to the ships movement in rough weather). Other wise on normal days food is nutritious and healthy.
- Working conditions can range from good to worst. For people working on deck a light breeze will be good , and hot humid weather will be worst, people consuming salt tablets during hot weather conditions to maintain electrolyte balance in the body is common. Engine room temperature can reach 50 deg cel easily, and it will also be very noisy, in such conditions engineers will have to climb up and down 2 to 3 storeys several times a day, mostly they can be seen drenched in sweat and oil.
- Now a days many ships have internet onboard, but they are expensive and most of the times limited to just whatsup and imo. On my last ship 25 mb data cost 10 usd.
- Drinking is not the way of life on a ship as many people assume, companies have zero alcohol policy and consuming liquor can cost your job.

LIFE AT SEA AS A MERCHANT NAVY OFFICER

- Mess timings are strict and no food is served after mess timings. Dinner is between 6 to 7 pm.
- As an officer you are entitled for family carriage, so you can bring your wife and child on the ship, provided the ship goes to safe places and if your accomodation is big enough and if your superiors are supportive.
- Sometimes you get to visit places on the earth that you never knew existed. I have myself been to places like the marina trench, bermuda triangle, magellan straits.
- Salary is good, expect to take home a few lakhs every month.
- Working at a stretch for months is usual, forget weekends and festivals.
- Staying away from family, especially at the time of need is difficult and hence people on the ship keep counting days remaining to go home.
- Although you work on the ship for months together you also get to stay at home for months together with your family.
- Life in the merchant navy has its own share of pros and cons, but in my opinion the pros out weigh the cons, as merchant navy will make you financially independent at an young age and as an added benefit you get to see the world.

Anubhab Sheet
MRE, 2nd YEAR
SOMS

Ankan Sarkar

CSE, 3rd YEAR

School of Science & Technologyogy

আমার চোখে স্বাধীনতা

আমার চোখে স্বাধীনতা মানে বন্দি খাঁচার পাখিটা শিকল
ছিঁড়ে উন্মুক্ত হাওয়ায় আকাশে উড়বে।
আমার চোখে স্বাধীনতা মানে গৃহ বন্দী পড়ুয়ারা,
স্বাধীন ভাবে স্কুলে দৌড়াবে।।

আমার চোখে স্বাধীনতা হল,
যে ছেলেটা পরের জু(তা পালিশ করছে,
যে ছেলেটা বাবার সঙ্গে মাঠে ক্ষেতি করছে,
সে ও একদিন পাঠশালায় যাবে,
দু চোখ ভরে স্বপ্ন দেখবে।
আমার চোখে স্বাধীনতা হল,
আরও অনেক নীরজ চোপড়া এগিয়ে আসবে।।

আমার চোখে স্বাধীনতা হল,
যে মেয়েটা পরের বাড়ি যাচ্ছে কাজে
যে মেয়েটা অন্যের বাড়ি বাসন মাজে ,
সে ও স্বাধীনতার আ(লা দেখবে।
তার বুকেও সূর্য উঠবে, গোলাপ ফুটবে।
আমার চোখে স্বাধীনতা হল,
পাড়ার রোহন রুচি (রাজা সকলে একসঙ্গে হাডুডু খেলবে।
রাণী রামপালের মতো আরো অনেক মেয়েরা ভবিষ্যৎ প্রজন্মকে (প্ররণা জাগাবে,
ত্রক হয়ে লড়বে ও সফলতার চাবি কাঠিতে নিজেদের নাম স্বর্ণাক্ষরে লিখে রাখবে।

প্রত্যেক নারী নির্ভয়ে এগিয়ে আসবে,
অন্যায়ের সঙ্গে আপোষ করবে না।
আর কোনও নির্ভয়া ভূমিষ্ঠ হবে না।
রণদেবীর মতো জেগে উঠবে প্রত্যেক দুর্গা,
অপরাধীর হবেনা কো(না নিস্তার,
বধ হবে সমাজের প্রত্যেক মহিষাসুর ।

আমার কাছে স্বাধীনতা হল,
সর্ব ভেদাভেদ ভূলে গিয়ে সকল মানুষ সম্প্রীতির মাঠে দাড়াবে,
আর প্রান খুলে মুক্তির গান গাইবে ।
সেই দিন, সেই দিনই
ভারতমাতা স্বাধীনতার সঙ্গা খুঁজে পাবে,
খুঁজে পাবেই।।
জয় হিন্দ ।।

কলমে SHREYA KAYAL
CSE, 3RD YEAR, NITMAS

GOVERNMENT NOTIFIES NEW LIBERALISED DRONE RULES 2021

The News

- Recently, Ministry of Civil Aviation through a press release dated 26th August, 2021 has notified liberalised Drone Rules, 2021 which will replace the UAS (unmanned aircraft system) Rules 2021.
- The stakeholders were of the view that the previous rules were restrictive in nature as they involved considerable paperwork, required permissions for every drone flight and very few "free to fly" green zones were available.

Major Highlights

- According to the liberalized Drone Rules 2021, several approvals have been abolished, which include approvals for unique authorization number, unique prototype identification number, certificate of manufacturing and airworthiness, certificate of conformance, certificate of maintenance, import clearance, acceptance of existing drones, operator permit, authorization of R&D organization, student remote pilot licence, remote pilot instructor authorization, drone port authorization, etc.
- The regulations notified by the Civil Aviation Ministry have lowered entry barriers — including cutting the number of registration forms to be filled to five from 25, and the number of fees payable to four from 72 — to make it simpler for operators to start using drones.
- The fee for a remote pilot licence fee has been reduced from ₹ 3,000 (for large drones) to ₹100 for all categories of drones; and is valid for 10 years.
- The government plans to open what is known as the Digital Sky platform, which manufacturers will be able to use for the certification process, and from where interactive airspace maps with green, yellow, and red zones can be accessed.

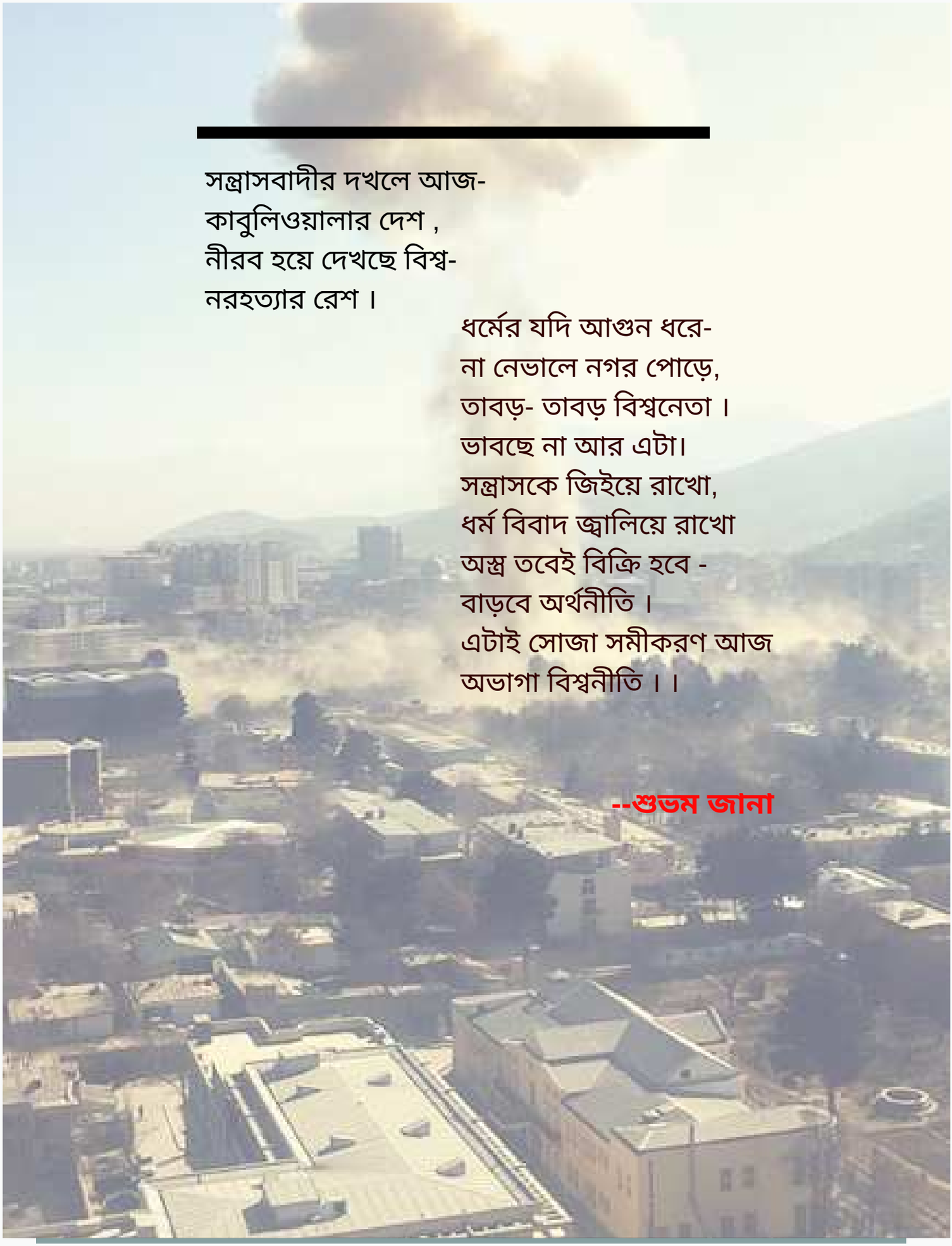
Digital Sky Platform

It is an initiative by MoCA, that seeks to provide a secure and a scalable platform in order to support the drone technology frameworks like 'No permission, no take-off'. It has been designed to enable flight permission digitally and manage unmanned aircraft operations & traffic in an efficient manner

