

St. Xavier's College (Autonomous), Kolkata

Department of Computer Science



X-CRYPTUS

Volume IV Connecting the New Normal



1815 - 1852



The more I study, the more insatiable do I feel my genius for it to be.

"



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Rev. Dr. Dominic Savio, SJ Principal

I hereby take great pleasure in announcing that the Department of Computer Science of St. Xavier's College (Autonomous), Kolkata, has published their annual technological magazine, X-Cryptus Vol. IV, a culmination of technological prowess and literary finesse in a single piece of work. Being a success in each of its previous publications, we can be rest assured that this edition will also provide us with content just as impressive and enriching, if not more.

We all stand witness to technology progressing with leaps and bounds into the future, to make the present easier for us. Taking cognizance of that, the theme chosen for the magazine this year is "Connecting the New Normal". It also acts as a tribute to technology and the people tirelessly working with it who have been devoted to building better connectivity for work and education in these critical times that we have been coping with. While we may be gradually getting back to the state of affairs as it was before Covid, the past two years continue to impact our present, shaping a 'new normal' that we now find ourselves in. This period also stimulated major advancements in technology owing to the pressing need for greater correspondence. The magazine places emphasis on these advancements, how they have been intrinsic to the massive changes we have been through, and how they will continue to affect our future.

Having organized eXabyte 2022, the Annual Technological Festival, on 10th and 11th February, that too with much triumph, we now look forward to the Department's Annual Magazine with greater enthusiasm. With contributions from not only students across all departments, but also professors and distinguished guest writers, the Editorial Board has flawlessly compiled the magazine for this year, and is as eager to present it as we are to receive it. I would also like to take this opportunity to congratulate the faculty and students of the Department of Computer Science for their ceaseless efforts, which will definitely make this edition of X-Cryptus a success too, and also wish them benevolence in all their future endeavors.



Prof. Bertram Da' Silva

Vice-Principal Department of Arts and Science

The New-Normal has made us all realize that we do not use technology, but we live technology. And Computer Science is the heart of it all.

The Department of Computer Science with the fourth volume of X-Cryptus, yet again has proved that the department is one of the most vibrant in the college, with talented young minds.

The magazine invites articles from diverse students and researchers, reflecting the potential that the youth of the country possesses.

I congratulate the Department of Computer Science for maintaining the professionalism and academic quality of X-Cryptus from its inception. I wish the department, the professors, and the students, all the very best for their ingenuity and state-of-the-art presentation.

X-Cryptus Volume IV



Dr. Tapati Dutta

Dean of Science

I am extremely pleased to be a part of the annual magazine X-Cryptus, by the Department of Computer Science. I take this opportunity to congratulate the department whose collective efforts have culminated in the successful launch of this issue. The theme 'Connecting the New Normal' not only rightly justifies the current unforeseen situation but also provides hope for the future. The magazine serves as a testimony to the enthusiasm of our students beyond the defined curriculum of study. I wish the department all the best for all future endeavors.



Dr. Romit S. Beed

Head of the Department Department of Computer Science

I am very happy to announce that, after the grand success of our annual technology festival, "eXabyte 2022", which was hosted virtually this year, we are launching the fourth edition of the departmental magazine, "X-Cryptus".

The magazine is themed "Connecting the New Normal" and aims to give an outlook on how technology is connecting and revolutionizing the world and give a glimpse into the future that it holds. The magazine has culminated the works of students from various departments and grants insights about modern technological innovations and future advancements. The magazine offers a tribute to Lady Ada Lovelace, who is widely regarded as the first person to write a computer program, presenting her life and contributions. The magazine also contains guest articles and interviews of eminent personalities from various fields, sharing their insights and experience.

I would like to congratulate the Editorial Board and the Design Team on the successful completion of the magazine after months of hard work and dedication. I express my heartfelt gratitude to our respected Principal, Rev. Dr. Dominic Savio, SJ, for his continued support and guidance. I would also like to thank our Vice-Principal Prof. Bertram Da' Silva, the Dean of Science Dr. Tapati Dutta, the Dean of Arts Dr. Argha Banerjee, Dr. Ayan Chandra, Member Secretary, Academic Council, and Dr. Partha Pratim Ghosh, Coordinator, IQAC, for their encouragement and support. Lastly, I would like to thank the faculty and students of our department for their effort and contribution.

X-Cryptus Volume IV



Mr. Anweshan Mukherjee

Student Convenor

The world, which had initially been shaken up by the unprecedented times, gradually got cured by doctors and connected by technology, forming the 'New Normal'. Standing in mid-2022, we can hardly think of any application in our daily lives which is devoid of the use of technology.

This edition of X-Cryptus focuses on how technology has served humanity throughout the tough times we are in since March 2020. The editorial board has put in their strenuous efforts in compiling the whole magazine, which has received more submissions than any of the previous editions.

I want to thank our Principal, Rev. Dr. Dominic Savio, SJ, our Vice-Principal (Arts and Science), Prof. Bertram Da' Silva, our Dean of Science, Dr. Tapati Dutta and the Head of the Department of Computer Science, Dr. Romit Beed, for always supporting and encouraging us in every way possible. I can never thank enough Dr. Anal Acharya, Dr. Asoke Nath, Prof. Kaushik Goswami and Prof. Shalabh Agarwal for being the supporting pillars of this magazine; the Student Editorial Board, led by Suvranil Dutta Biswas (Editor-in-Chief); the Designers, Shreea Bose and Monimoy Ghosh; and Arnanta Chatterjee (former Editor-in-Chief of X-Cryptus which could not be published due to the pandemic) for their constant hard work and dedication towards X-Cryptus Vol. IV.



Mr. Suvranil Dutta Biswas

The Editor's Desk

It was around two years ago when everything started to change abruptly. The definition of normal started to be redefined. Two years down the road, numerous changes have shaped our society into what would have been unimaginable a decade ago. Amidst these changes, new strides in technology have taken communication and collaboration to an unprecedented high. As we are adjusting to the new normalcy, I am proud to present to everyone, the fourth edition of X-Cryptus that is themed "Connecting the New Normal".

"Connecting the New Normal" explores how innovations in technology have revolutionized the way people and enterprises interact, work, and function. With the advent of the internet, the world started being described as a global village. Now, it can be said that a person can have the world in his palm.

While X-Cryptus is the departmental magazine of the Department of Computer Science in name, in spirit, it is the culmination of efforts of the students of multiple disciplines. I would like to thank all the students who have given their time and effort to make contributions to the magazine. This magazine could never have been completed without the guidance and support of our Principal, Rev. Dr. Dominic Savio, SJ, our Vice-Principal of the Department of Arts and Science, Prof. Bertram Da' Silva, and our Dean of Science, Dr. Tapati Dutta. I would also like to thank Dr. Romit S. Beed, Head of the Department of Computer Science, for his unconditional support and encouragement, Dr. Anal Acharya and Dr. Asoke Nath, who went to great lengths to review and provide valuable feedback to bring out the most from the magazine. I would like to commend the Student Editorial Board for their hard work and effort as well as the designers who have worked hard to give the magazine its visual appeal. Lastly, I would like to thank Mr. Anweshan Mukherjee, Student Convenor, eXabyte 2022, for his support and help.

ABOUT THE DEPARTMENT

"Technology is just a tool. In terms of getting the kids working together and motivating them, the teacher is the most important " - Bill Gates

In times of crisis, when the world is fighting together, against the invisible enemy, and progressing slowly towards what we call the 'new normal', it is undeniable that advancement in science and technology has thrown a light of hope to the human race.

It has to be agreed that computer science has played an eminent part in our day-to-day life. The beauty of the subject lies in the fact that it is in perfect harmony with almost any subject that we can think of. Connecting the New Normal would not have been possible without the plethora of Research and Development work being done in the advanced field of computer science, which has a vision, a vision to change the world, questioning itself every time, "Can we do better?"

Right from the time of its inception in 1995, the Department of Computer Science had the vision of breaking notions, and is capable of winning wars, even with the microscopic enemy. The department of computer science, having completed its Silver Jubilee in 2020, has achieved a few milestones on its way. In the year 2021, the department introduced its Ph.D. course in Computer Science. The department of computer science is a centre of excellence, providing opportunities for innovation and research to its students. The department continues not only to excel in academics but also in co-curricular activities under the guidance of dynamic professors and support staff members, headed by Dr. Romit S. Beed.

The faculty at the department of computer science ensures that the very roots of the subject, i.e. innovation, move on constantly, crossing boundaries every time. The department currently offers programmes for BSc, MSc, and PhD. Our department has been producing quality professionals, working in reputed IT firms like TCS, Wipro, IBM, PWC, Deloitte, etc. Many students opt for higher studies across India in reputed Universities/Institutes like NIT, Jadavpur University, IIT, etc. Some of them have been selected for education and scholarship programs abroad, in colleges and universities like Oxford University, Worcester Polytechnic Institute, Massachusetts, and RWTH Aachen University, Germany. Our students continue to bring us fame and glory through their academic achievements. Our students have been the representatives of the college at various National and International conferences. Our students have been in the limelight with their research papers published in acclaimed National and International Journals published by Springer, Sage Publications, IGI Global, and IEEE.

The department along with its student base is committed to its endeavor to deliver to the society groomed men and women who are ready to face all challenges that this world has to offer. They continue to give effortless solutions to various problems plaguing the world, without forgetting the implicit pillar of the subject in asking, 'Can we do better?'





Our hearts started pounding faster as February arrived and imported the first-ever online edition of the Annual Technological Festival of St. Xavier's College (Autonomous) Kolkata, eXabyte 2022.

The year 2022, witnessed a phenomenal version of eXabyte which earned 1150+ registrations. Students from 62+ colleges from all over India participated in 11 events organized in two days of eXabyte. eXabyte 2022 organized an abundance of events from photography to cryptography, coding, designing, and many more that captured the hearts of such a wide range of participants. eXabyte 2022 stood more successful than it ever was.

Even amidst the current unprecedented situation, the remarkable event emerged with flying colors on the 10th and 11th of February,2022. The celebration of technology was initiated with an opening ceremony graced by Mr. Tamal Chakravorty, Group Head of IT, Landmark Hospitality - Middle East and India; Mr. Sanjay Prasad, Chief Information Officer, RPSG CESC Power Group; Rev. Dr. Dominic Savio, SJ, Principal, St. Xavier's College (Autonomous), Kolkata; Dr. Romit Beed, Head of the Department of Computer Science along with all other professors and students of the Department of Computer Science. An insightful and enlightening speech by Rev. Dr. Dominic Savio, SJ marked the inauguration of the two-day technological festival

The opening ceremony was followed by "Trends and Techniques in Computer Science", where eminent IT personalities, Mr. Tamal Chakravorty and Mr. Sanjay Prasad gave insights on the latest technologies and shared their experience in the field of Information Technology. The interactive session made the students familiar with the technologies of the future and experiential learning. The first day of eXabyte came to an end with the conduction of events like Snappit, Byte Tales, Em-Bleed, eXathon, Digibit, and X-Hunt. The second day engaged the participants in events like Verb-O-War, Codeplay, Webbed, Brainstorm, and the second rounds of eXathon and X-Hunt, and finally, the day came to an end with Pitch-to-Rich. The two days of eXabyte were endorsed with coding clashes, catchy and competent web designs, breakthrough business ideas, captivating prose, and mesmerizing photographs.

The phenomenal success of the first online colossal event is the outcome of the ceaseless efforts of the students of the Department of Computer Science, which shall be remembered forever.



To Lady Ada Lovelace

(10/12/1815 - 27/11/1852)



The Enchantress of Numbers – as she was popularly acknowledged, Ada Lovelace is said to be the world's first computer programmer. In a field where female personalities, though significant, were infrequent, she was the pioneer who first recognised the power of the mighty 'computer'. Here is a tribute to the mathematician, the programmer, the researcher, the bold, and the visionary, an icon for every computer enthusiast!

Born on 10 December, 1815 as Augusta Ada Byron, she was the only legitimate child of the notorious yet romantic poet Lord George Gordon Byron. But her birth was not celebrated much as Lord Byron expected a 'glorious boy'; thus eventually her mother Lady Anne Isabella Milbanke Byron separated from her husband, taking five-week-old Ada with her. She never saw her father again.

Lady Byron's obsession to prevent her daughter from inheriting her father's moody and unpredictable temperament led to Ada's unusual upbringing. She was taught mathematics and science from an early age. It may be a norm for us in the 21st century but it was not standard for women in the mid-19th Century. She was tutored by William Freud, William King, and Mary Somerville, the noted 19th Century researcher and scientific author, who later introduced her to Charles Babbage – the 'Father of Computer'. Thus, she developed a keen interest in mathematics and science.

When Ada was twelve years old, she wanted to fly. Methodically yet passionately, she began her project. As her first step, she constructed wings in February, 1828. She even examined birds and decided on the required equipment. She recorded her findings and illustrations in a guide called 'Flyology'. More than half a century before the Wright brothers had their first flight!

Her educational and social exploits brought her into contact with scientists such as Andrew Crosse, Charles Babbage, Sir David Brewster, Charles Wheatstone, Michael Faraday, and the author Charles Dickens, contacts which she used to further her education. Ada described her approach as "poetical science" and herself as an "Analyst (& Metaphysician)".