GOVERNMENT NOTIFIES NEW LIBERALISED DRONE RULES 2021

Rabi Paik

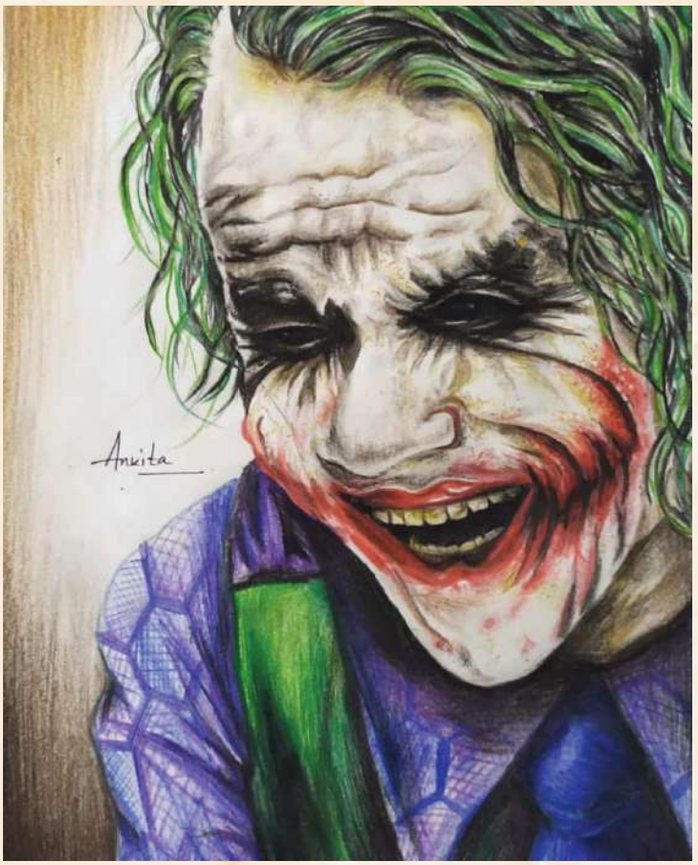
MRE, 3rd YEAR
SOMS

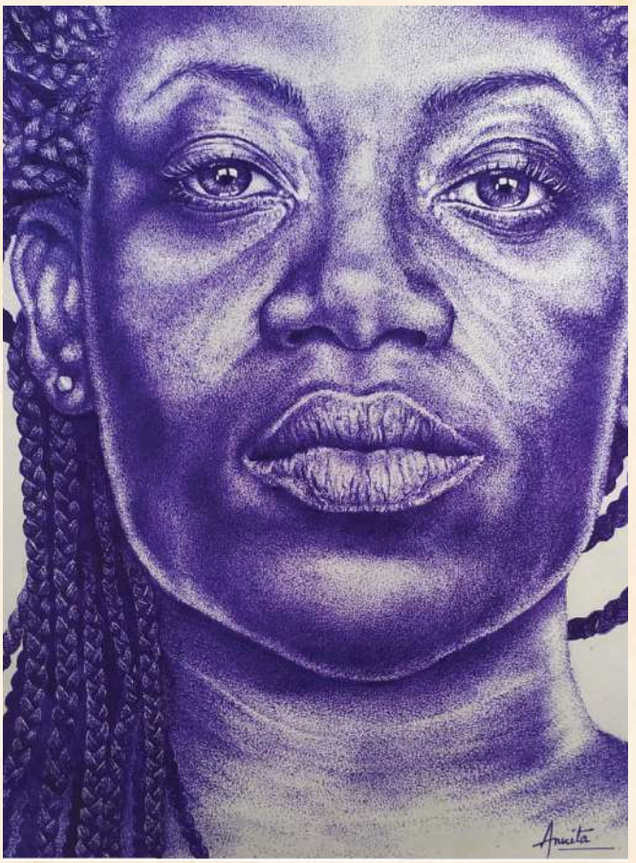


সন্ত্রাসবাদীর দখলে আজ-
কাবুলিওয়ালার দেশ ,
নীরব হয়ে দেখছে বিশ্ব-
নরহত্যার রেশ ।

ধর্মের যদি আগুন ধরে-
না নেভালে নগর পোড়ে,
তাবড়- তাবড় বিশ্বনেতা ।
ভাবছে না আর এটা।
সন্ত্রাসকে জিইয়ে রাখো,
ধর্ম বিবাদ জ্বালিয়ে রাখো
অস্ত্র তবেই বিক্রি হবে -
বাড়বে অর্থনীতি ।
এটাই সোজা সমীকরণ আজ
অভাগা বিশ্বনীতি । ।

--শুভম জানা





Ankita Saha, CSE (Cyber security)

LAHRON SE MOHABBAT

KISI NE HUMSE PUCHA KI APP KAHA MARNA PASAND KARENGE
HUMNE KAHA
APP TOH AHSIQUE HAI JANAB
APP TOH APNI MEHABOOBA KI AAKHON MAI DOOB JAYENGE
USKI CHAND SE MUKHRE MAI MAR JAYENGE
OR USKE
HOTO MAI KHILTI HUI HASEEN MAI BHI MAR JAYENGE
MAGR
HUM TOH SEAFEARERS HAI JANAB
HUM TOH KHULI SAMUNDAR MAI
APNE HATON KO FAILAKAR SAMUNDAR KE
BARI BARI LAHARO MAI DUBKI LAGAKAR
SAMUNDAR KI BAHON MAI
MARNA PASAND KARENGE

DOSTI

DOSTI SE KIMTI KOI JAAGEER NHI HOTI
DOSTI SE KHOOBASOORAT KOI TASVEER NHI HOTI
DOSTI TOH EK KACHCHA DHAGA HAI
MAGR
IS KACHCHE DHAGE MAJBUT KOI
JANJEER NHI HOTI

Ayush Bhattacharjee
MRE, 4th YEAR
SOMS

THE PEGASUS SPYWARE

Why in News

- Recently, it has been reported that Pegasus, the malicious software, has allegedly been used to secretly monitor and spy on an extensive host of public figures in India.

Key Points

- About Pegasus:
- It is a type of malicious software or malware classified as a spyware.
- It is designed to gain access to devices, without the knowledge of users, and gather personal information and relay it back to whoever it is that is using the software to spy.
- Pegasus has been developed by the Israeli firm NSO Group that was set up in 2010.
- The earliest version of Pegasus discovered, which was captured by researchers in 2016, infected phones through what is called spear-phishing – text messages or emails that trick a target into clicking on a malicious link.
- Since then, however, NSO's attack capabilities have become more advanced. Pegasus infections can be achieved through so-called "zero-click" attacks, which do not require any interaction from the phone's owner in order to succeed.
- These will often exploit "zero-day" vulnerabilities, which are flaws or bugs in an operating system that the mobile phone's manufacturer does not yet know about and so has not been able to fix.

Targets

- Human Rights activists, journalists and lawyers around the world have been targeted with phone malware sold to authoritarian governments by an Israeli surveillance firm.
- Indian ministers, government officials and opposition leaders also figure in the list of people whose phones may have been compromised by the spyware.
- In 2019, WhatsApp filed a lawsuit in the US court against Israel's NSO Group, alleging that the firm was incorporating cyber-attacks on the application by infecting mobile devices with malicious software.

Recent Steps Taken in India

- Cyber Surakshit Bharat Initiative: It was launched in 2018 with an aim to spread awareness about cybercrime and building capacity for safety measures for Chief Information Security Officers (CISOs) and frontline IT staff across all government departments.
- National Cyber security Coordination Centre (NCCC): In 2017, the NCCC was developed to scan internet traffic and communication metadata (which are little snippets of information hidden inside each communication) coming into the country to detect real-time cyber threats.

THE PEGASUS SPYWARE

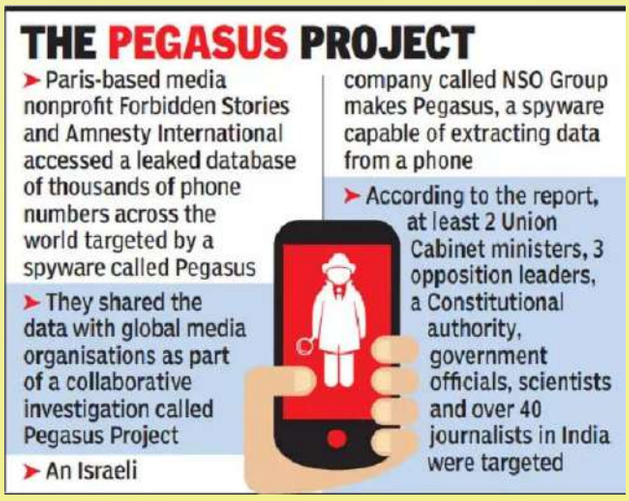
- Cyber Swachhta Kendra: In 2017, this platform was introduced for internet users to clean their computers and devices by wiping out viruses and malware.
- Indian Cyber Crime Coordination Centre (I4C): I4C was recently inaugurated by the government.
- National Cyber Crime Reporting Portal has also been launched pan India.
- Computer Emergency Response Team - India (CERT-IN): It is the nodal agency which deals with cybersecurity threats like hacking and phishing.

Legislation

- Information Technology Act, 2000.
- Personal Data Protection Bill, 2019.

International Mechanisms

- International Telecommunication Union (ITU): It is a specialized agency within the United Nations which plays a leading role in the standardization and development of telecommunications and cyber security issues.
- Budapest Convention on Cybercrime: It is an international treaty that seeks to address Internet and computer crime (cybercrime) by harmonizing national laws, improving investigative techniques, and increasing cooperation among nations. It came into force on 1st July 2004.
- India is not a signatory to this convention.



Types of Cyber Attacks

- Malware: It is short for malicious software, refers to any kind of software that is designed to cause damage to a single computer, server, or computer network. Ransomware, Spy ware, Worms, viruses, and Trojans are all varieties of malware.
- Phishing: It is the method of trying to gather personal information using deceptive e-mails and websites.
- Denial of Service attacks: A Denial-of-Service (DoS) attack is an attack meant to shut down a machine or network, making it inaccessible to its intended users.
- DoS attacks accomplish this by flooding the target with traffic, or sending it information that triggers a crash.
- Man-in-the-middle (MitM) attacks: Also known as eavesdropping attacks, occur when attackers insert themselves into a two-party transaction.
- Once the attackers interrupt the traffic, they can filter and steal data.
- SQL Injection: SQL stands for Structured Query Language, a programming language used to communicate with databases.

Arghya Nath
CSE, 3rd YEAR
NITMAS

The Murderer

I see him everyday,
In my jail, happy and gay,
He is a KILLER.....
The murderer of his own daughter.
His daughter's body was found slaughtered
And beside the body stood the man
Standing expressionless at the fan
In his eyes there were no tears
In his heart there was no fear
And he is still the same
Thinking life is a game
Where after death ones comes back to life
Gets another chance to live and strive.....
And came the day when he would be hung
He came on the platform showing no grief but his tongue
When his last wish was asked
His diary to be published was tasked,
After his death I took his diary to the publishing house
In the diary there was a picture of a mouse.
And while going I read the pages
I realized how the man felt for ages.
His daughter from his first wife was killed by his second wife
He loved his wife and also his daughter who was beautiful like swan
And he took the crime upon himself.
His daughter was gone,
His wife the KILLER
Whom should be blame
So he became lame
He had no wish to live
Outside he looked happy and gay
But deep inside he was already dead
Hung was the body with no life
It was dead.....UNALIVE.

Aneervan Ray
CSE, 4th Year
NITMAS)

VANISHING OF WILLIAM

Back in summer in the town of Nottingham when four kids were enjoying the surroundings. Four kids were best friends to each other. They were spending quality time. One day, William , Mike, Robert, Edward playing basketball in the ground and it was lightning thundering storm. Each of them ran towards their house. But while going home William was passing by a forest. He felt someone is watching him from behind and started to paddle his cycle fast and somehow, he lost control of his cycle and crashed into forest. He was desperate to go home but couldn't. It was dark and raining and no signs of people out there. And rest of the boys made it to their home safely. 12 o' clock at midnight the sky became clear and moon can be seen as heaven. Robert asked her mother to stay with her as he felt something could happen. Next morning Robert, mike, Edward packs his back for school and when they reached there they found William is missing. But they didn't care as they discussed the possibilities that maybe he is sick due to get wet from rain.

Then a woman with anger, emotions was seen coming towards the school. Mike identified the woman and told the group mates that she is William's mother. Everyone is shocked as William was missing and presence of her mother made something coincident. Three of them followed her quickly and saw her entering in principal's office. There they learnt that William was not at home last night and this got heartbreaking of Robert, mike and Edward as their friend is missing. Mother asked them (Edward, Robert, Mike) as where they have been last night

.They told them the truth that he was with them till the lightning strikes. When William suddenly goes missing, the whole town of Nottingham, turns upside down. Many people are on the search for William, including his mother (Mary), his brother (Jonathan), his friends Mike, Edward and Robert, the police chief (John Beckham) and other notable people. But another story pops up in news, creating a discovery of other child was also missing from the town. And things get even weirder when a little girl with a small hair comes into the story. Robert, Edward, and Mike decided to go to the forest. As they enter into forest there was sudden footsteps coming nearby, as soon as the footsteps approach them they saw that little small haired girl. They decided to take her to Mike's house, where they were asking her some questions. Three of them then observed that she is scared and cold. She tried to change out of her wet shirt, and the trio gave her space to do so. Edward and Robert thought she can't speak, but Mike stayed positive, told them not to reveal about this girl to another soul. After the young boy William disappeared, his family tried to contact different organisations to find his son. The boy's mother (Mary) desperately tried to find him, learned that he maybe in trouble, while the police chief continued his investigations. Mike tried to help that little girl but

VANISHING OF WILLIAM

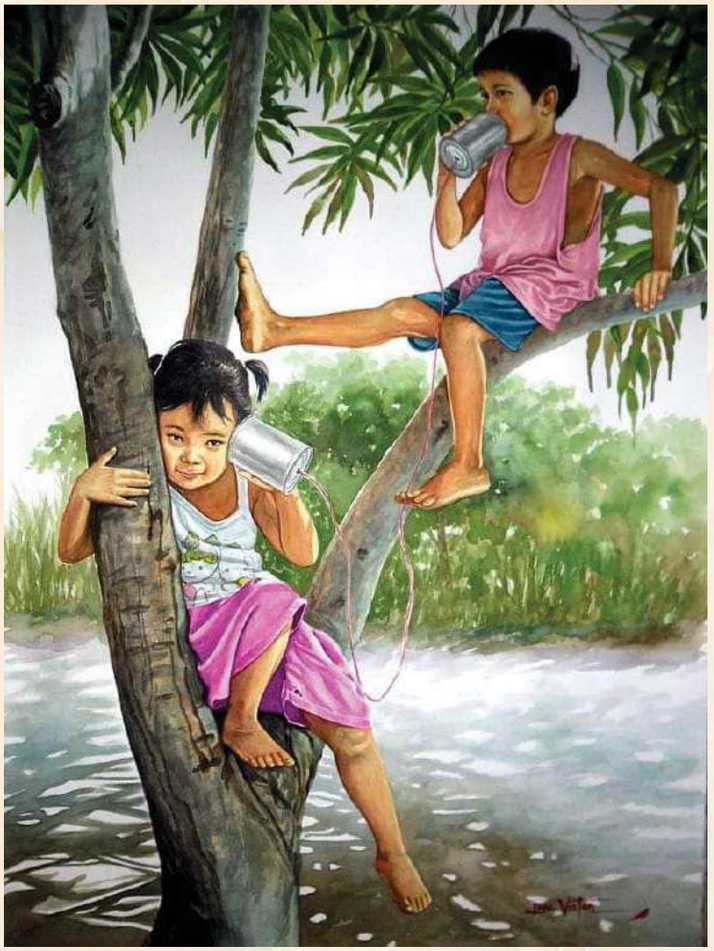
she didn't opened her mouth for a while but afterwards she told in unclear voice. Mike asked her again and she replied that some sort of "bad people" tried to kidnap her. The girl was afraid that she could not utter a word after 'bad people'. Three of them tried to help her out but she couldn't operate with them. And they came to point that where they had a concept that vanishing of will is linked to this girl.

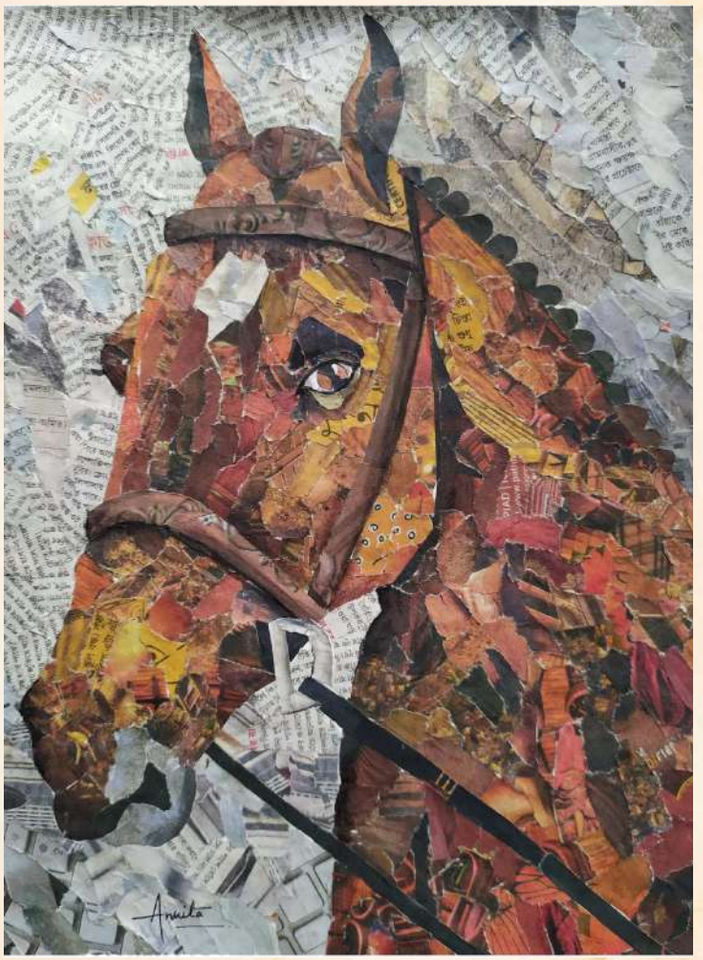
On the other hand William's mother and brother were worried out where her son is? When Mary's 12-year-old son, William, goes missing, she herself went out to negotiate with local authorities. As she search for answers, local authority team found out a secrets involving government experiments where they use children for their lab experiment. Police team raided that building but no sign of people there. Mary then went to look for William in the forest. She then remembers getting him tickets to see the film he wanted to see. But in reality, he is missing. Jonathan is also there looking for him as well, both calling out to him. But no response came and no signs thus Mary was silent for a moment, she was feeling like she permanently lost him, this made her heartbroken. She did not give up and went to police chief again. John and his team then found Will's cycle where he left, exactly in the same position. Mike and his family started fighting over investigating case for Will's family, but his family says "Not to intervene". Mike and Edward then had a conversation over the walkie talki that they have. Mike told that Will might've put himself in trouble cause maybe he learned the secrets of that government lab. Edward and Mike then resolve to meet each other at 10. Robert, Edward, and Mike are then going down the back road, forest road.