In spite of Lady Byron's attempts, Lovelace discovered her inner poet, often integrating poetry and science. While studying differential calculus, she wrote to De Morgan:

"I may remark that the curious transformations many formulae can undergo, the unsuspected and to a beginner apparently impossible identity of forms exceedingly dissimilar at first sight, is I think one of the chief difficulties in the early part of mathematical studies. I am often reminded of certain sprites and fairies one reads of, who are at one's elbows in one shape now, and the next minute in a form most dissimilar" Lovelace believed that it was vital to have intuition and imagination to effectively apply mathematical and scientific concepts.

On 8 July, 1835, she married William King, who was made Earl of Lovelace in 1838, Ada thereby becoming Countess of Lovelace.

By the time Ada was a teenager, the Industrial Revolution was in full force. It was a glorious time in history for the advancement of technology and a perfect time for inquisitive Ada to shine. In 1833, seventeen years old Ada meet Charles Babbage where he learned that Ada was very knowledgeable about mathematics and so he unveiled to her a small part of his latest machine, a massive mechanical calculator known as the "Difference Machine". The design for Babbage's machine was revolutionary. Ada was completely captivated by the concept; she understood its working and saw the great beauty of the invention. Babbage was impressed by Ada's intellect and enthusiasm for the machine. From that day Babbage became her mentor and life-long friend.

In 1834, Babbage came up with a far more complicated machine which he called the "Analytical Engine" - the world's very first programmable general-purpose computer. The basic structure of the engine is essentially the same as modern-day computers except that the machine was massive in size. Indeed, the Analytical Engine concept was completely ground-breaking and a work of incredible genius on Babbage's part. Ada was deeply interested in the genius behind the machine and wanted to know how it works. For the next ten years between getting married and having three children, Ada focused all her energy on learning everything she could about the Analytical Engine. She said, "The Analytical Engine weaves algebraic patterns just as the Jacquard loom weaves flowers and leaves".

Ada Lovelace is credited with writing the first computer program. In 1843, Ada published a complete article about the Analytical Engine in the Scientific Memoirs. In this article, Ada wrote how the engine could be programmed with a code to calculate with numbers. This was an algorithm – the Bernoulli number algorithm - to be carried out by the machine and thus the first computer program. She was the first to introduce the concept of coding. Ada's papers on Analytical Engine later on greatly influenced a scientist called Alan Turing who is now considered as the father of theoretical computer science. Ada's work influenced Turing's concept of The Universal Turing Machine.

Seeing some mechanical looms using punched cards to direct the weaving of beautiful patterns, reminded her of how Babbage's engine used punched cards to make calculations, and she developed the historic insight that a calculator, or essentially a computer, could be instructed to handle not just numbers but anything that could be notated in logical symbols, such as music or words or graphics or textile patterns. In other words, she envisioned the modern computer. She drew up a step-by-step sequence of operations for programming Babbage's engine to generate the complex series of Bernoulli numbers. It included subroutines, recursive loops, and a table showing how it would feed into the computer, all of which would be familiar to any C++ coder today. It became the first published software program, earning Ada the title of "the world's first computer programmer."

Although this is still a topic of controversy with many historians having different opinions, Ada Lovelace was a "visionary" and a "prophet" for the age of computers. In 1932, Ada began translating Luigi Federico Menabrea's paper, "Sketch of the Analytical Engine" to English for *Scientific Memoirs*. She was encouraged by Charles Babbage to annotate the translation. This led to Ada publishing the first paper which in detail discussed the programming of a computer. It was also the only such paper that existed in the next century.

Ada greatly elaborated on Menabrea's descriptions and performed in-depth research on programming the Analytical Engine. Her emphasis was on the computational importance of the engine's ability to branch to different instructions based on certain conditions, and she drew the distinction between what was theoretically possible to compute and what was, in reality, impractical. Ada also wrote about the benefits of the Analytical Engine's ability to reuse code. In addition, she identified its potential to compose music:

Supposing, for instance, that the fundamental relations of pitched sounds in the science of harmony and of musical composition were susceptible of such expression and adaptations, the engine might compose elaborate and scientific pieces of music of any degree of complexity or extent.

Lovelace's vision of the Engines' potential for the future of computation may now be seen as having exceeded Babbage's own vision for his machines in several key ways. She became the first person known to have crossed the intellectual threshold between conceptualizing computing as only for calculation on the one hand, and on the other hand, computing as we know it today: with wider applications made possible by symbolic substitution.

Ada died of uterine cancer on 27 December, 1852, at the age of 36, and at her request, was buried beside the father she never knew. In her memory, the second Tuesday of every October is recognised as Ada Lovelace Day, since 2009, to celebrate the achievements of women in science, technology, engineering, and mathematics.

Ada broke new ground in computing and identifying an entirely new concept. She was far ahead of her time as well as her mentor as she saw something that even Babbage failed to see. In Babbage's world, his engine was bound by numbers but Ada saw that numbers could represent entities other than quantities. She realised that the analytical engine could go beyond numbers. This was the first-ever perception of a modern computer, not just a calculator, but a machine that could contribute to other areas of human endeavours. Ada said that anything that could be converted into numbers such as music or alphabets could then be manipulated by computer algorithms. A huge transition was made in the history of technology by Ada with her papers in 1843. Her contributions to science and technology got little recognition during her lifetime but many biographers, now, can only attest to the fascination of Babbage's "Enchantress of Numbers".



COVER STORY

"CONNECTING THE NEW NORMAL"



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Introduction

If someone had told us in April of 2019 that by April 2020, millions of people all over the world would be stranded in their own homes for an extended period of time, no one would have believed that. Doesn't the above lines sound almost like a Hollywood script? However, it has happened so fast that it almost feels unreal — situations like these point out the immense uncertainty of the times. There has never been a time in history that ever had complete certainty. In this definite uncertainty, computer science has emerged as a big player in the grand scheme of things. At a time when people living side by side became bound by barriers, when keeping a distance of one meter became the norm, computer science and technology took strides to connect this shattered world and forge a new normal.

COVID-19 has transformed how people work, with the population adapting to new ways of working. The proportion of Indians working from home has gone from one in 100 to more than one in three. COVID has been a transformation that has raised questions like - Do individual workers need to commute into the office every day? Is homeschooling with proper guidance more than enough?

These questions have emerged primarily due to the freedom and accessibility of current and emergent technologies.

Interestingly, across the eons, humans have a record of having adapted to changes from time to time. From riding horses and bullock carts, cars have become a habit today. The 20th century was the age of writing letters, but email was introduced and it became the new normal. Internet was once the right of the privileged, but now cheap and accessible internet has become the normal thing. With the speed at which technology advances, new and interesting instruments come to the forefront, which are being adapted and becoming an indispensable part of everyday life. And now the focus is shifting toward gathering the individual bits and pieces of today and connecting them to create a much simpler, enriching, and attractive platform to interact with the new normal.

We take a look at a few of the technologies that have taken strides in this direction and aim to redefine the new normal.

Hologram Tech in Meetings

"Join the Zoom meeting now!", a phrase that we've heard a million times during the past two years, and probably responded to with a groan every single time. With the pandemic lockdown approaching its second birthday in no time, it will also mark the completion of two years of all of us sitting in front of our laptop screens, looking at friends, colleagues and teachers, people with whom we haven't had a tangible interaction with ever since. Even with the Covid Graph declining, a large percentage of the population still hasn't returned to their respective "offline" workplaces. While these unavoidable online video conferences lack the feel of the workplace environment or the interpersonal interaction, the technology industry has been capitalising on this necessity. Seeing the sales of Zoom soar to 326% in the onslaught of the pandemic in 2020, other companies like Google and Microsoft also turned their attention to developing better video conferencing facilities to attract more users to their platforms. With companies, courts of law, and educational institutions implementing hybrid modes of interaction and in some cases even permanent work-from-home/anywhere policies, not only in India but all across the world, holographic technology is seeking a rapid advancement in the corporate world.

The foremost company to bring the future of video conferencing to reality was Cisco, introducing its new collaboration tool called "Webex Hologram", which aims to take virtual meetings to a completely different level by simulating an in-person meeting for the user.

As the name suggests, Webex Hologram projects 3D holograms using augmented reality (AR) headsets, providing a more immersive experience than widely-used meeting platforms such as Google Meet and Zoom, which though well-developed, still have many limitations. Producing "photorealistic, real-time holograms of actual people", this technology enables participants to share and collaborate with both digital and physical content. It was developed to assist those teams which require greater hands-on collaboration during meetings, which can't normally be achieved when working remotely. Although the tool supports the inclusion of multiple participants, the number is yet to be revealed by Cisco. With availability to limited companies right now, it is expected to be made widely available soon.

On 19 August, 2021, Facebook also announced its latest technology, known as "Horizon Workrooms", a technology which uses virtual reality to bring colleagues as avatars within a simulated meeting room. They aim to help users escape dreaded zoom calls by re-creating the alchemy of working together in person. Believing that online meetings don't work as well as offline ones, they elaborate on their concept of "working in metaverse", where they can provide higher interpersonal interaction and perception, the most crucial piece of in-person meetings which is greatly lost on camera. Workrooms belong to the Facebook Horizon, the company's VR metaverse which was earlier used primarily for gaming. Now, users can wear their VR headsets and set up an avatar to access their virtual desk. While the software provides a lot of customisations on the virtual workspace and mirrors the user's real-life movements on their avatar's gestures, it is still not fully developed. Moreover, the whole tool, and especially the headsets, are very expensive for both individuals and companies, which means that it will take time for Horizon Workrooms to become widely used.

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March 2021 also saw the launch of Microsoft's augmented and virtual reality workroom tool called "Microsoft Mesh". It is a collaborative platform allowing anyone to have shared virtual experiences on a variety of devices. While the initial aim of the technology was to present people as virtual avatars, it is now being developed to support "holoportation", which allows people to appear as themselves in a virtual space, basically making the user feel like they can teleport from various mixed reality devices and be with people despite not being physically present together, that too in real-time. It is much more immersive than Zoom video calls, enabling organisations and colleagues to collaborate in a mixed reality gathering as if everyone was actually present in the same room, even if they were joining in from all across the globe.

"Project Starline" is another 3D video conferencing tool which has been under development at Google, surprisingly since much before the pandemic. Although it is a hologram-like tool, it is predicted to be impressively realistic compared to other hologram technology. This is because it involves sitting in a booth fitted with cameras and sensors which capture your image and movements from different angles and then transmits this imagery to another identical booth located elsewhere, in which the person you are meeting with is seated. The booth also includes spatial audio to simulate the actual sound of the person's voice-over instead of it coming from a definitive speaker. However, beyond the Big Tech, other companies have also been disrupting virtual meetings. ARHT Media based in Canada launched a 3D digital system which could place users into meetings virtually, enabling them to appear in not just one, but multiple places at the same time. Another tech-startup based in the US, called Spatial, also facilitated holographic-type meetings using the Oculus Quest headsets by Facebook.

With so many companies developing such tools and technologies to bridge the gap between in-person and online meetings, they are after all fundamentally relying on the necessity of other organisations and institutions for better tools to improve remote connection. While there is an immense irreplaceable value to seeing others face-to-face, people are also realising the importance of time, and how much of it is saved by opting for virtual meetings instead. With an elevated expectation of hybrid workspaces, it is highly likely that many organisations will continue with online meetings and invest in better technology to make them more immersive. Only time will tell whether virtual will be the new reality.

India's Vaccine Intelligence Network - CoWIN

It was the March of 2020 when the invisible enemy struck, and wearing masks and staying locked inside our homes became the new normal. Fast forward two years from that time, India has barely recovered from

the third wave of coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and is currently preparing to mitigate the predicted fourth wave of COVID-19 in the coming months. To avert the subsequent waves of the COVID-19 in the nation, in part linked to emerging variants of concern such as the Delta (B.1.617.2) and Delta plus (B.1.617.2.1), among others such as the variants of interest, the Government of India is executing the mass vaccination program with dual-dose vaccines Covishield (AstraZeneca/Oxford), Covaxin (BBV152 A, B, C), and Sputnik V. So far, the country has delivered more than 1700 million doses to its population. However, a big challenge has been unleashed amid the mass COVID-19 vaccination drive in the form of fake vaccines. India, known to be the world's largest manufacturer and distributor of vaccines, started its free vaccine programme on 16 January 2021. To administer vaccines to its 1.38 billion population, the National Expert Group on Vaccine Administration for COVID-19 was formed to oversee collaborations at national, state, and district levels for effective vaccination and roll-out.

In West Bengal and Maharashtra, around three thousand people had been vaccinated by the fake COVID-19 vaccines which include distilled water, glucose, and antibiotic agents. The fraudsters have generally pasted the labels of Covershield (AstraZeneca/Oxford) or Covaxin on the injection used for curing bacterial infections. As the COVID-19 vaccines administered in these instances were fake, the beneficiaries did not receive any vaccination message on registered mobile numbers. As per the directives of the Government of India, to avail the facility of the COVID-19 vaccine, all beneficiaries had to register on the CoWIN app portal with a valid identity card and mobile number. After the vaccine registration, the beneficiary gets a message of successful COVID-19 vaccination and a link to download the vaccination certificate.