However they crossed the restricted area of the woods, and Mike telling Robert to stay on walkie talkie channel, and not to do anything stupid. Mary and Jonathan are then back at home, mourning over Will and his absence. Jonathan then regrets that he should've been there for his brother Will, which her mother tells him not to regret about it because it was not his fault. She then gets a phone call from, she ran rapidly and picked up the phone and shouted to the caller, "Where is my boy?",then the call dropped. They were more worried and tried to console each other. Mary and Jonathan discussed about copying a missing poster for Will. When John arrives, telling Mary that Will hasn't been found yet. On the other hand, Mike then told the small hair girl to get help, but she declined and uttered "bad people" who want to kill her. Edward and Robert, at school, asked Mike, staying home to look after the girl. Jonathan remembers him and Will listening to his favourite song as he became emotional. Mike stayed in home and asked her name once again this time she replied 'Elly'(small hair girl).

Gourab Bhakta
CSE, 3rd YEAR
NITMAS

Based on the premiere episode of the American science fiction horror television series Stranger Things.





Subham Jana, EE

Ankita Saha, CSE (Cyber security)

TRAGIC DAY OF MY LIFE

Let's face it! Working on ship is not only tough physically but mentally as well. Dealing continuously with conflicting opinions, racing nerves, and altering egos, a mariner fortunately or unfortunately falls prey to a system, wherein molding according to a situation becomes imperative. Unlike in other fields, professional politics on ship can sometimes take a form too ugly to fathom.

Debajyoti Dutta, a 4th engineer working with a reputed shipping company, narrates an incident which changed his point of view not only on certain aspects of the shipping world but also on the complexity of life we live.

For a Few Kind Words...

He seemed a good kid when I recruited him. He was sharp, young and oblivious to the way in which life is beheld in the merchant navy. He wanted to be a deck cadet. Let me call him Raj, for the sake of our convenience.

Raj was an ambitious kid from my point of view. "I want to be a Captain, sir", he told me the moment he entered the interview hall. He was wearing a black tie with a blue shirt which seemed to complement his deep set green eyes and tall lanky frame. For a kid whose mother had passed away at 10 and had to help raise two little sisters all on his own, he had done a pretty good job. He wanted to head to sea to educate his sisters and help his father out. I vividly remember his presence which seemed far beyond his years and an intelligence coupled with maturity that could have been easily mistaken for overconfidence.

Two years later, on a cold winter morning, my Blackberry buzzed to life at 3 A.M.

"Sir, I am sending back the cadet. He has had some.....problems onboard and we cannot afford to have him here, lest risk commercial pressures of getting the ship arrested", my captain called me from the vessel. As I proceeded deeper into an annoying conversation, I shook off my disbelief when I heard the words, "Sir, the kid tried to kill himself .....in US waters. We had to inform the port, his parents and you. The Chief Officer has reported his mental instability. He is being accompanied by a US Marine till he is in safe hands."

I dazed off just a moment to remember Raj and wondered myself if the sea could really change a person to that extent. Wearily, I breathed soft reassurances to Raj's troubled father over the phone and headed off to the airport to receive the kid. Three hours later, I saw a glimpse of the sad green eyes that were once jubilant with enthusiasm. Accompanying him was a seven foot tall US Marine who sat as grim as he appeared when he had arrived. When I went on to thank him for his service. He greeted me with a surprisingly pleasant smile and assured me that he was just doing his duty and there was no need to go about thanking him

Just when I was about to leave, he wanted to have a word with me, " Sir, I have escorted madmen ranging from psychosis patients to schizophrenics in my career and I guarantee you that the kid is mentally very stable but if you insist he is not, then he must be the most pleasant madman I have ever come across."

As I handed over Raj to his father and headed home, I could not shake off the Marine's words and how it coincided with so much of my own opinion about Raj's mental condition. I had left him bundled in his father's arms, tinged with a feeling of guilt. On the drive back home, I gazed out on to the dew covered prairies and tried to let go of the missing pieces in the story that my mind was battling with." What happens on the ship stays on the ship", I told myself.

Today, I am older by a year, not any wiser. A year since I forgot all about the day when I last saw Raj sobbing away only to drench his father's shirt at the airport. I ran across him at the same airport at the same terminal. Fate or Irony! I'd dare not guess.

He fell to my toes asking for my blessings the moment he saw me. Embarrassed and pinched by a sharp sense of guilt, I went on to ask him how he was doing and how his father was. He tried unsuccessfully to withhold a sad smile and told me, "Sir, he died six hours after you left me at the airport a year ago. He could not take the shock that I was mentally unstable, especially when I was not. Sir, I was framed by the Chief Officer who had certain concerns about me. He ran after me onto the deck to hit me and trying to evade him, I fell overboard into the water. Saving himself, he reported a suicide attempt. That is all there is to it. "

When I tried to process those words, I could not. I was too dazed to react to him. I bid him goodbye as he boarded his flight. I sat there for another hour at an isolated area of the terminal, long after collecting my bags, trying to absolve my self-doubt. But no matter how many times I told myself, "There was nothing you could have done", my thoughts travelled to the orphaned sisters who were still in school and the green eyed brother who went out to sea to educate them.

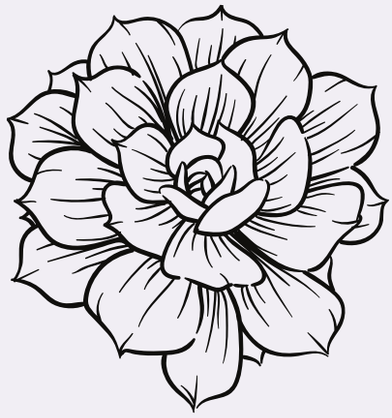
A few kind words, those were all that he needed, be it sea or be it shore.

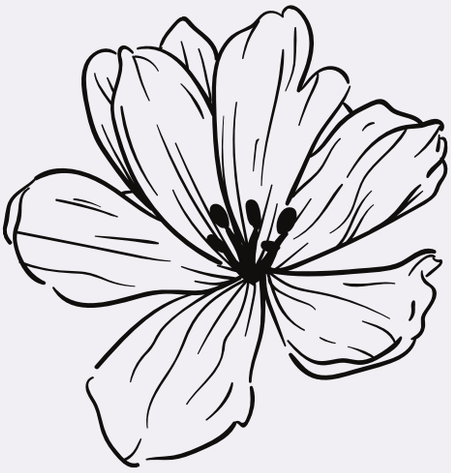
A few kind words, those that could have changed his life.

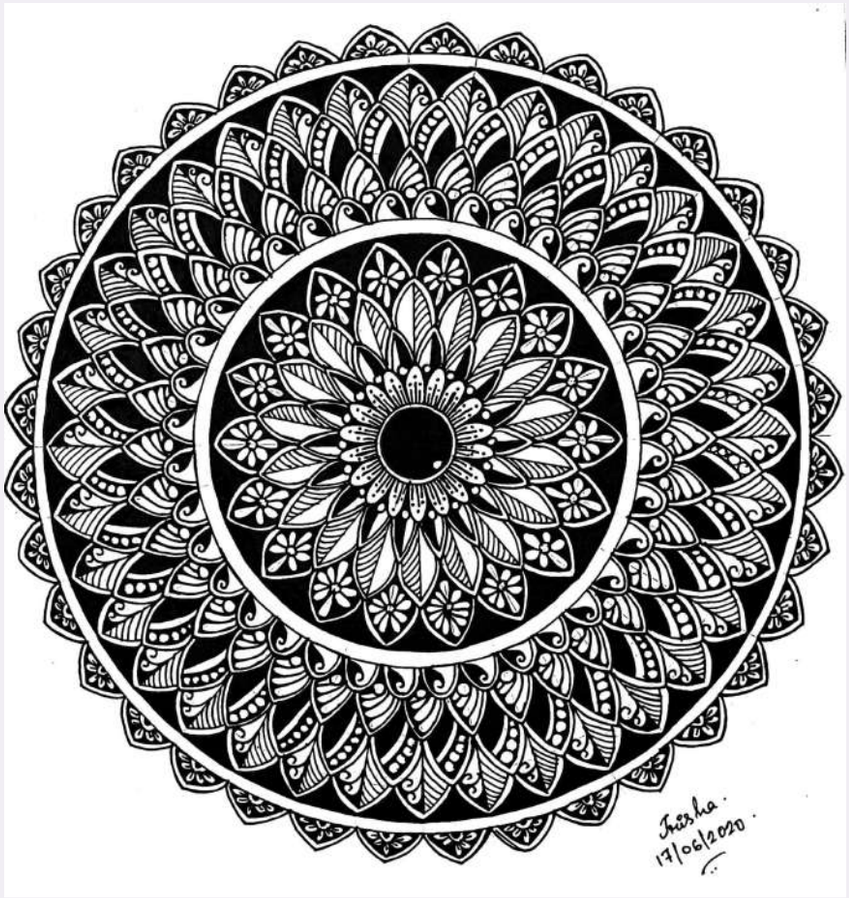
Debajyoti Dutta
MRE, 2nd YEAR
SOMS

Akash Singh
BNS, 3rd YEAR
SOMS

Sayantani Chatterjee & Ranit Bhowmick
RE, 3rd YEAR
School of Science and Technology