CoWIN (COVID-19 Vaccine Intelligence Network) is a version of eVIN (Electronic Vaccine Intelligence Network), developed in partnership with the United Nations Development Programme (UNDP) and the Ministry of Health and Family Welfare. CoWin is used to collect real-time data on the vaccination programmes. This platform not only tracks vaccinations on a real-time basis, but also the wastage of doses. The CoWIN software is a robust, dependable, and agile technology. It offers anytime and anywhere registration for COVID-19 vaccination. The capacity of the servers has been ramped up, in order to match the unprecedented scale of immunization. Inclusivity, speed, and scalability have been kept in mind while designing the unique digital platform with all components being portable, synchronous without excessive and unnecessary dependencies.

Under the Digital India initiative, the country has been focusing on increasing the reach of technology. QR code scan-based batch number registration (identification) in the government website should be made mandatory before opening a vial.

QR code scanning has been incorporated into the CoWIN app as well. The Government of India has taken a step to link the Indian passports of the fully vaccinated people on the CoWIN application for its use during international and domestic travel.

MAJOR CHALLENGE

But just storing data would not be enough. There can be data redundancy at times when a person registers with a different mobile number. Considering the sensitivity of data, security would be of prime importance too. The main challenge is the data, not the CoWIN software itself. Considering the scale of the data, it is a pain for the developers to manage the huge chunk of data.

Technical challenges: The app may crash due to massive traffic on the network. Another challenge is the delay in OTP generation for further actions. Users have taken to social media sites, complaining about their experience.

Privacy policy: The app has no specific privacy policy in place and is linked to the National Health Data Management Policy. The Data Protection Bill has also just been passed recently in the parliament. The government has said that it cannot provide the privacy policy for CoWIN as it is accessible only to central and state governments.

FUTURE SCOPE

The technology should be combined with blockchain, artificial intelligence, and machine learning, in order to build a Peer-to-Peer network, which does not have any central authority. In this way, communication can be faster and in situ production costs can be lowered. Artificial Intelligence can be embedded into the system to give the location of vaccination centres nearby the user. Digital literacy can be improved with subsequent webinars and awareness programs at the district level of the country.

With CoWIN going global, India is on the rise to its aim of being a \$5 trillion digital economy. According to experts, by making the Co-WIN platform available to the world, India is also taking a stand that will be unique to the world. Pramod Varma, the chief architect of Aadhaar and India Stack, has said, "With CoWIN, India has created a unique model that addresses diversity, is interoperable and hence the ecosystem is friendly that allows for innovation."

Medical Robots

Artificial Intelligence has noticeably been around the corner for quite some time now. From automating rather monotonous human tasks which were too intellectual for a machine to understand and perform, AI has taken over the industry with a boom. However, AI and healthcare are two difficult terms to put together, or at least, was, even a few years ago. In a situation where a person has a health problem, that pertains to his life at large, he would rather trust a human more than a machine fed with some routine algorithm. But lately people have come to understand, that although machines are not as versatile or smart as humans are, they can be extremely efficient in what they do, however limited that domain might be. And it turns out, that is exactly what turns the game over. When performing heart surgery, the fingers of a robot will not tweak even by one centimetre outside the boundaries of what's necessary to perform. Well, it's not tired after three back-to-back operations.

We have already seen numerous research studies suggesting that AI can perform as well as or better than humans at key healthcare tasks, such as diagnosing disease. Today, algorithms are already outperforming radiologists at spotting malignant tumours, and guiding researchers in how to construct cohorts for costly clinical trials. Speaking of radiology, there are Natural Language Processing (NLP) applications that are getting better day by day at preparing reports for radiology examinations, and are quite firmly expected to dominate in analysing unstructured clinical notes, transcribing patient interactions, and conducting conversational AI in the coming future.

Robots are no more the fancy gadgets we used to see in Transformers alone. More than 200,000 industrial physical robots are installed all around the year per year. Pause, if that number did not strike you enough in the first instance. That is approximately 4 times the total population of American Samoa. So, statistically speaking, in just 3 months, every individual would be saying hello world instead of good morning there, if we wanted. Now, that is a lot, and more so as the number is actually increasing every year. 'Surgical robots', as initially approved in the USA in around 2000, are like angels to surgeons, improving their ability to see, create precise and minimally invasive incisions, stitch wounds, and so forth. The common surgical procedures using robotic surgery today include gynecologic surgery, prostate surgery, head and neck surgery, etcetera. Although the most critical decisions are still made by humans today, research suggests that it is not long in the future when a robot will decide whether the nerve that controls one's facial expressions should be pulled to the left or right. Nobody wants to end up looking like a sarcastic emoji after all, isn't it? Robots however are costly to realise, implement and maintain. The lovely little bots do not demand payment of course but do get upset if strict attention and care is not maintained.

This brings us to Robotic Process Automation (RPA), which does not really involve robots. This technology rather focuses on structured digital tasks, due to which they are easy to program, transparent in their actions, and much easier to maintain. Although these technologies can stand on their own, with recent advancements, they are increasingly being combined and integrated; robots are getting AI-based 'brains', image recognition is being integrated with RPA. Perhaps in the future these technologies will be so intermingled that composite solutions will be more likely or feasible.

Moving on from surgery, diagnosis, and treatment of disease with the help of AI is not new and has been in focus since at least the 1970s when MYCIN was developed at Stanford for diagnosing blood-borne bacterial infection. In more recent times, IBM's Watson has received considerable attention in the media for its focus on precision medicine, particularly cancer diagnosis and treatment. Now Watson employs a combination of machine learning and NLP capabilities to develop and train better machine learning models for achieving higher records in healthcare, ever done by a `non-human'.

Scarcely a week goes by now without smaller research labs coming up with new approaches to using AI or Big Data to diagnose and treat long known diseases with equal or mostly greater accuracy than trained clinicians. They use various technologies and techniques ranging from radiological image analysis, retinal scanning or genomic-based precision medicine.

The most difficult hurdle for AI in many healthcare fields is assuring its acceptance in daily clinical practice, not whether the technologies are capable enough to be useful. AI systems must be approved by regulators, integrated with EHR systems, standardised to the point that similar products work in a similar way, taught to physicians, paid for by public or private payer organisations, and updated over time in the field in order for widespread adoption to occur.

Decentraland

Decentraland is a 3D virtual world platform, opened to the public in February 2020 and managed by the Decentraland Foundation, a non-profit organization. Being a virtual world, users can buy virtual plots of land in that platform. For buying, instead of physical currency, cryptocurrency is used known as the MANA cryptocurrency. Purchased virtual plots of land are regarded as NFTs. For developing the land, users can either use Decentraland's own editor or import 3D models from other tools.

The platform is developed using languages C#, GLSL, and HTML. To gain access to the system, a user will need a desktop internet browser and a crypto-currency wallet, although a guest experience is also available. After the system is loaded, the user is presented with a virtual character creation prompt. A list of current events is also displayed and by just choosing the "Jump In" option, the user can visit that virtual event. So, one can travel the entire world at the click of a button!

Users of Decentraland can explore, engage, and play games in this virtual environment while buying and selling digital real estate. Users

may now use interactive apps, in-world payments, and peer-to-peer communication, thanks to the platform's evolution.

All operations are governed by two tokens:

LAND: A NFT used to define ownership of digital real estate. It represents virtual assets that can be owned and traded, their corresponding coordinates, and the details of various content built on them. MANA: A cryptocurrency used to purchase LAND and other virtual products and services in Decentraland. It is based on Ethereum's ERC20 standard. It is the standard currency for all forms of trading in Decentraland.

The Decentraland application is designed to track LAND token-defined real estate properties. The software uses the Ethereum blockchain to monitor ownership of the digital land. Users must keep their MANA token in an Ethereum wallet to interact with its ecosystem. Developers are also free to experiment and innovate in the platform by customizing the animation and interactivity that users see on their virtual properties.

Decentraland is managed by a Decentralised Autonomous Organization (DAO). Important contracts and assets of Decentraland are held by the DAO. The DAO allows the control of Deecentraland to be held by its community. The community votes to determine the policies that govern the behaviour of this virtual world through the means of votes. This would give the community the power to decide on moderation, eligibility of virtual items, auctions, and policies regarding LAND. The Decentraland team has also developed a marketplace for trading LAND, non-fungible assets, and virtual items. A drag-and-drop editor for users, termed as "builder", can be utilized to develop the LAND and create structures on it. Decentraland also houses virtual art galleries, auction halls, malls, and casinos. Users can also take part in various quests and events while interacting with each other.

With the concept of metaverse coming to the forefront of futuristic technologies, Decentraland has seen increasing popularity and can be envisioned as becoming a parallel world based on the principles of autonomy, privacy, and community. Currently, still in its infancy, Decentraland can grow into an integral part of the future world, and become the next normal in connecting people across the globe.



MR. PRITHWIS MUKHERJEE SPEAKS

DIRECTOR, PRAXIS BUSINESS SCHOOL



Mr. Prithwis Mukherjee is an engineer, a coder, a teacher, and an author whose alma mater is St. Xavier's Collegiate School, Kolkata. He was awarded a Mechanical Engineering degree from the Indian Institute of Technology, Kharagpur, and a Ph.D. in Management Science from Naveen Jindal School of Management, UT Dallas. Professionally, he was the Director at IBM and the Head of Calcutta Delivery Centre. He was also a professor at the Indian Institute of Technology, Kharagpur. He is an author of two science fiction novels exploring the collapse of human civilization on Earth and its rebirth and reincarnation, namely Chronotantra and Chronoyantra. Presently, he is the Director and Professor at Praxis Business School. Under his guidance, Praxis Business School has been recognized among the top 5 Indian institutes having a Data Analytics curriculum.

Q. What do you think about the role of data in today's world?

Ans. Data is the new oil in the industry. It is a very precious commodity. The main strength of all the major tech companies, like Google and Facebook, lies in the quantity of data they have. In order to compete with them, companies need large amounts of data. The major challenge to building algorithms today is the lack of data to build models.

Q. In your career as a Data Scientist, can you share some experience about what kind of projects people work on in this field?

Ans. Going forward, I feel the most useful concept will be that of Artificial Neural Networks. Of course, nothing is exclusive, but most of the interesting applications are being developed on Artificial Neural Networks.

Q. The need for data scientists is rapidly increasing every day. Any words of wisdom for the data science enthusiasts?

Ans. Kaggle and KDnuggets are good places to keep yourself up to date. The best way to learn is to find information on the web or google for answers. But Kaggle is a wonderful place to start.

Q. As a pioneer of data science, what are the devices or tools you use to upgrade yourself or use daily in your field of work?

Ans. Initially, we were using R, but python is more popular now. This is because R is mostly statistics oriented whereas python has TensorFlow and Keras which is greatly helpful in Machine Learning. In addition to this, python has the backing of Google. Some new languages like Julia are gaining popularity but right now Python is the king.

Q. Is Google the global leader spearheading the world of Data Science?

Ans. Google is a very big user of data science. But then Google is not alone, there are others like Amazon, Netflix, and Facebook, who are strongly dependent on AI and Neural Networks.

Q. Since Data Science is the biggest technology at present, how is it going to change society in the future?

Ans. Complete and catastrophic loss of privacy. As it is Google knows everything about you. Although the Google search page looks quite simple, it's actually crawling with software. In a way, Google knows you better than yourself. You'll have to go to extraordinary lengths to maintain your privacy to the extent of giving up your cell phone. I know people who are so paranoid about their privacy that they don't use cell phones and credit cards.

Q. As a student, we come across many terms like Data Science, Machine Learning, and AI. How do you think Machine Learning, AI, and Data Science are connected?

Ans. They all overlap. Machine learning and data science are reasonably close to each other. AI is an extension of machine learning. We start with descriptive statistics then we move on to inferential statistics then finally predictive statistics which is similar to machine learning. Then there is machine learning without statistics, where we bring in Baye's Theorem, Belief Networks, Bayesian Belief, and finally Neural Networks. Neural Networks feed into AI, but AI can also be done otherwise. Thus AI is not a neural network but neural networks are AI.
Q. With AutoML coming into play do you think that the future of a Data Scientist can be at stake?

Ans. Yes, there is a threat. In the past, automation has made blue-collar workers redundant. White-collar workers were safe but not for much longer. There is something called Robotic Process Automation (RPA) that is making waves. So a lot of AutoML stuff can take away the role of Data Scientist. Thus, a threat exists.

Q. Nowadays, the majority of Statistics and Computer Science professionals and students are going into the domain of Data Science. What do you think about the reason for this?

Ans. Because it is all interdisciplinary. Why should you stay conserved in your own world? I began as a mechanical engineer, and I have changed my career four times. I did my Ph.D. in Operations Research, then I went to Tata Steel as a Database Administrator then I went to PricewaterhouseCoopers and started there with an E-Commerce business. After which I went to IBM and did something else with the virtual world, MMORPG games like "Second Life". Then I went to IIT Kharagpur and started Data Science there. So you'll have to keep reinventing yourself. There is obviously more opportunity in the field of Data Science.

Q. What are the differences between a Data Analyst and a Data Scientist?

Ans. These are all artificial divisions. The end goal is to solve a problem. Our job, in the end, is to figure out how to use data to solve problems.

Q. Everyone knows where you currently stand, but many don't know about this journey. Can you please brief us about your journey from scratch?

Ans. You must step out of your zone of comfort. I was initially a Database Administrator at Tata Steel. But then I realized that database administration is an endgame there is little further scope. E-Commerce and websites were the new things. I had gone to the US to meet my friend where I first saw a website in the year 1994 and I realized that this is the thing of the future. So when I came back and started building websites, then I created my own portal called Yantrajaal. Now you see, I had stepped out of my comfort zone into the absolutely new area of E-Commerce. I went on with that to PwC, I became their partner of E-Commerce. I and my wife started an online teaching portal but somehow it didn't work out. I realized this is flooded. Way too many big companies were there and I couldn't compete with them. Then I moved to data science. If you live in your zone of comfort, you'll be stuck there. You have to change direction at least two to three times in your life.

Q. Many of us want to become successful Data Scientists. So what are the problems that we need to overcome to become Data Scientists in India?

Ans. There is no problem as such. I won't say there is any problem, it's like any other field. There is a lot of hard work, a lot of new things to be done. I do not foresee any problem as such. You can if you want to be a data scientist. But I would like you to think a little bigger. Data science is currently the biggest interesting thing, after 10 years it may not be. When I started my career, RDBMS was the hardest thing. But now RDBMS administrators are everywhere. So consider being a data scientist as a stepping stone towards a larger platform.

Q. What other interests do you have apart from your work life?

Ans. You should check out my science fiction novel - Chronotantra. I have a point of view on AI, for which I do not have the resources to conduct formal research. I have also written a few other novels. I discovered that while writing a novel, you are freed from the constraints of reality. It is an expression of my philosophy. I have also maintained my blog at Yantrajaal since 1999. That was the third website that I had created.



Robotic Process Automation: Future of Automation Industry



Sabyasachi Mukhopadhyay

Assistant Professor, Bhavans Institute of Management Science Kolkata

Google Developer Expert in Machine Learning

Visiting Faculty, Symbiosis Center for Information Technology Pune

Visiting Faculty, University of Calcutta Visiting Faculty, Techno India University

In this article, we shall discuss briefly an interesting topic which has a huge job demand. In 2017 Infosys launched a theme "Software Is The New Hardware" [1]. In brief, we must find a way to modernize our infrastructures and existing workloads to take advantage of the new soft power in order to utilize low-cost product availability opportunities for the sake of billions of lives. The whole scenario can be realized by a few simple examples. For instance, we can take examples like, Paytm payment instead of carrying cash in the wallet, early-stage cancer detection utilizing mobile camera scan instead of the optical fiber probe, automation industry, etc. Here we shall discuss a state of modern automation tool i.e., Robotic Process Automation.

Due to the failure of handling automated lightweight data and processing tasks, people can't spend enough time on value-added activities. They keep on using forms to fill in information, creating spreadsheets to collect, analyze, report data and so on which actually have a negative impact on the productivity of the industry. Automation aims to change the workplace as rapidly as the machines of the industrial revolution period changed the factories in the 18th century. According to a study on the western economy, automation can save around \$2 trillion in wages, has an impact over 130 million jobs with the highest level of productivity [2]. In order to reduce the operating costs with high operating efficiency and support growth through automation, the organizations want to prefer 'Process Automation' as an optimal solution. 'Process Automation' requires less or no human intervention and 'Information Technology' (IT) is the prime enabler of that. Among the traditional methodologies of 'Process Automation', 'Enterprise Resource Planning' and 'Business Process Automation' are mentionable. While these traditional methods have their own limitations, process automation can be achieved using two genres of tools: Robotic Process Automation (RPA), Intelligent Automation (IA).

According to the report of 'The Institute for Robotic Process Automation' (IRPA), RPA is an application-oriented technology which permits employees of an organization to make configuration of computer software, or a 'robot', for capturing and interpreting existing applications to process a transaction, manipulation of data, triggering responses as well as making communication among other digital systems.

Processes that can be automated using RPA must have the following features: 'Repetitive', 'Template-driven and Rules' based. Here it can be mentioned that RPA tools do not store any data. RPA is being applied in the following domains, such as, 'IT Management and Support', 'Financial Services', 'HR Management' and 'Supply Chain' in order to achieve better accuracy, easier integration, and high-quality services.

Some of the leading RPA tools in the market are: 'Automation Anywhere', 'Blue Prism', 'UiPath', 'WorkFusion' [3].

According to the leading newspaper of India 'The Hindu Business Line', Robotic Process Automation will create 2 lakh jobs in India by 2021 [4]! Due to the huge demand for 'Robotic Process Automation' in MNCs like TCS, it is better for students to pursue online training on RPA in order to explore careers in the Automation industry.

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Virtual Reality – the Technology & Us – Today & Tomorrow



Subhakar Rudra

Chief Information Officer, WPIL Ltd Cybercrime Intervention Officer -National Security Database Program Certified ISO/IEC 27001:2013 Lead Auditor

Let us start by considering one of the biggest Social Media Giants – Facebook Inc. On 28th October 2021, Facebook rechristens itself as 'Meta'. Well, was it only just another rebranding bid? Not actually.

Considering Facebook's reputation, the rebranding was certainly a strategic move with the objective of causing distraction from the numerous serious allegations against them such as privacy issues, spreading misinformation, facilitating violence/ hate speech, etc. through their platform. There was another reason hidden behind the Metaverse and that was, to align the company and its business to a new direction – towards building a Virtual Reality (VR) based world, a technology that in the coming days, is going to be one of the most important cogs in the wheel called Extended Reality (XR) along with Augmented and Mixed Realities (AR and MR).

So, what exactly is Virtual Reality or VR, and what does this technology represent?

To put it simply, it is a computer-simulated environment consisting of seemingly-real objects and surroundings, which, however, do not physically exist, allowing a user to experience and interact with the environment and the objects inside it through the use of a physical device, such as a headset, that connects a person's sensory and perception systems to the simulated environment.

VR is not a new technology. It has already been in existence for quite some time. It is slowly integrating into our present and is going to redefine the way we see, feel and perceive things in the future. By now, almost all of us are have become used to being in our office room and having meetings with our colleagues, from the comfort of our own home without the need of being there physically. Let us now explore a few applications of VR to get a better understanding of the extent to which this technology has started playing critical roles in today's world.

Gaming and Entertainment:

just the beginning.

The market size of the VR gaming & entertainment industry is growing at a fast pace. On top of that, the increased adoption & engagement owing to the COVID-19 pandemic has given the industry a further boost. The games and movies that are based on VR have become surreal, immersive, engaging, and often addictive. As VR makes its continued push into the gaming and entertainment world, as of date, billions are being invested into this industry with the focus primarily on exploring its potential itself.

Healthcare and Medicine:

In Healthcare and Medicine, major breakthroughs have been achieved using VR. On the internet, we would find, how major research bodies, like The Spanish National Research Council, have achieved success in reducing the effects of Parkinson's by applying a treatment that uses VR, how VR assisted rehabilitation training helps Parkinson's disease patients to improve balance and avoid obstacles while walking, how VR assisted therapies are being used to treat people with mental issues or having certain phobias by creating soothing environments and simulations where they are made to face their phobias head-on so that they can get over it and begin to lead a normal life. There is a famous case study, dated as far as five years in the past, of bringing back a baby from the brink of death, using Google Cardboard. With the advent of VR, many fascinating and exciting developments are happening in the field of healthcare and medicine that has helped healthcare technology to advance by leaps and bounds.

Manufacturing:

The Manufacturing Industry has started to leverage Virtual Reality technology in its own way. 3D images of the prototypes based on the proposed designs of a product are viewed and assessed, to ascertain all the technical challenges & sort those out much in advance, before the actual physical product is manufactured.

Learning & Training:

Practical learning always adds more value to academic knowledge. There is a big difference between learning about something through reading and actually getting to experience it. VR technology is allowing us to create & reproduce realities virtually, which otherwise would have been impossible to avail, leading to the opportunity of practical training and physical exposure. For years, VR technology is being used to train pilots before they get to fly real planes. Education establishments have started using VR to engage their students by allowing them to experience the stories that otherwise had to be explained. Meanwhile, in military training, to ensure higher effectiveness, VR technology is used to simulate battlefield scenarios.

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By now, we have experienced how the pandemic has changed many things about us and the way we work, collaborate, plan our entertainment, etc. These changes have led VR technology to experience a surge in demand as businesses have started to shift to virtual platforms for business continuity. It is no more surprising that, more and more companies have started to frame their Virtual Reality Strategies. Business Leaders have started considering Virtual Reality as one of their top priorities in terms of investment choices. Reports state that Spatial, which creates a tool best described as a VR version of Zoom, reported a 1,000% increase in the use of its platform since March 2020. Facebook, Google, Microsoft, etc. are planning huge investments towards the virtual reality business through the process of R&D and acquisitions. Consulting giants like Accenture are investing in procuring 60,000 Oculus Quest 2 headsets to replicate the in-person work environment while preserving the safety and flexibility of working from home.

Statistics show that VR gaming revenue is expected to grow by 150% by the end of 2024. The Virtual Reality Market is expected to register a compounded annual growth rate (CAGR) of 18.0% by 2028. Another report states that the VR market value is expected to exceed \$180 billion by 2026, a time when the technology is expected to be well past its nascent stage.

Undoubtedly, this points to an exciting future.

Finally, any technology brings certain pitfalls and challenges along with it. VR technology is no exception. Already issues & negative impacts over individual privacy, ethics, physical ailments, lack of human-to-human contact, etc., are being discussed, debated, and scrutinized. In the future, there will be more issues that might crop up. Yet, the potential benefits of VR far outweigh the challenges. With the enhancement in virtual reality, new ways of exploring new worlds will open up, making our life better and more practical. It all depends on us. How we plan to look at it and how we intend to use this exciting technology depends only on the limits of our imagination.

The doors of possibilities within virtual reality are unlimited. Yes, this is just the beginning.

Facility Location Problem



Arup Kumar Bhattacharjee

Assistant Professor Department of CSE RCC Institute of Information Technology

Facility Location Problem (FLP) is a branch of computational geometry which deals with the optimal placement of facilities. This means that FLP seeks to optimize the placement of facilities such that the demands of consumers can be met at the lowest cost and/or shortest distance.

French mathematician Pierre de Fermat presented the initial version of FLP as:

"Given three points in a plane, find a fourth point such that the sum of its distances to the three given points is as small as possible." [3]

Alfred Weber proposed FLP with an objective of locating the geometric median between three points with different weights and this type of problem is called Minimum FLP. Minimax FLP, the second type of FLP, seeks a location which minimizes the maximum distance to the sites. There is another variation of FLP called Maxmin FLP or obnoxious FLP where the objective is to maximize the minimum distance to the sites. An example of Maxmin FLP is avoiding the placement of hazardous materials near housing and competitors' facilities.

These FLPs may be further divided into two categories: capacitated or uncapacitated. In a capacitated model the capacity of each facility is fixed and known, as a result, a facility located at the least cost from a demand node does not ensure service because its production is limited whereas for the uncapacitated version each facility can produce and ship unlimited quantities of the product or service.

FLPs are often solved as integer programming. Simple versions of FLPs usually have x facilities and y customers as input and common outputs are to select which facilities to open among these x options, and which (open) facilities to use to supply the y customers, in order to satisfy some fixed pre-specified demand at minimum cost F.

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Applications of FLP:

1. Public policy like locating hospitals, police stations, solid waste management

Telecommunications like placing mobile towers in a city
 Physics like separation distance between repulsive charges etc.

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TECH THOUGHTS BY STUDENTS

TIME SERIES ANALYSIS OF AIR QUALITY INDEX FOR SEVERAL INDIAN CITIES USING STATISTICAL AND DEEP LEARNING



Tanmoy Dutta M.Sc. Batch of 2021-2023 Department of Computer Science St. Xavier's College, Kolkata

Abstract

Accurate monitoring of air quality is of great importance to our daily life. By predicting the air quality in advance, we can make timely warnings and defenses to minimize the threat to life. These systems impact a specific region based on multiple factors, therefore the task of accurate forecast with adequate lead time is enormously complex and challenging. With many environmental data, the air quality prediction based on deep learning technology is studied. Based on long short-term memory (LSTM), a comprehensive prediction model with multi-output and multi-index of supervised learning (MMSL) was proposed. In our project we try to discover the weather of different cities of India and observes their AQI level and based on the other factor we try to observe how much the air is polluted and based on the trend of the graph of previous years' stats of weather we try to predict

that how the weather will change in next few years.