Trisha Sinha

RE, TNU

SHIPBUILDING :MERCHANT NAVY

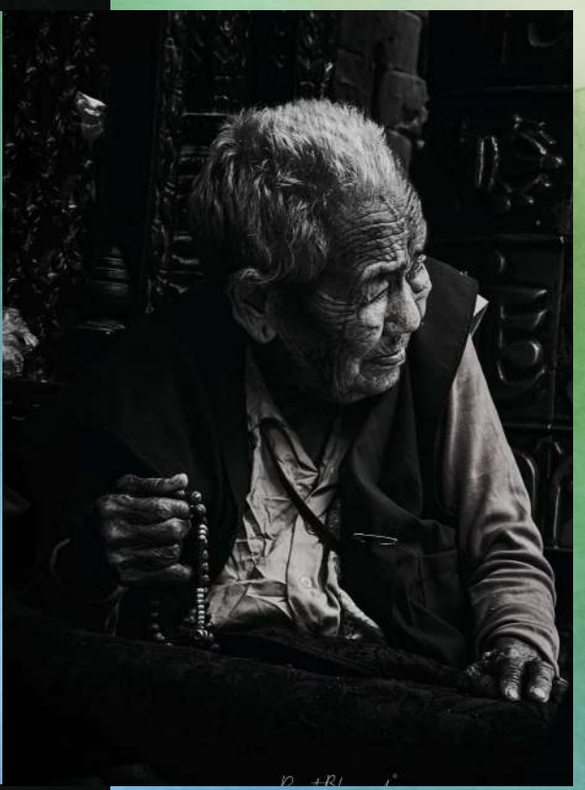
POINTS

- Shipbuilding is technology driven, skill and material intensive assembly operation.
- Being a labour intensive industry, the cost of labour plays an important determinant in a country's competitive position vis-à-vis others. Over the years, the industry has shifted from Europe to Japan and then to Republic of Korea and has now taken firm roots in China. The factors governing this shift have been relatively high wage in Europe coupled with strong competitive strength of manufacturing and steel making sectors and active state support in the leading shipbuilding nations of East & Far East Asia. This decisive shift in shipbuilding activities from Europe to Asia has opened up window of opportunities for Indian ship yards in both public and private sectors. Over 90% of shipbuilding in 2018 occurred in China, the Republic of Korea and Japan.
- India has a coastline of 7,517 kms. with 12 Major ports and 205 notified Non-major
- Ports facilitating sea-borne trade. Coastal and overseas cargo movement is effected through ocean-going vessels. In addition, small ships/crafts also ply on inland waterways and canals. Indian owned ships/vessels carried 7.7% of India's overseas trade during 2018-19. India's emergence as a major economic power would mean greater integration in terms of trade with the rest of the world requiring huge shipping tonnage.
- With the opening of Indian economy, there has been a steady increase in handling of cargo traffic at Indian Ports. India's share in global exports has increased from 0.8% in 2003 to 1.7% in 2018 (Source: World Trade Statistical Review, 2019). To sustain the momentum of foreign trade and improve competitiveness, the country would need adequate and efficient infrastructure in terms of ports, ships and maritime services.

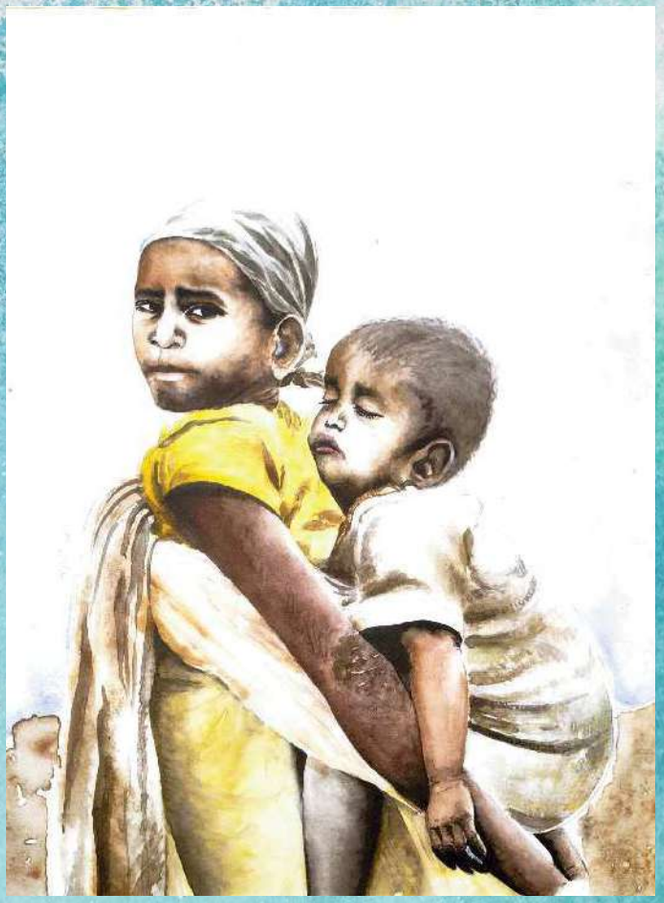
SHIPBUILDING :MERCHANT NAVY

- The “Manufacturing Plan – Strategies for Accelerating Growth of Manufacturing in India in the 12th Five Year Plan and Beyond” released by the Planning Commission lists “Ship building and Ship Repair” as one of the key sectors of strategic importance.
- Make in India’ has been initiated to promote growth of manufacturing sector in the country as it has higher employment multiplier effects compared to service and agriculture sectors. An impetus on shipbuilding and ship repair industry in India is needed for the following reasons:- (a) The shipbuilding industry has the same impact as infrastructure sectors due to higher multiplier effects on investment and turnover and high employment potential. (b) The shipbuilding industry is a strategically important industry. To ensure safety of our vast coastline, naval requirement of sophisticated and modern vessels is growing rapidly.
- The Indian Ship-Building Industry can broadly be categorized into following categories:- (i) Large ocean-going vessels catering to overseas as well as coastal trade; (ii) Medium size specialized vessels like Port Crafts, Fishing Trawlers, Offshore vessels, Inland and other smaller crafts and; (iii) Defense /Naval crafts and Coast Guard Vessels.
- There are 33 dry-docks for repairing ships in India both in public and private sector as per data reported. These dry docks include the 9 dry docks operated by 5 major ports. The major ports which have no dry-dock facilities are Mormugao Port, JNPT, New Mangalore, Chennai, Kamrajar, V.O. Chidambarnar and Haldia Dock Complex of Kolkata Port. Cochin Port Trust has handed over its Dry Dock to M/s Cochin Shipyard Ltd.

Pratham Paul
MRE, 2nd YEAR
SOMS

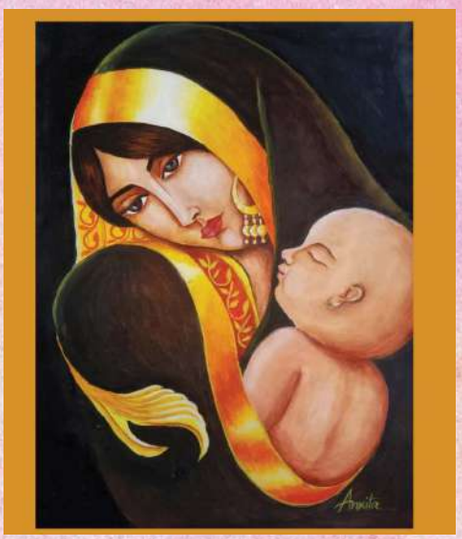


RANIT BHOWMICK
-RE 2ND YEAR



Kuntal Dhenki
EE, 4th YEAR
School of Science & Technology

Subham Jana
EE, 3rdYEAR
School of Science & Technology



ANKITA SAHA CSE
(Cyber security)

Trisha Sinha
RE, TNU

SUMIT JANA CSE 2ND YEAR

Trisha Sinha
RE, TNU

CAREER AT SEA:MERCHANT NAVY

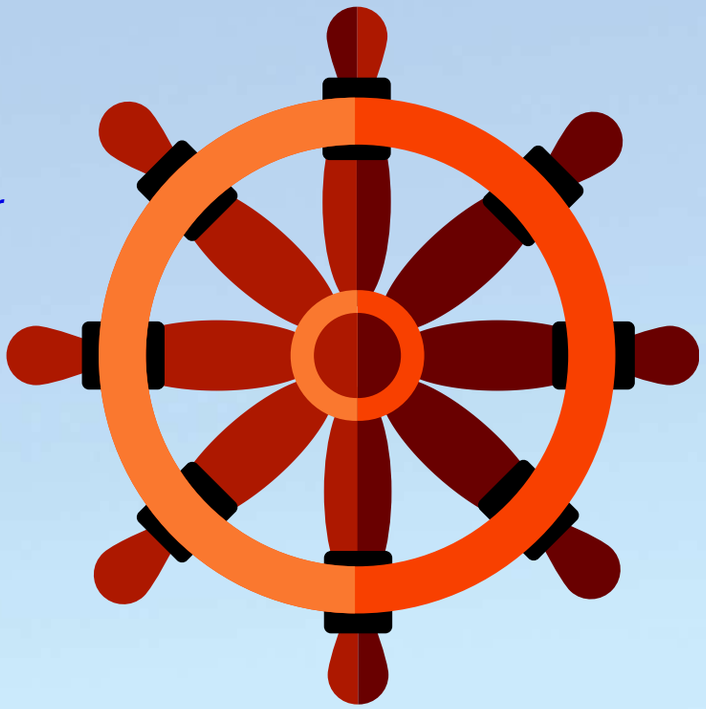
Merchant navy is one of the oldest careers and even today the attraction towards the vast expanse of the seas is holding the interest of the aspiring seafarers.

The global commerce largely depends on merchant navy as most of the trade carried out across the world take place through merchant ships. Because of the Globalization and increase in global sea traffic the future of merchant navy is very bright and competitive. The ocean routes are full of merchant ships which includes different types of vessels such as cruise liner, bulk carrier, oil tankers, container ships, gas carriers and this all requires trained Navigating Officers and Marine Engineers to safely navigate the ships through the sea.

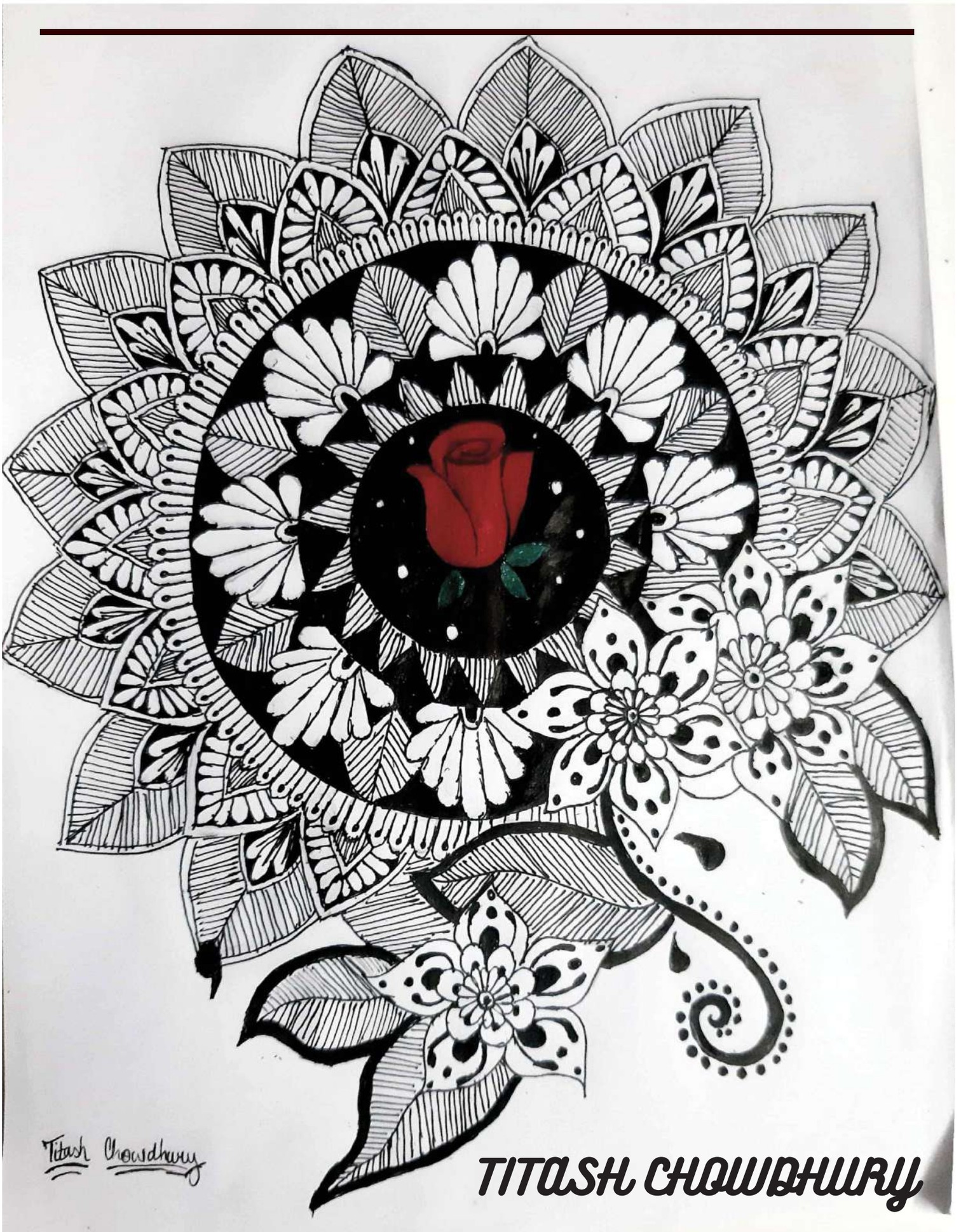
The Navigating Officers and the Marine Engineers are trained to handle and maintain the modern technology and equipment used in the ships and other water transports.

A career at sea is an exciting way and opportunity to get to travel the world whilst working. Merchant navy although being a glamourous profession it is also sacrificing and quite challenging. Professional in merchant navy career gets to meet and socialize with people of different nationalities and cultures. The profession encourages individual to work as team and automatically increases adaptability to the situation and environment. As merchant navy is a tough and tiring job the vacations and the tax-free salary offered to the marine professionals are equally compensating towards the sacrifices. Being a merchant navy officer, you will have to do the most responsible job throughout the day. Every career needs professional skills but merchant navy profession demands both professional and personal qualities. Besides being mentally and physically strong you must possess:

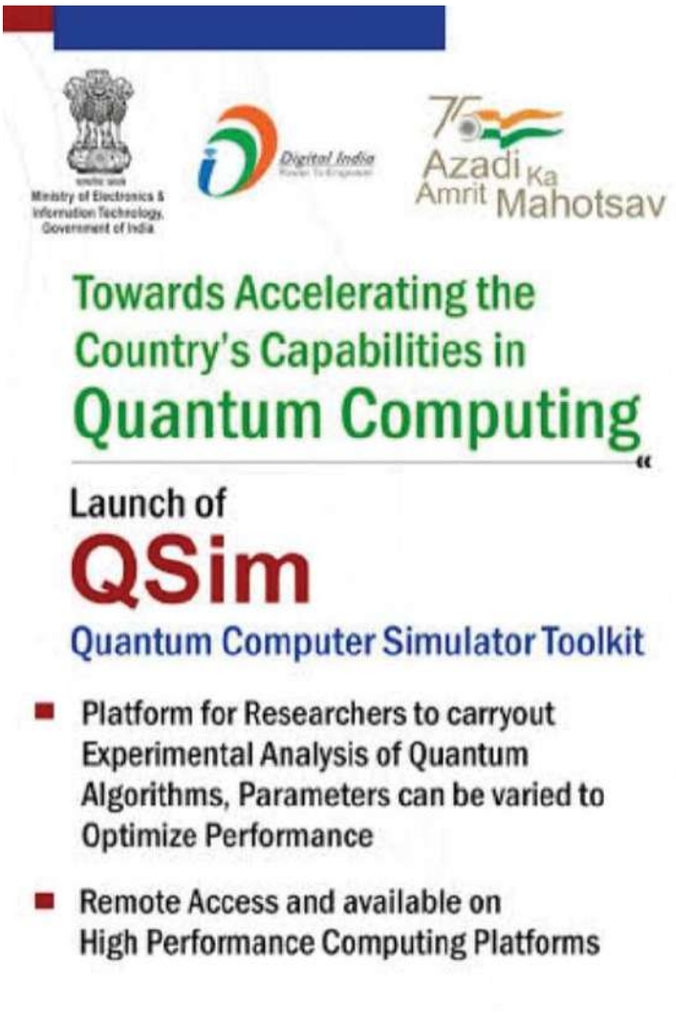
- ***Effective communication Skills***
- ***Leadership***
- ***Teamwork***
- ***Self-Control***
- ***A zeal for Adventurous and Challenging Career***



Binet Kr. Mishra
MRE, 2nd YEAR
SOMS



INDIA DEVELOPS IT'S FIRST QUANTUM COMPUTER SIMULATOR TOOLKIT



The News

Recently, India's first Quantum Computer Simulator (QSim) Toolkit was launched by the Ministry of Electronics and Information Technology (Meity) which is considered as the first-of-its-kind toolkit to be indigenously developed in the country.

The development of the QSim toolkit is a collaborative effort of IISc (Indian Institute of Science) Bangalore, IIT (Indian Institute of Technology) Roorkee and C-DAC (Centre for Development of Advanced Computing).

What Is QSim?

Quantum computing is a rapidly emerging computational paradigm that can perform a variety of tasks with greater speed and efficiency than present day digital computers by harnessing the power of Quantum Mechanics.

In areas such as cryptography, computational chemistry and machine learning, Quantum computing promises exponential growth in computing power.

QSim will also assist researchers to make necessary arrangements for experiments to run on actual Quantum Hardware.

It will work as a platform where students and users can acquire the skills of 'programming' and 'designing' real Quantum Hardware.

One of the unique features of QSim is its Intuitive User Interface, which offers a robust Quantum Computer Simulator integrated with a Graphical User Interface based Workbench to create Quantum programs and visualize the instant circuit generation simulated outputs.

Rabi Paik
MRE, 3rd YEAR
SOMS

POEM

ভ্যাকসিন ভ্যাকসিন ভ্যাকসিন ভায়া
নিলে কোনটা কোভ্যাকসিন না কোভিশিল্ড?
এসো দেখি,গল্প হোক কিছুক্ষন
দেখা হয়নি যে অনেক দিন!
ও দাদা.. চা লাগান, একটায় চিনি কম দিন,
আহ্ আর ভালো লাগেনা ঘরে বসেই কেটে যায়
দিনের পর দিন!
ওয়ার্ক ফ্রম হোম ভায়া
সে কি বললে চলে? সুস্থ আজও আছি যে আমরা
ভগবান কে ধন্যবাদ দিন!
হ্যাঁ তো কি নিলে বললে না তো তুমি,
“ওই নিয়েছি আমিও,কোভ্যাকসিন”
যেই না বলে উঠলাম নানা দিক থেকে এলো স্বর ভেসে
“কোভ্যাকসিন ভালো,না না ওর থেকে কোভিশিল্ড ভালো”
কেউ আবার বলে উঠোলো
“না বাবা স্পুটনিক ছিল সব থেকে কার্যকরী,
ভাগ্যিস আর পাওয়া যাচ্ছে না বলে,
পেলেই নিয়ে নিতাম নয় মোটা দাম দিয়ে”
উফফ্ এ কি মুশকিল সব ই তো ভ্যাকসিন!
একি কাজেই লাগে,
এতেও কি বাছাই করা টা,না করলেই পারতে?
বরং এই তক্কো ভুলে,মানুষ কে উৎসাহ দিন
“ ভ্যাকসিন নিতে বলে!”