Introduction

A time series is a sequence of observations that were taken over a certain time. Time series generally are two types-Univariate and Multivariate. A univariate time series consists of the values taken by a single variable at periodic time instances over a period, and a multivariate time series consists of the values taken by multiple variables at the same periodic time instances over a period. Nowadays time series is used everywhere-

- » Financial Analysis It includes sales forecasting, inventory analysis, stock market analysis, price estimation.
- » Weather Analysis It includes temperature estimation, climate change, seasonal shift recognition, weather forecasting.
- » Network Data Analysis It includes network usage prediction, anomaly or intrusion detection, predictive maintenance.
- » Health care Analysis It includes census prediction, insurance edges prediction, patient observance.

Mathematical Model

VAR (Vector AutoRegression)

Vector autoregression (VAR) is a statistical model used to capture the relationship between multiple quantities as they change over time.

Definition

A Vector Auto-Regression model describes the evolution of a set of k variables, called endogenous variables, over time. Every period is numbered, t = 1, ..., T. The variables are collected in a vector, $y_{,,}$ which is the length of k.

Mathematical Forms

In general, for a VAR(p) model, the first p lags of each variable in the system would be used as regression predictors for every variable. $Y_{t} = a + A_{1}Y_{t-1} + A_{2}Y_{t-2} + \dots + A_{p}Y_{t-1p} + \varepsilon_{t}$

Where

- $Y_t = (y_{1,t'}, y_{2,t'}, \dots, y_{n,t})$: an (n x 1) vector of time series variables a : an (n x 1) vector of intercepts >>
- ≫
- A_i (i=1, 2, ..., p): (n x n) coefficient matrices >>
- ϵ : an (n x 1) vector of zero mean error term (white noise) **»**

VARMA (Vector AutoRegression MovingAverage)

Definition

The VARMA representation implies that we can represent y, in terms of the innovations as

 $y_{t} = (I - A_{1}L)^{-1}(I + M_{1}L)u_{t} = A(L)^{-1}M(L)u_{t}$

where A(L) and M(L) are the Auto-regressive polynomial and the moving average.

VIF(Variance Inflation Factor)

Definition

A variance inflation factor(VIF) detects multicollinearity in regression Multicollinearity is when there's correlation between analysis. predictors (i.e. independent variables) in a model;

This gives you the R-squared values, which can then be plugged into the VIF formula. 'i' is the predictor you're looking at (e.g. x_1 or x_2).

Interpreting the Variance Inflation Factor

A rule of thumb for interpreting the variance inflation factor:

- 1 = not correlated. >>
- Between 1 and 5 = moderately correlated. >>
- Greater than 5 = highly correlated. »



 $VIF = \frac{1}{1 - R^2}$

A VIF above or more than 10 indicates high correlation and is cause for concern. Some authors suggest a more conservative level of 2.5 or above.

LSTM(Long Short Term Memory)

Definition

Long short-term memory (LSTM) is an artificial recurrent neural network (RNN) architecture used in the field of deep learning. Unlike standard feedforward neural networks, LSTM has feedback connections. It can not only process single data (such as pictures), but also entire sequences of data (such as speech or video).

Recurrent neural network

Recurrent neural networks, or RNNs, are a class of neural networks that allow previous outputs to be used as inputs of the current state input while having hidden states. They are typically as follows:



Fig: Workflow of RNN

(source: https://www.analyticsvidhya.com/blog/2021/03/introduction-tolong-short-term-memory-lstm/)

For each timestep t, the activation $a^{<t>}$ and the output $y^{<t>}$ are expressed as follows:

where Wax, Waa, Wya, ba, by are coefficients that are shared temporally and g1, g2 activation functions. The internal structure of RNN is as follows:



(source: https://www.analyticsvidhya.com/blog/2021/03/introduction-tolong-short-term-memory-lstm/)



LSTM Architecture

LSTM works very much like an RNN cell from the top level. Here is the internal functioning of the LSTM network. The LSTM consists of three parts, as shown in the image below and each part performs a separate function.



(source: https://www.analyticsvidhya.com/blog/2021/03/introduction-tolong-short-term-memory-lstm/)

The first part chooses whether the information coming from the previous timestamp is to be remembered or is irrelevant and can be forgotten. In the second part, the cell tries to learn new information from the input to this cell and store it id required. At last, in the third part, the cell passes the updated information from the current timestamp to the next timestamp. The first part is called Forget gate, the second part is known as the Input gate and the last one is the Output gate.

Forget Gate

In a cell of the LSTM network, the first step is to decide whether we should keep the information from the previous timestamp or forget it. Here is the equation for forget gate.

$$f_{t} = \sigma(x_{t} \times U_{f} + H_{t-1} \times W_{f})$$

WHERE

- » X_{t} : input to the current timestamp.
- \gg U_f: weight associated with the input
- » H'_{t-1} : The hidden state of the previous timestamp
- » W_{ϵ}^{-1} It is the weight matrix associated with hidden state
- » σ : the activation function

Input Gate

Input gate is used to quantify the importance of the new information carried by the input. The equation of the input gate is

$$i_t = \sigma(x_t \times U_i + H_{t-1} \times W_i)$$

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WHERE

- » X_{t} : input to the current timestamp t.
- » U: weight matrix of input
- » H_{t-1} : The hidden state of the previous timestamp
- » W: Weight matrix of input associated with hidden state
- » σ : the activation function (Sigmoid function)

Again, we have applied sigmoid function over it. As a result, the value of I at timestamp t will be between 0 and 1.

New information

Getting the new information

 $N_{t} = \sigma(x_{t} \times U_{c} + H_{t-1} \times W_{c})$

However, the $\rm N_t$ won't be added directly to the cell state. Here comes the updated equation

 $C_t = (f_t \times C_{t-1} + i_t \times N_t)$ [Updating Cell]

Here, C_{t-1} is the cell state at the current timestamp and others are the values we have calculated previously.

Output Gate

This gate will produce the appropriate and perfect matching output according to the previous inputs with the help of previously discussed gates Here is the equation of the Output gate, which is pretty similar to the two previous gates.

$$o_{t} = \sigma(x_{t} \times U_{o} + H_{t-1} \times W_{o})$$

Its value will also lie between 0 and 1 because of this sigmoid function. Now to calculate the current hidden state we will use o_t and tanh of the updated cell state. As shown below.

$$H_t = o_t \times tanh(C_t)$$

The hidden state is a function of Long term memory (C_t and the current output. If we need to take the output of the current time-stamp just apply the SoftMax activation on hidden state H_t .

Output =
$$softmax(H_{+})$$

Here the token with the maximum score in the output is the prediction.





Kolkata

From the above heat map, we can see the correlation between the parameters and it's clearly visible that the AQI is highly correlated with PM2.5, PM10, NO, NO₂, NOx.

AQI Change With highly correlated elements

From the above plot it is visible the change of AQI with respect to highly correlated elements with it.

AQI Change over years

The above plot shows that the AQI value for Kolkata slightly getting low between July to September and again it's getting increased from November to March.





Variance inflation factor

From the pie chart we can conclude that the AQI value is more than 90% dependent on some parameters like PM2.5, PM10, NO₂, NOx.



	NOx.
	PM10
	PM2.5
	AQI
-	NO2
	NO
	Toluene
-	NH3
	Senzene
	S02
=	CO
	03



From the above heat map, we can see the correlation between the parameters and it's clearly visible that the AQI is highly correlated with PM2.5, CO, Benzene.

AQI Change With highly correlated elements

From the given plot it is visible the change of AQI with respect to highly correlated elements with it.



AQI Change over years

Though the plots are a little noisy but we can conclude that from MAY to JUNE the AQI are lower and the rest of the months are high.



Variance inflation factor

From the pie chart we can conclude that the AQI value is more than 90% dependent on some parameters like PM2.5, PM10, NO₂.



	AQI
	PM10
	NO2
	PM2.5
	03
	NO
	NOx
	NH3
	Benzene
	CO
10	502
	Toluene

Hyderabad

Correlation

From the above heat map, we can see the correlation between the parameters and it's clearly visible that the AQI is highly correlated with PM2.5, PM10, CO, O_3 .

Hyderabad



AQI Change With highly correlated elements From the above plot it is visible the change of AQI with respect to highly correlated elements with it.



AQI Change over years

AQI LEVEL



Though the plots are a little noisy we can conclude that from MAY to JUNE the AQI are lower and the rest of the months are high.

Variance inflation factor



From the pie chart we can conclude that the AQI value is more than 90% dependent on some parameters like Benzene, PM10, NOx, NO2, Toluene.

Multiple predictive methods and their result

For this project we have used some advanced statistical methods and as well as deep learning approach.

Used methods are VAR (Vector AutoRegression) VARMA (Vector AutoRegression MovingAverage) LSTM (Long Short Term Memory)

For this results analysis we have used the" Air Quality Data in India (2015 2020)", which has a lot of data. From the dataset we have predicted the AQI level of some cities in India with the help of different parameters (e.g. NO, NO_2 , CO, etc.)

Kolkata

From the given plots we can conclude that the VAR method can't capture the correlation between the parameters and that is the reason it can't predict the future value properly.

PH10 Benze Totule NOx NO2 NH3 PH2_5 O3 NO SO3 CD



Figure: VAR Figure: VARMA Figure: LSTM From the above plots we can conclude that the VARMA method can't capture the correlation between the parameters and that is the reason it can't predict the future value properly.

Hyderabad



Figure: VAR Figure: VARMA Figure: LSTM Here we can see that the deep learning method had found the correlation between the parameters and the AQI level and properly predict the future value accurately.

Model	Kolkata	Bangalore	Hyderabad
VR	81.52	82.03	85.63
VARMA	76.911	73.23	51.61
LSTM	22.94	14.94	13.12

Error Values of the model & Conclusion

Table: Mean squared error for predicting AQI value From all the above plots and error values we can conclude that the DEEP LEARNING method (LSTM) is one of the best approaches for predicting continues values and capturing the co-relation in data.

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DEEP LEARNING FOR ENHANCEMENT OF COMMUNICATION SKILLS OF THE HEARING IMPAIRED



Gyan Krishna Sreekar¹ Swarnadip Dutta Raunak Chatterjee

¹M.Sc. Batch of 2021-2023 Department of Computer Science

St. Xavier's College, Kolkata

Abstract

As per the data accumulated by the World Health Organization (WHO) in the year 2015, it was found that over 5% of the world's total population suffers from the serious problem of hearing disability. This accounts for approximately around 360 million people and another shocking data reveals that the unemployment rate in the case of deaf people is nearly about 75%. So, with the sole purpose of establishing a mode of communication between ordinary people and hearing-impaired people several sign languages using different hand shapes and finger positioning were invented. American Sign Language (ASL) is one of the prominent sign languages amongst them. This sign language is the primary language used by hearing-impaired people. One of the biggest challenges they face is communication with other people without a translator which negatively affects their social life. In order to overcome this challenge, a deep learning-based solution to translate ASL Signs from images/videos is proposed.

Introduction

American Sign Language (ASL) consists of two types of gestures – Static and Dynamic. Letters 'J' and 'Z' have dynamic gestures and include movement of hand and fingers during the gestures whereas the remaining 24 letters are static as they include only finger positions and no movement. The primary vital component of any sign language is finger-spelling which means each letter has a unique corresponding sign. The secondary component is word-level sign vocabulary which means each word has a corresponding associated sign in the language. When compared to traditional face detection, device-free hand detection is more difficult because hands tend to move more frequently and have complex backgrounds.

The system will be contributing to society by catering to the special needs of hearing-impaired people. With the aid of an auxiliary tool, deaf or mute people can easily communicate with normal people via a computer. So, the principal objective of this system is to make smoother interaction between normal and deaf or mute people as well as act as a platform for learning ASL.



Methodology

The model training process has been divided into multiple phases these phases include

- » Data Collection and pre-processing
- » CNN Model Creation and Training

Data Collection and Pre-Processing

The primary objective of this stage is to collect raw images for the model training and perform feature extraction on the raw images. The extracted features are in the form of 21 3D Landmarks that will be used as input for the CNN Model. The image gathering is done using

the OpenCV library in Python, which has extensive support for image processing and computer vision tasks.



Data Set Collection

The dataset for the classification consists of over 3000 images of each category, 'A' to 'Z', taken by a standard laptop camera. The data acquisition process is done using a python script. The python script takes an input video stream from the webcam and uses media-pipe, which is a high-fidelity hand and finger tracking model to ensure that the frames captured have a hand present with extractable features. The frames of the video feed which have desired image quality are selected and added to the dataset. This will ensure smooth feature extraction later in the preprocessing stage.

Image Augmentation

One of the biggest challenges in training deep learning models is the requirement of a big dataset which in many cases is hard to provide. For example, the very popular CNN model, VGG16 has a total of 16 layers with 138 million parameters to train, which needs huge datasets to successfully train. The dataset we have obtained for the classification of sign language consists of 3000 images for each classification, which is not sufficient for a good deep learning model. Image augmentation is the process by which the size of the data set is artificially expanded by creating augmented versions of the images already present in the dataset, this can be done using classical methods like rotating and cropping, zooming, flipping, histogram-based methods, etc. and also using generative adversarial neural networks to generate synthetic data.





Feature Extraction

Feature extraction is done using a media-pipe hand detector model, a high-fidelity hand and finger tracking model developed by Google. The hand tracking solution uses an ML pipeline consisting of several models working together. The pipeline starts with a palm detector model, known as BlazePalm, which is used to extract the bounding box for a hand. This is followed by using a hand landmark model that operates on the cropped image which returns high fidelity 3D hand landmarks.



Figure 9: Landmarks Extracted By Media-Pipe Framework

Data Splitting

In order to prevent overfitting, and model selection bias, the input data set is divided into three parts:

Training set: This is the set of data that will be used to fit the model. The CNN Model Observes and learns from this data set to optimize its weights and biases. The training set is the largest data set among the three splits and for the CNN ASL Translator model, 80% of the original data has been taken for training *Validation*: A validation set is used to validate the trained model. It is separate from the training set to give a mode unbiased estimate of the performance of the model during the training phase. For the CNN ASL translation model, 10% of the original data set has been taken for Validation.

Testing Set: The testing data set is used to evaluate the performance of the model. For the CNN ASL translation model, 10% of the original data set has been taken for Testing.

When implemented in python, the data set is divided into two parts, train (90%) and test set (10%), the train set is split into train and validation during the model fitting process.

CNN Model Creation and Training

Model Topology

The 3D Landmarks are in the shape, [21, 3] initially. This is reshaped into [7, 9] for better feature extraction by the First Convolutional Neural Network (CNN) Layer with 32 neurons and kernel size (3, 3) and ReLu Activation function. Typically, CNN Layers have padding and is followed by a pooling layer this is done to downsample the input, however, due to low input dimensions already, strides and pooling are

skipped. The first CNN layer has an output dimension of (5, 7, 32).



Figure: CNN Model For ASL Translation

The CNN layer is followed by a flattening layer followed by a series of three dense layers with 400, 200, and 50 neurons respectively and 30%, 20%, and 10% dropouts respectively and ReLU as Activation Function. These will increase the depth of the network and thereby increase the accuracy of the network. This is followed by the output layer which has 26 neurons, with a softmax activation function. Each

of these output neurons corresponds to an ASL alphabet.

Layer (type)	Output Shape	Param #
conv2d_3 (Conv2D)	(None, 5, 7, 32)	320
flatten_3 (Flatten)	(None, 1120)	0
dense_12 (Dense)	(None, 400)	448400
dropout_9 (Dropout)	(None, 400)	0
dense_13 (Dense)	(None, 200)	80200
dropout_10 (Dropout)	(None, 200)	0
dense_14 (Dense)	(None, 50)	10050
dropout_11 (Dropout)	(None, 50)	θ
dense_15 (Dense)	(None, 11)	561
Total params: 539,531 Trainable params: 539,531 Non-trainable params: 0		*************

Figure: Description of the Model Created

Trainning the baseline model

```
baseline_log = baseline.fit(x_train, # x data for training
                                   # y data for trainning
            y_train_cat,
            batch_size = batch_size,# batch size for trainning
            epochs = epochs,
                              # number of epochs
            validation_split = 0.2, # 20% of input data goes for validation
            verbose=1)
                                   # show detailed stats of trainning
```

```
Epoch 1/25
```

```
=========] - 18s 8ms/step - loss: 2.0163 - accuracy: 0.3726 - val_loss: 0.4738 - val_accuracy: 0.8584
1301/1301 [=
Epoch 2/25
1301/1301 [=
           ===============] - 8s 6ms/step - loss: 0.6661 - accuracy: 0.7981 - val_loss: 0.3314 - val_accuracy: 0.9062
Epoch 3/25
                      ===] · 9s 7ms/step - loss: 0.5079 · accuracy: 0.8555 - val_loss: 0.2721 - val_accuracy: 0.9213
1301/1301 [
Epoch 4/25
          ======] - 8s 6ms/step - loss: 0.4370 - accuracy: 0.8778 - val_loss: 0.2435 - val_accuracy: 0.9301
1301/1301 [
Epoch 5/25
1301/1301 [
           Epoch 6/25
1301/1301 [
                Epoch 7/25
```

Figure: Training the model

Since the model is a multi-class categorical classifier, categorical cross-entropy is used as the loss function. And Adam is used as the optimizer for the model. Due to its less memory requirements and efficiency.

The model is trained using the following parameters: Epochs = 18 Batch size = 32



Model Evaluation

Using the training log, the accuracy and loss vs epochs was plotted using matplotlib. Also, the overall training accuracy, validation accuracy, and testing accuracy were obtained from the training and testing logs. The data obtained is shown below:



Results and Discussion

The model trained has performed exceptionally well with a testing accuracy of 95.47%, 95.67% validation accuracy, and 95.47% training accuracy. The model was trained for 18 epochs. The ASL alphabet set can be considered difficult to train with raw images and classical pre-processing techniques since quite a few hand symbols are very similar with slight subtle changes like 'e' and 's'. These hand gestures would be very hard to classify using images only. This is where the

pre-processing where landmarks are extracted plays a major role. The media-pipe model extracts three-dimensional landmarks which helps in better training accuracy for the model. These landmarks along with the first CNN layer goes a long way in providing high accuracy for the model. We can verify that the model does don't wrongly classify the hand gestures by generating a confusion matrix and plotting it on a heat map.

Future scope of research

Future plans for improvement of the application include

- 1. Adding natural language processing for auto-correction and auto-completion of predicted words.
- 2. Lowering the complexity of the model to port the model for use in single board computers and mobile devices

Conclusion

Concluding the paper, we would like to say that our "ASL Deep Learning Translator" would bring in an utmost change in the field of communication and interaction between normal and deaf or mute people by making it a lot easier. Predominantly ASL is used all over the United States of America and in most parts of Canada and likewise, our translator would be working in the above-mentioned regions. Also, our translator can work with other sign languages from around the globe. All it needs is to be trained with a proper data set.

The main application of "ASL Deep Learning Translator" is to ease down the complexity of communication between normal people and hearing-impaired or mute people by taking in WebCam Video Feed as input, processing the input, and displaying the result on-screen and through an audio output. Apart from this, our translator can be used to teach people about American Sign Language who are new to the subject. Thus, having multiple uses of the same software is undoubtedly a uniqueness of this translator.

While designing and developing the "ASL Deep Learning Translator", one of the major constraints faced by us was recording the data sets for dynamic symbols. Letters 'J' and 'Z' in ASL have finger motion which makes it more complex to record data compared to the remaining 24 letters. Our plans to incorporate further improvements in the future include the addition of NLP or Natural Language Processing which would add a predictive feature to the translator and would cut down the requirement of making very accurate symbols.

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REALTIME POTHOLE DETECTION AND ALERT SYSTEM



Soumyadip Chattopadhyay M.Sc. Batch of 2021-2023 Department of Computer Science St. Xavier's College, Kolkata

ABSTRACT

This article is intended to develop a system that can detect Potholes on road and alert the driver at an earlier state. Pothole and bad road conditions are the key contributors to the number of road accidents that occurs, which indicates the need for a system, which is cheap, easy to use, that can help to cut the ever-increasing rate of accidents. This article proposes a technique that has been designed and implemented to resolve the problem of detection and warning of an approaching bad road patch, the PDAS (Pothole Detection and Alert System). The logging and reporting system, located on an android mobile device, will store the pothole locations to Firebase Realtime Database. These locations will be fetched and will be used to alert the driver a few Kilometers before the vehicle's location.

INTRODUCTION

Potholes and bad road conditions are a headache in India. According to a report in 2019, more than 1800 deaths took place due to accidents which incorporated bad roads and potholes as the cause. On highways and Expressways, it can be fatal if a vehicle at high speed meets a pothole. The results can cause permanent damage to the vehicle, even, taking the lives of the passengers inside the vehicle, away.



This article proposes and comes up with two individual implemented solutions that can be installed on any passenger vehicle. It would detect the potholes with the help of i. *Image Processing Based Approach* and ii. *Sensor-Based Approach*.

Before going into each of these detection techniques and algorithms, you should know, that much research has already been done in this domain. Several CNN and Sensor-based Algorithms and Models have been developed earlier. Premium Car manufacturers like Land Rover, Jaguar, and Mercedes C-Class already have this technology installed in their vehicles, with their own algorithms, databases, and features like Depth Sensor. But being held by the premium band of brands, this pothole detection facility comes with a hefty price tag, which many people cannot bear.

The solution, which this article proposes, provides a simple, cost-effective, and functionally efficient way to detect potholes and bad road conditions with the help of a smartphone or a webcam. So, without spending much time, let us see, how we can detect and alert the driver about an approaching pothole or a bar road patch, with the help of the two approaches that have been proposed.

Image Processing Based Approach to Detect Potholes

The image processing-based approach is the simplest and the most lightweight approach. In this approach, we load the image of the road, which is captured by the dashcam, or any camera installed on the vehicle, then process that image frame through a pipeline. Before moving into the pipeline, we must know some concepts which will be needed to understand some stages of the pipeline.

Edge Detection: Edge detection is a technique in image processing, through which, the sharp edges in any image can be detected, based on an upper threshold and a lower threshold value. There are many good algorithms available to implement, like Sobel, Prewitt, and Robert, which come under Gradient-Based Method, and Canny and Laplacian from Gaussian Based Method. In our implementation, we are going to use the Canny Edge Detection algorithm. Here are some of the advantages of this algorithm:

1. The Gaussian filter removes any noise in an image.

2. The signal can be enhanced with respect to the noise ratio by non-maxima. Suppression method which results in one-pixel wide ridges as the output.

3. Detects the edges in a noisy state by applying the thresholding method.

4. The effectiveness can be adjusted by using parameters.

5. It gives a good localization, response and is immune to a noisy environment.

Thresholding: Thresholding substitutes each pixel in an image with a black if the image intensity is less than a constant, or with a white pixel if the intensity is greater than a constant. The result of this operation on an image is a monochromatic image, which only consists of black and white pixels, as the name suggests. It makes it easier for us, to clearly detect the edges of the pothole on the road

Dilation: Dilation expands the image pixels. It is used to expand an element A by using structuring element B. Dilation adds pixels to object boundaries. The value of the output pixel is the maximum value of all the pixels in the neighborhood. A pixel is set to 1 if any of the neighboring pixels are 1. In this implementation, this technique is used to increase the area of the detected edges, in other words, the number of white pixels, in order to clearly detect the pothole from the monochromatic edge traced images.

That's all we need to implement the whole pipeline. The figure shown below represents the pipeline, the sequences of steps to be performed to get potholes detected from a video frame, and the same is repeated on each frame of the video.



Fig: Flowchart of Image Processing based pipeline The output of each step of the above-mentioned pipeline is shown below:



Original Frame

Gray image conversion

Thresholding and edge detection

Dilation
🖉 Alert !	×	
Pothole Detected in image C:/Users/chatt/Desktop/IRSA-Admin/IRSA	A-Admirv/test_images/	
	ОК	

Fig 7.: The warning shown if a pothole is detected

This is the first approach using which, potholes can be detected from a video frame. However, there are some limitations of this approach such as the inability of the algorithm to work with low light images. For such conditions, we need to use thermal or night vision cameras for which, we need to develop a completely different algorithm. Apart from that, if there are some marking on the road, like zebra crossings or dividers, the algorithm may consider those as potholes after dilation.

Then, what be done to overcome this problem? can This when second approach comes is our into action, the Sensor-Based Approach. Let qo through it. us

Sensor-Based Approach to Detect Potholes

Asstated earlier, the previous approach has some limitations. That's why the sensor-based approach is developed. Let us see how this technique works.

Everyone has a smartphone these days. Other than Facebook, WhatsApp, and YouTube, these smartphones can do wonders if used correctly. Each smartphone is a collection of very interesting sensors. One of those sensors is the Accelerometer Sensor, which we will use to implement this approach and design our algorithm.