..... -ঋভু।

Hribhu Debnath
BSc(H), BT, 3rd YEAR
School of Science and Technology

Subham Jana, EE

THE WORLDNEEDS YOU

When things go wrong never lose hope
Ask from heavens the strength to cope
Life's though not a fairy tale
The journey isn't uphill always as well

When times are all frost and blinding snow,
Leaving us jilted and feeling low,
Values strong, values right
Will give us the zeal, the power to fight!

Never lose courage, never lose faith,
Kindle love and shun hatred.
Spread glory far and near
Be the healer with your hands and care.

With a mind sacred and austere heart,
Blissfully in life do play your part.
Never let a moment pass in vain.
And the key to all joy is yours to gain.

Let's make the world is better place,
Let bring a smile on every face,
Christ the Redeemer died for man
Be todays Saviour, if you can.

The world needs you this hour the most
Awake, arise, give life a toast!

Rajrupa Mitra
ECE, 4TH YEAR
NITMAS

Ranit Bhowmick
RE, 2nd YEAR
School of Science and Technology

A BRIEF HISTORY OF PANDEMICS & VACCINES

Diseases and pandemics have been linked for centuries. The first time the human race experienced an outbreak was in 1350 BC, plague of Megiddo. The data is more of an estimate as it wasn't recorded in sophisticated manner. The location of this incident was Megiddo, land of Canaan. As found in transcripts, the data found as evidence was Amarna letters EA 244, by Biridiya, mayor of Megiddo who complains to Amenhotep III of his area being 'consumed by death, plague and dust'. Ref. Amarna Tablet 244.

Today, as we are in between an ongoing global pandemic, the one thing that has become clear to all of us is the value or importance of vaccines, it has saved us before and it will save us again. Vaccines are also called immunisations because they use our natural immune system's ability to prevent infectious illness. The main idea behind vaccines is to stimulate an antibody memory response without actually producing an illness. When this happens, you get the immunity without getting the actual disease. A vaccine must contain at least one antigen from the disease causing bacteria or virus in order to get a response.

Speaking of Vaccines, the first one was used in 1796 by Dr. Edward Jenner, he tested the rumoured theory of how smallpox can be prevented if one already has been infected by cowpox. Dr. Edward infected a boy, James Phipps, with cowpox pus on 14th May 1796, and 1.5 months later with smallpox pus to test the theory, James did not get small pox as he had been ill by cowpox when he was first vaccinated. This concluded that injection of a non deadly germ can help fight deadly germs. Of course, at this time there were many challenges faced by this theory and people feared side effects, they even believed that one would grow tails or start looking like a cow if they took the vaccine! In fact, it was not until 1850s, countries in Europe finally passed laws to mandate vaccination against small pox. Since then, the concept got more attention and researchers started experimenting more around the idea and created various vaccines for diseases.Polio is another disease that still affects many people around the world, Jonas Salk, a US scientist invented the first polio vaccine in 1954. Later, in 1957, Albert Sabin, another American scientist invented a more effective vaccine, this vaccine wiped out Polio in many countries. Today, as we fight covid we see scientists coming up with different vaccines to help humans fight this deadly stand of SARS, hoping this covid is eradicated soon!

FUN FACT:

Scientists have been lately working on non invasive methods of vaccination that could be eaten instead, they are known as genetically engineered plants that contain vaccines.

References:

Book- The History of Medicine by Micheal Woods & Mary B Woods

Websites:

https://www.winchesterhospital.org/health-library/article?id=222982

https://en.wikipedia.org/wiki/List_of_epidemics#cite_note-Amarna-31

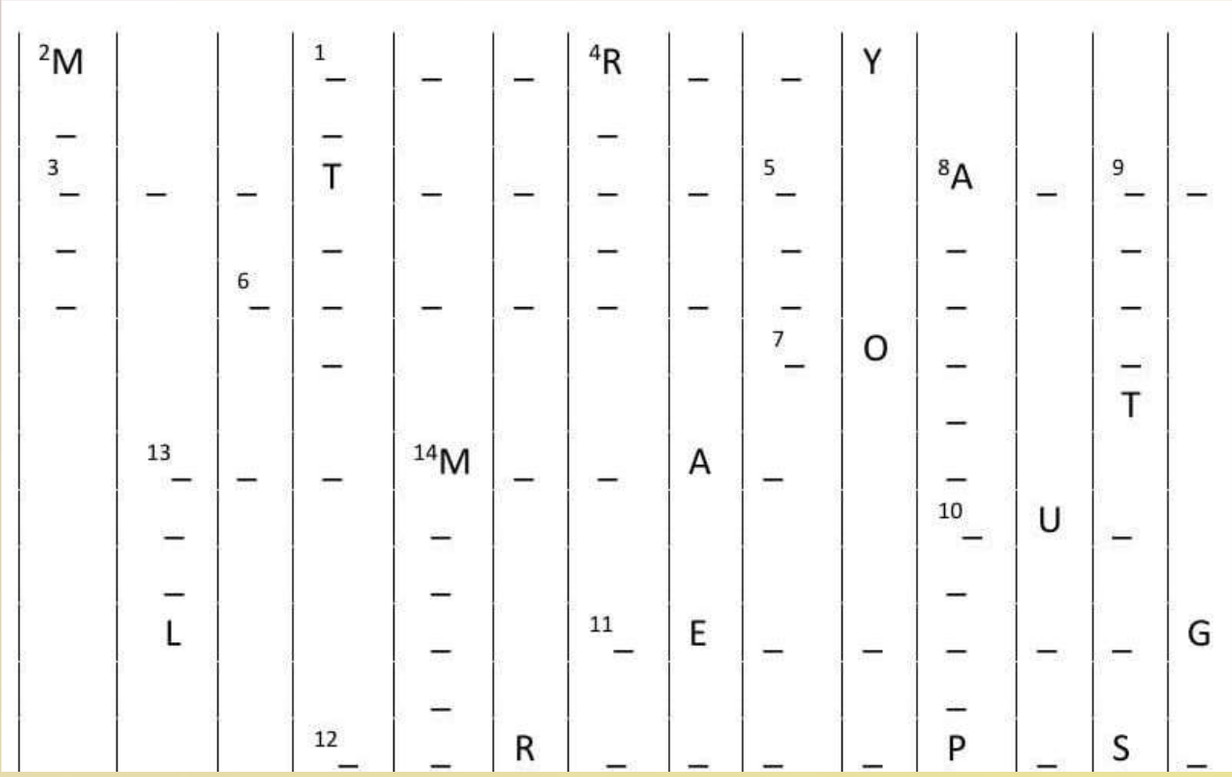
Drishti Mukherjee

Int. MSc Biotechnology, 5th year

School of Science and Technology

drishtimukherjee62.dm@gmail.com

CROSSWORD PUZZLE



ACROSS

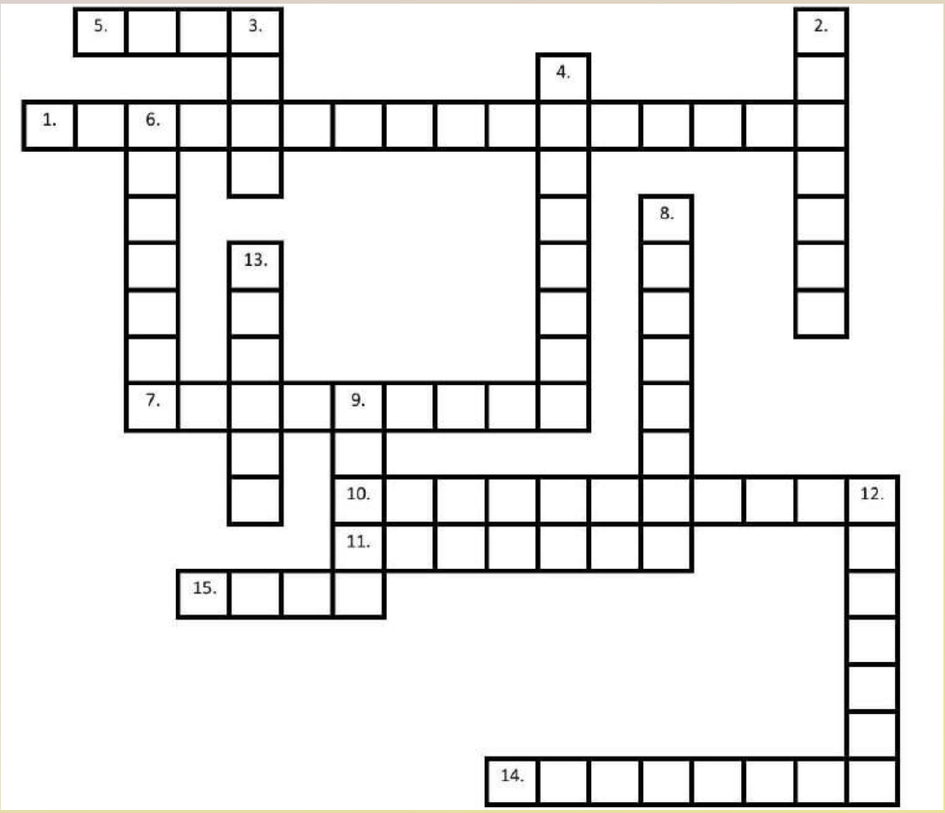
1. A navigable part of a river, bay or harbor
3. The Biggest Port in Europe
6. Also called the North Star
7. Pushes or pulls vessels on a waterway
8. Automatically provides a radar target's speed, course and Closest Point of Approach
10. Assists other vessels into and out of port
11. Process of securing a ship in its allotted place
12. It's a non-magnetic compass
13. A Person who steers a ship or boat