Before moving into the algorithm, let us go through a guick tour of the accelerometer sensor of a smartphone. The basic purpose of this sensor is to detect the phone's orientation. It measures the linear acceleration of movement based on the readings of the three axes, which are X, Y, and Z. By processing the readings of these axes, the phone can say if it is in Portrait or Landscape orientation. We will utilize this feature of the accelerometer sensor to detect potholes. how we doina that? То understand So, are that, let us consider scenario follows: а as

Suppose a car is moving on a smooth road at 70 KM/H Speed. The accelerometer sensor is reading the values of acceleration of X, Y and Z axes. As there are no potholes on the road, the car is moving without any major vibration or jerking, the reading of the sensor remains more or less same and below a certain threshold. Now the car falls into a pothole at the same speed, a non-negligible vibration or jerking will

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occur, along with which, a huge change in reading will occur in the sensor, which represents a pothole or a bad road condition. This is how, the pothole is being detected using the accelerometer sensor. Let us see the logic behind the processing of sensor data. First, we have the stream of continuous raw data of X, Y and Z axes, which we have normalized using Euler angle formula [2], to process through our developed algorithm. Now we have the normalized sensor data of X, Y and Z axes. Using these data, the pothole detection function is generated, which is as follows:

$$= \begin{cases} 0, & if \frac{\sqrt{X^2 + Y^2 + Z^2}}{G^2} < Threshold \\ 1, & if \frac{\sqrt{X^2 + Y^2 + Z^2}}{G^2} > Threshold \end{cases}$$

Where,

be

X : Normalize value of X axis reading

- Y : Normalized value of Y axis reading
- Z : Normalized value of Z axis reading
- G : Gravitational Acceleration (9.81 m/s²)

 $\sqrt{X^2 + Y^2 + Z^2}$ Here G^2 moving vehicle,

determined

f(n)

represents the acceleration value of the and the threshold or the limit has by experimentation in

Following are the result of the app which has developed to implement the approach: been



Fig: Flow Diagram to Detect Pothole Event

Unlike the previous image processing-based approach, this algorithm can work in any condition, day and night, as it only requires the data of the accelerometer. And as it is just an application which can be installed on any smartphone, this implementation is lightweight, fast, cost-effective and above all, user-friendly. Both the implementations

to

scenarios.

real

of the above-mentioned approaches have been found to function with good accuracy. But what to do with only detecting the potholes? If we only detect potholes one after another and don't do anything with them, then the whole effort developing these algorithms is wasted. That's why, a Warning system is developed which will warn the driver, that a pothole or a bad road patch is arriving in his/her route. How that is being done? Let us understand. Every one of us use has used Google Maps, where we can see the traffic conditions like jams, slow-moving traffic on maps, represented by different colours (Brown - Heavy Traffic, Red - Moderate Traffic, Yellow - Slowly moving, and Green - Clear Roads). How is this generated? Google tracks the GPS of each mobile's location and their movement activity on the roads, which later is interpreted in the Google Maps Servers in order to calculate the traffic load on the road. Our warning system will use the same approach. One user will detect potholes on roads, and the geolocation (latitude and longitude) will be pushed in the database, and other users' app/system will check their live locations with all the potholes' locations recorded in the database. If the cars and the next potholes distance is less than a certain threshold of Kilometers, then an alarm of warning will be displayed at the user's car. То clearly understand the functionality of the consider the diagram process, below:



Fig: Working Flow Diagram of Sensor Based Method

Here we can see, if a pothole is detected, the latitude and longitude of the pothole (which is the car's location at that time), is sent to

the real-time database. The database is a collection of latitudes and longitudes which represent pothole locations. The next vehicle coming on the same route constantly checks and compares its location and distance with all the locations available in the database. If found that their distance is less than say, 1KM, an alert is shown at the vehicles screen/app. Google Maps API can be used here for mapping the potholes at the user's end.

Now, generally, a question can come to your mind - "Somebody has to go first and face the pothole, with his PDAS on, to send the location of the pothole to the database. Then how is this system useful?". Certainly, it is a valid question. As it has been mentioned earlier in this article, Google Uses its users' locations to generate traffic condition data, without which, it is not possible. That means a significant number of users of Google Maps have to go to any particular road to generate that road's traffic on Google Servers, the very first cars who stuck in traffic jams did not know that there is huge traffic on that road. Similarly, our system also needs a huge user database in order to generate data of pothole locations.

RESULTS ANALYSIS

This section accentuated the results of the implementation of Pothole Detection and Alert System (Image Processing and Sensor Based Methodology) and Drowsiness Detection and Alert System. Real-life scenarios were simulated first to test the effectiveness of our developed algorithms. It was found that, the proposed algorithms are working properly. After testing the algorithms in simulation, the application was put to test in real situations and it has been found that all the modules were working with a good accuracy. Though some false detections were found recorded in sensor based PDAS due to hard braking of the vehicle or unintended moderate jerking of the mobile phone installed on a stand suspended from the windscreen of the vehicle.



Conclusion and Future Scope

In the end, it can be summed up that, both the approaches mentioned in this article have their own characteristics in detection algorithms, whereas the alert system is the same for both. Despite the accuracy of the implementations being quite high, there is always a window for improvement. The algorithms can be improved by determining the threshold of detection through thorough experimentations and research. Machine learning-based approaches can be implemented, and a model can be developed for better results. Apart from that, this whole system can be integrated into an IoT device that ensures both the security of the vehicle and does the work of the proposed pothole detection and alert system, providing a package of services altogether, which can be installed in the vehicle as an external gadget.

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Birth of Simultaneous Orthogonal Gliders



Shiladitya Sarkar B.Sc. Batch of 2020-2023 Department of Computer Science St. Xavier's College, Kolkata

Abstract:

In this paper, the author has discovered an unique pattern for the Conway's Game of Life, which can completely degenerate to give birth to two simultaneous orthogonal five celled gliders.

Introduction:

The Game of Life, or Life as John Horton Conway called it, first came into existence in the late 1960s. On an infinite chessboard, any random permutation of checkers begin the game. At every iteration of the game, a new pattern (not necessarily different) is created from the current pattern following a set of rules. By applying the rules again and again, the player produces a sequence of patterns. More than often, these sequences turn out not only to be aesthetically pleasing but also mathematically intriguing. Given Conway's proof that the game can be made to simulate a Universal Computer, or in other words, it could be programmed to compute any complex computation that a traditional computer can do - the extremely simple rules can give rise to the most complex and most unpredictable behaviour possible. The Game of Life motivated the use of cellular automata in the rich field of complexity science, with simulations modelling everything from ants to traffic, clouds to galaxies.

Rules of the game:

Contrary to the unbound beauty and complexity of the results, the rules of the game are extremely simple.

The game of Life is a single-player board game. The playing pieces are checkers, all the same colour. The board is a checkerboard that extends to infinity in each direction. We refer to the squares of the board as cells, and we consider a cell to have eight neighbours: the eight cells that share one or two corners with it.

In the figure given, all the blue cells are neighbours to the red cell, while the yellow ones are not.



The initialization phase: To begin the game, the player constructs an initial pattern, placing checkers in some of the cells of the board. Which cells receive a checker and which ones don't is entirely up to the player. We refer to a cell with a checker in it as alive or living and a cell without one as dead. The initialization phase is the only part of the game in which the player makes any decisions.

The main phase: The player executes this phase over and over again. Each time, the player follows the three simple rules listed below and produces a new pattern from the current one.

- » If a cell currently has exactly two living neighbours, then its state—living or dead—must be the same in the new pattern as it is in the current pattern.
- » If a cell currently has exactly three living neighbours, then it has to be alive in the new pattern.
- » If a cell currently has fewer than two, or more than three, living neighbours, then it has to be dead in the new pattern.

We refer to these rules as the status-quo rule, the birth rule, and the death rule. Note that the death rule is really two rules: a 'death by solitude' rule and a 'death by overcrowding' rule. We refer to the initial pattern as the t=0 pattern, the pattern that results from the first execution of the main phase as the t=1 pattern, and so on. We say that a cell is alive (dead) at t=i if it is alive (dead) in the t=i pattern.

Related Works: Since the beginning of this game, numerous mathematicians have worked to discover several patterns, some of which can represent significant phenomenon occurring in nature. One such example is the 101 founded by Achim Falmmenkamp in August 1994. The name was suggested by Bill Gosper, noting that the following phase can display the period in binary –



One more interesting discovery is the 119P4H1V0 - a spaceship discovered by Dean Hickerson in December, 1989. This was the first spaceship of its kind to be found. The structure he designed looks

like –



Following there is the 135° MWSS - to - G converter, discovered by Matthias Merzenich in July, 2013. It accepts an MWSS as input and produces an output glider travelling at an 135° relative to the input direction.



And of course, there are guns, with the Gosper Gun being the first known finite pattern displaying infinite growth, found by Bill Gosper

in 1970.





The list goes on and on and on...

Proposed Structure: What sets my discovery apart is that, it is the first discovery which can completely degenerate to produce two simultaneous orthogonal gliders. The structure looks like –



Now if we follow the rules of this game, and continue modifying the cells, we will eventually end up with exactly two simultaneous orthogonal gliders at exactly t=12. The two orthogonal gliders produced from the above structure travel till infinity..

Conclusion: We have successfully discovered this structure and we believe that this will be an effective addition in the Conway lexicon and will be of particular interest among other researchers working in this domain, or in any discipline that either fully or partially relates to this.

Further Research: I am currently working to develop a gun from this. If we can reproduce this structure automatically within the given constraints, then this will be the first ever gun in history that can produce simultaneous orthogonal gliders. I humbly encourage anyone, working independently or with some organization, to think on this.

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THE DATA BUZZ: EVOLUTION OF BIG



Subhajit Saha B.Sc. Batch of 2019-2022 Department of Computer Science St. Xavier's College, Kolkata

Every day we generate 2.5 quintillion Bytes of data which is equivalent to 10 million blue-ray DVDs. Big data "size" is a constantly moving target, as of 2012 ranging from a few dozen terabytes to many zettabytes of data. The present generation where every organization in the world, is interested in collecting tons and tons of datasets and analyzing them regularly for obtaining strategies to establish their foothold in the market, has occurred in increasing trends. Data is considered to be the ultimate mode of wealth in the modern age. The one who has more data is considered to be richer than others. But what does this data consists of? It consists of the vast amount of ordered and unordered datasets that are obtained from different sources. Characteristics of Big Data are described as the V5 which consists of Volume, Velocity, Variety, Veracity, and Value of data. The quantity of generated and stored data is the Volume which determines the value and potential insight. Variety determines the different types, in which data is accumulated. Velocity is the speed at which data is generated. The veracity of data is the data quality i.e. the certainty of data whether it's pure or impure. The data which is generated should be of some value and not gibberish. Big data is not a type of data that you can store or analyze using the traditional database management system within the given time frame. For E.g.: When you are trying to attach a file, which is of size 100MB through an email, you will not be able to do that, as the respective email server system will not support an attachment of this size. Therefore, this 100 MB of data with respect to the email system can be referred to as Big Data.

Big data is about extracting information and analytics from previously untouched data and thus integrating those valuable facts and figures into an organization's business operations like effective decision making, future projects, data warehouses, business processes, and its applications. But what are the real-time sources of this huge amount of data? The sources are spatial analysis, statistics from Weblog and log data, Text analysis, Temporal analysis, Machine Learning, Image analysis, Audio analysis as well as video analysis, to name a few. What are the processes to analyze this data? The major processes are Query and Reporting, Data mining, Data Visualization, Predictive modelling, Optimization, Streaming analytics of real-time data, Geospatial Analytics, Video analytics, and Voice analytics. There are 5 important steps in Big Data Analysis:

1. Selecting Data: The quality of data is very essential for analysis and any type of impure data might provide irregular analytics. At times, data are readily available for further processing but at times they might be incomplete or incompetent. In that case, other sources of data must be identified or new data collection initiatives, including surveys, must be planned. The type of data, its size, and frequency of collection have a direct effect on the analytics drawn from it.

2. Preprocessing Data: Raw data is often messy containing erroneous or irrelevant data with missing aspects. So, importing the data in a proper way and cleaning it is very much important. The irrelevant attributes must be identified and expunged from further consideration. A formal method must be developed on how to deal with missing data, and decide whether the data are missing randomly or systematically.

So, if the data is missing randomly, then a simple set of solutions would suffice. However, When the data is missing in a systematic way, the impact of the missing data on the results must be identified. e.g.: Suppose that in a particular survey, some individuals have refused to disclose their monthly income. Therefore, findings relying on an individual's income would exclude details of those individuals whose income was not reported. This would lead to systematic biases in the analysis. Therefore, it must be decided from beforehand whether missing data has to be excluded from the entire analysis or part of it.

3. Transforming data: After the relevant attributes of the data have been stored, the next step is to determine the appropriate format in which data is to be stored. An important consideration is to reduce the number of attributes to explain a particular phenomenon. This may require transforming data. Data Reduction Algorithms such as Principal component analysis can reduce the number of attributes without having a significant loss of information. In addition, variables may need to be transformed to help explain the phenomenon being studied.

4. Storing data: The transformed data must be stored in an effective way to make it conducive for mining and drawing analytics from it. During the process, new variables emerge which must be added to the original database, which is why the data storage scheme should facilitate efficiently reading from and writing to the database. It is also important to store the data on servers or on storage media that keeps the data secure and prevents the mining algorithm from unnecessarily searching for pieces of data scattered on different servers or storage media. Data safety and privacy should be a primary concern for storing data.

5. Mining Data: After the data is preprocessed, transformed, and

properly stored, it is then subjected to mining procedures to draw analytics from it. This step includes data analysis methods, including parametric and non-parametric methods and machine learning algorithms. It is better to start with data visualization which consists of plotting different types of graphs from the data obtained. This helps in understanding the preliminary trends in the particular dataset.

Now a very important question to answer, what is the difference between "Big Data" and "Data Science". Now the answer to this has always been a very vague one. On the contrary, apart from the definition of "Big Data" earlier provided, Data Science is the study or processing of data, which leads to meaningful insights for an individual or a business. For example: Based on historic data of sales, the company wants to predict how many sales they can make in the next month? So, answering questions like these, require the use of Data Science. Data Science is the study of data, which can also be in the form of Big Data. Therefore, to sum it up, "Big data" is the fuel required by Data Science to arrive at meaningful insights.