DOWN:

1. Nautical term for 6 feet
2. Signaling code using dots and dashe
4. Detects targets from a ship using radio waves
5. Vertical structure carrying the sails of a sailing vessel
8. From side to side across a ship
9. The Guide who helps navigate the ship during Port Entry
13. The Ship's exterior (Shell)
14. The international radio signal used as Distress Call

Swapativ Chaudhari
BNS, 3rd YEAR
SOMS

CROSSWORD PUZZLE



Clues for across

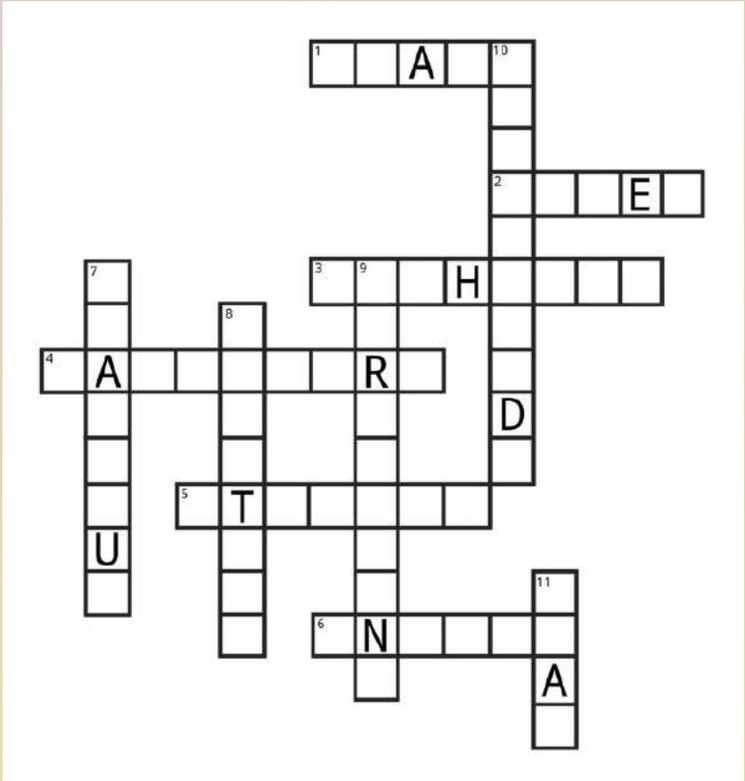
1. Propulsion system that includes two or more source of propulsion in one design
5. Factor in force
7. Directly ahead on the extension of the ship's fore and aft line
10. Get away from ship, as in an emergency
11. Code flag which means affirmative
14. A man who works on ship for a living
15. Flag which means Diver below, keep well clear at slow speed

Clues for up and down

2. Ship to shore link
3. A large boat for transporting people or goods by sea
4. Partition in a ship
6. Strongest post in ship for attaching mooring lines
8.Becketted line around outside of a life boat fitted for man in water to grasp them
9. Plant indigenous to Philippines from which manila hemp is made
12. A short piece of rope secured in the bow of a small boat used for making her fast
13. Board a ship

Souvik Mondal
BNS, 3rd YEAR
SOMS

CROSSWORD PUZZLE



Clues for across

1. I am an antimicrobial substance especially active against Bacteria
2. Movement of Cancerous cells from one to another part of the body
3. I am the genetic information carrier in nearly all living beings. Who am I ?
4. I generate most of the chemical energy needed to power the cell's biochemical reactions. Who am I?
5. I control the level of blood cells, also remove any old or damaged RBCs. Who am I ?

Clues for up and down

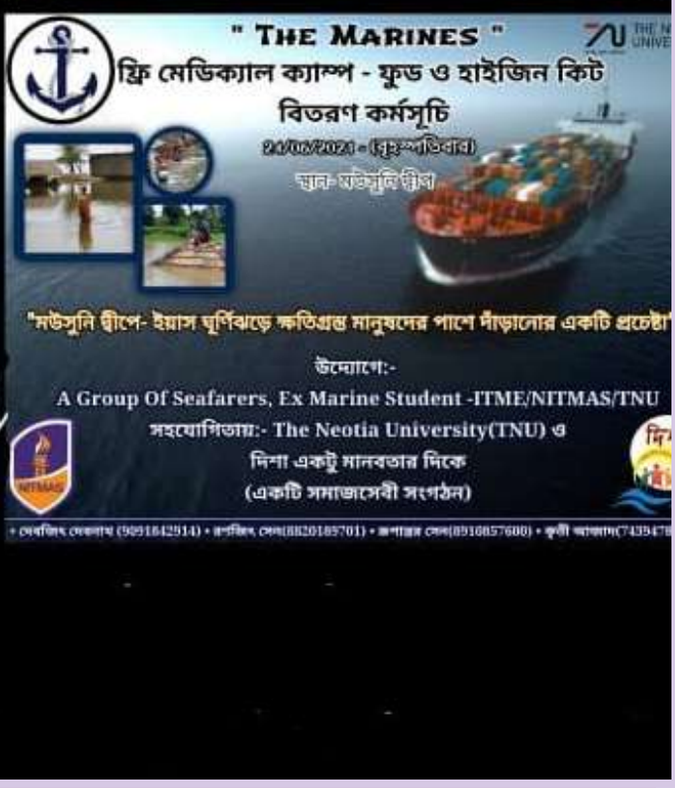
6. I am a biological substance that lowers the activation energy of a reaction.
7. Change in the structure of parent gene is called
8. I am a body part responsible for coordinating voluntary movements. I am also called 'Little Brain'
9. I recognise and protect your body against foreign pathogen. Who am I ?
10. Anti-inflammatory medicine that contains 17 carbon atoms arranged in four rings.

Sourin Das
BSc(H),BT, 3rd YEAR
School of Science and Technology

NEWS

দিশা

FB.COM/DISHAYOURFRIEND



thank you all who extended kind help

NEWS

পশ্চিমবঙ্গের মেরিন ইঞ্জিনিয়ারিংয়ের ছাত্ররা ত্রাণ নিয়ে মৌসুনি দ্বীপে

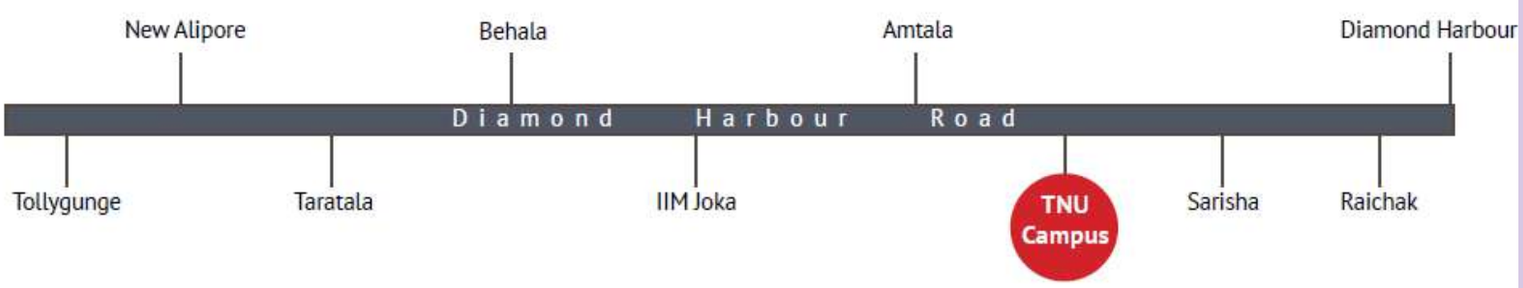
সিদ্ধার্থ সিংহ জুন ২৮, ২০২১

ভারতের পশ্চিমবঙ্গের দি নিওটিয়া ইউনিভার্সিটির মেরিন ডিপার্টমেন্টের এক ঝাঁক প্রাক্তন এবং বর্তমান ছাত্র ইউনিভার্সিটির সহযোগিতায় আয়োজন করেছিলেন ত্রাণ এবং বিনামূল্যে চিকিৎসা শিবিরের।

মৌসুনী দ্বীপের দুর্গত পরিবারের পাশে বেসরকারি বিশ্ববিদ্যালয়

নিজস্ব সমাচার, গামখানা ঃ গত ও পূর্ণিমার ভরা কটালে মৌসুনী দ্বীপের দুর্গতি পরিবারগুলির পাশে দাঁড়াল ডায়মন্ড হারবারের দি নেওটিয়া ইউনিভার্সিটি। শুক্রবার তারা

খাদ্যসামগ্রী ও মশারি দেয়। আড়াইশোর বেশি পরিবারের হাতে মুলত প্রতিবন্ধীদের জন্য এসব দেওয়া হয়। পাশাপাশি ফ্রি মেডিক্যাল ক্যাম্পেরও আয়োজন করা হয়। কলেজের ছাত্র রূপান্তর সেন বলেন, এখানে প্রচুর ক্ষতি হয়েছে। না এলে বোঝা যেত না।



AmbujaNeotia

THE NEOTIA UNIVERSITY
জ্ঞানম্ আদ্য ঘরীযায

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