The most efficient big data software is Hadoop which solves lots of problems involving massive amounts of data and computation. It is a collection of open-source software utilities that provides efficient storage and data mining facilities. The basic mechanism is based upon big data clusters. Originally, in a big data cluster, Larry Page and Sergey Brin took the data and they sliced it into pieces after replicating or triplicating them, they send those pieces of those files to thousands of computers (nodes). After that, they would send the same program (packaged code) to all these computers (nodes) in the cluster for processing the data in parallel and then send the results back to the main server. The results are then sorted and those are again redistributed for another process. The core of Hadoop contains a storage part known as HDFS (Hadoop Distributed File System) and a processing part which is called the MapReduce programming model. This facilitates the processing of data faster and is much better and more efficient than the parallel file system.

As an ever-evolving technology, what is the role of the cloud in big data and data science? Cloud is like a godsend for data scientists primarily because the data and valuable information can be put into the cloud, which is a type of central storage system. It allows the scientists to bypass the physical limitations of the computers and the systems and it allows them to deploy the analytics and storage capacities of advanced machines that do not necessarily have to be the user's machine or the company's machine. This type of technology is easily portable and can be accessed from any part of the world. As an advantage, it allows us to deploy very advanced computing algorithms and the ability to do high-performance computing.

In the 2016 US Presidential Elections, data science was highly implemented by the media houses to predict the winning chances of

each candidate as well as those who were competing for the election. They used the analysis of this data to shape up their campaigning procedure. Political data consisting of Debates and tweets from where sentimental analysis was done and the response of each candidate to a particular issue was also taken into account. RTAP or Real-time analytic processing was used in measuring the public opinions from social media feed and analytics were drawn from it. The foundation of data is ever increasing. According to some recent reports, the world's technological per-capita capacity has approximately doubled every 40 months since the 1980s. IBM estimated that as of 2012, 2.5 exabytes of data are generated each day. Based on IDC (International Data Corporation), the global data volume will grow exponentially from 4.4 zettabytes to 44 zettabytes between 2013 and 2020, and by 2025, it will cross the mark of 163 zettabytes of data. The Indian government also utilises a vast amount of data visualization techniques in analyzing how the Indian electorate is responding to government actions, as well as the various policies undertaken by the government.

Developed economies have increased their use of data-intensive technologies. Astonishingly, there are 4.6 billion mobile-phone subscriptions worldwide, and about 1-2 billion people access the internet on a daily basis. Interestingly, between 1990 and 2005, more than 1 billion people worldwide entered the middle class, which means people became more literate, which in turn led to information and data growth. The world's information exchange capacity through telecommunication networks was 281 petabytes in 1986, 471 petabytes in 1993, 2.2 exabytes in 2000, 65 exabytes in 2007, and predictions put the amount of internet traffic at 667 exabytes annually by 2014. A recent estimate shows that one-third of the globally stored information is in the form of alphanumeric text and still image data, which is the format most useful for most big data applications. This also shows the potential of yet unused data (i.e. in the form of video and audio content).

The huge amount of criticism regarding big data is the data privacy, security, and the amount to which it can be secured by an organization. The challenge of data privacy is to use data while protecting an individual's privacy preferences and their personally identifiable information. The fields of computer security, data security, and information security design use software, hardware, and human resources to address this issue. There have been numerous instances of data breaches but effective protocols and international laws must be applied to effectively handle them. One such is in the UK, the Data Protection Act is used to ensure that personal data is accessible to those whom it concerns, and provides redress to individuals if there are inaccuracies. This is particularly important to ensure individuals are treated fairly, for example for credit checking purposes. It has been rightly said by Geoffrey Moore, an American management consultant and author,

X-Cryptus Volume IV

"Without Big Data analytics, companies are blind and deaf, wandering out onto the web like deer on a freeway."

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DEEP LEARNING FOR A BETTER TOMORROW



Manjistha Paul M.Sc. Batch of 2020-2022 Department of Computer Science St. Xavier's College, Kolkata

The term "Machine Learning" refers to the process through which computers learn from data. It symbolizes the juncture where computer science and statistics converge. Algorithms are utilised to execute a task without having to programme it directly. Human brain is a wonder in itself. Now, Deep Learning seeks to emulate the human brain, while it falls far short of its capabilities, allowing systems to organize data and generate extremely accurate predictions. Each algorithm in the hierarchy performs a nonlinear transformation on its input before yielding a statistical model as an output. Iterations continue until the output is accurate enough to be useful. The term "deep" corresponds to the quantity of processing layers that data must flow through.

DEMYSTIFYING THE BUZZWORDS: ARTIFICIAL INTELLIGENCE VS. MACHINE LEARNING VS. DEEP LEARNING:

Nowadays, there are misconceptions with regard to the words "AI", "Machine learning" and "Deep learning", people think all things are the same when it comes to the word "AI" but, this exactly is not the case. Well, yes they are all related to each other, but not the same.

"AI is the ability of computer programs to function like a human brain."

"Machine Learning can be defined as the process of inducing intelligence into a system or machine without explicit programming"- Andrew NG, Stanford Adjunct Professor.

Deep Learning is a subfield of Machine Learning(ML) in artificial intelligence(AI) that deals with algorithms inspired from the biological structure and function of a brain to aid machines with intelligence.

Today, we can leverage Deep Learning for almost all use cases that were earlier solved using Machine Learning and expect to outperform our previous achievements, provided that there is a surplus of data. This realization has led to distinguishing the order of fields based on data.

A new thumb rule was established: ML would not be able to improve performance with increased training data after a certain threshold, whereas DL was able to leverage the surplus data more effectively for

increased performance.

The following chart is an illustration to represent the overall ides of model performance with data size:



Figure 1: a) Performance Comparison of Deep learning-based algorithms Vs Traditional algorithms (Source: Alejandro [2016]) b) Difference between Artificial Intelligence, Machine Learning and Deep Learning.

DECOMPOSING A DEEP LEARNING MODEL: INTRODUCTION TO ARTIFICIAL NEURAL NETWORK

The biological inspiration of "neural networks" is our human brain. We do not need to talk about the complex biology of our brain structures but suffice to say, the brain contains neurons which are kind of like organic switches. Neurons in our cerebral cortex are connected through axons. A neuron "fires " to the neurons it is connected to when enough of its input signals are activated. This kind of appears to be very simple at the individual neuron levelbut layers of neurons connected in this way could lead to learning behavior. Learning occurs by repeatedly activating certain neural connections over others, and this reinforces other connections.

Artificial neural networks tend to simplify and mimic this human brain behavior. They can be trained in a supervised or unsupervised manner.

In supervised ANN, the network is trained by providing matched input and output data samples, with the intention of getting the ANN to produce the desired output for a given input.

In unsupervised ANN, an attempt is made to make the ANN "understand" the structure of the provided "input data" on its own.



Figure: (a) Comparison of a natural neuron and a digital neuron (b) Basic architecture of a neural network.

CLASSIC TASKS PERFORMED BY DEEP LEARNING:

Many traditional tasks saw massive performance gains because of Deep Net technologies.

Deep Nets are capable of performing a wide range of visual tasks. Boundary detection, semantic segmentation, semantic boundaries, surface normals, saliency, human parts, and object detection are examples of these techniques. The self-driving mode in Tesla's cars, predictions of the next word on our iOS or Android phone, Alexa, Siri, and Google Assistant responding to us as humans, Facebook suggesting tagging our friends when we upload a picture are all applications of Deep Learning.

Although deep learning outperforms alternative techniques, they are not general purpose. Here, some questions are raised.

Deep Nets work well on benchmarked datasets. Would they still work well on real-world images outside the dataset?

Don't we also need billions of samples to train a system with billions of degrees of freedom?

With effectively infinite potential folding/spin/wiring configurations, how does the system find the precise arrangement that leads to useful and robust results?

As deep neural networks grow in size from thousands to millions to billions of weight, our ability to accurately train them becomes a limiting factor in their effectiveness. The success of deep learning indicates that models can be trained with ample amounts of data. A simple sampling of the possible configurations until the optimum one is reached is not a viable option even if one waited for the age of the universe. The resolution lies in the fact that evolution has created a mechanism of folding which involves the rapid formation of local interactions. These interactions determine the further folding of the protein.

STEPPING INTO THE FUTURE

Today, Deep Learning is ubiquitous. The first step would be to start Deep Learning for Computer Vision. Here is where we shake hands with CNN.

CONVOLUTIONAL NEURAL NETWORKS (CNN):

A CNN is a deep learning system that can take an input image and assign importance (learnable weights and biases) to distinct aspects/ objects in the image, as well as distinguish one image from another. A ConvNet is successfully able to capture the spatial and temporal dependencies in an image through an application of relevant filters. Due to a reduction in the number of parameters involved and the reusability of weights, the architecture delivers a better fit to the picture dataset.



Figure: A Convolutional Neural Network to classify basic vehicles

RECURRENT NEURAL NETWORKS(RNN):

The Recurrent Neural Network is a unique take on a traditional neural network. The past is remembered by the recurrent neural network, and its judgments are influenced by what it has learned in the past. It connects a layer to itself and thereby gets simultaneous access to two or more consecutive input samples to process the end outputs. This property is unique to RNN, and with its rise in research, it delivered amazing success in the field of natural language understanding.



Figure. Standard RNN architecture and an unfolded structure with T time

EXPLORING THE INCONCEIVABLE THROUGH DEEP LEARNING:

GENERATIVE ADVERSARIAL NETWORKS(GAN):

GANs are at the forefront of disruptions in DL and have been an active research topic recently. In a nutshell, a GAN allows a network to learn from images that represent a real-world entity(say, a cat or dog when we develop a simple DL model to classify between a cat and a dog) and then develop a new image using the same image it has learned in the process; that is, it can generate a new image of a cat that looks (almost) authentic and is completely different from the set of images provided for the training. If the training time and the sample images provided during training are sufficiently large, it can learn a network that can generate new images that are not identical to the ones provided during training, it generates new images.

Generating natural text-like descriptions from an image(image captioning) is already existent. Think about providing a natural text description to a system, and generating an image in return. The idea may sound too futuristic, but we are close to that possibility. Just imagine, you saw a criminal on the road and the police needed your help in sketching his face to investigate further; with future GAN systems, we can imagine a system where you describe the details of a face and the system sketches the face for you. The applications of GAN are too futuristic, but still in progress. Currently, researchers' GAN networks can render/produce high-definition photos, and there are ongoing experiments and research in the field to construct GAN networks that can also generate high-definition films.

CONCLUDING THOUGHTS:

So, what's next for machine intelligence?

In a very real sense, we are teaching machines to teach themselves. Despite the breakthrough with regard to how "AI is becoming the new electricity", deep learning algorithms still can't reason the way humans



Figure. General Adversarial Networks (GANs)

do. That could change soon, though. Deep learning, despite vast data and processing capacity, remains a difficult task. With everyday advancement and the betterment of technology, nothing is far apart.

There is still a lack of developers trained to use these deep learning techniques. There is not a simple course that developers can take to gain deep AI specialization. Machine learning is already a very highly specialized domain, and those with the knowledge to train deep learning models and deploy them into production are also highly selected.

Nonetheless, the number of businesses wishing to analyze unstructured data such as photographs, images or text is quickly growing. The trend will continue primarily because deep learning techniques are yielding impressive results. It is important that the people capable of training neural nets are also able to share their work with as many people as possible. In essence, there must be a start to democratizing access to machine intelligence algorithms, tools, and techniques.

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"ARE OUR COMPUTERS INTELLIGENT THAN US?"



Deep Kumar Ganguly M.Sc. Batch of 2020-2022 Department of Computer Science St. Xavier's College, Kolkata

Humankind is not unknown to hardships – from the inception of thought, our brains have realized that there are conditions that are favourable and unfavourable. Throughout the years, we have hunted, been hunted, stroked stones for fire, or been struck by lightning, all these experiences are so basic that these sensations have been burned into our DNA but tasks like solving math problems, analyzing ledgers, choosing the best path to a location require a more intricate train of thought. Furthermore, the requirement of well-formed and established methods that can successfully tackle these problems in the least amount of feasible effort is the need of the hour. Of these methods, some are very much common which brings us to the question of how fast can one pick up such a skill – days? Months? Or years?

The synchronization of our analytical left brain and creative right is collectively what we term as 'intelligence'. Though there exist well-established metrics to quantify it yet it remains as elusive as always to this day.

Most of the qualities that we say are intrinsic to humans like creating artworks, sculptures machines, designing buildings can be broken down into somewhat complex patterns and a lot of experience that often comes from spending a considerable amount of time being engrossed with the activity – where the brain forms links to create responses for stimuli generated from partaking in these activities. Also, the links may be destroyed or replaced when foregoing the same activity.

These links are what neurobiological scientists term as "cognition" so evidently everything boils down to one grand question i.e. if these links are efficiently simulated by some machine that should be equivalent to a human in terms of collective intelligence. Hence, the grand domain of artificial intelligence is born summed up famously in many neurobiological journals as – "an inception of man on its way to overtake man".

Machines have evolved greatly from bug-filled punch hole computers occupying the size of living rooms to small pocket size encyclopedias; whose computation power is equivalent to supercomputers of the '50s. This constant evolution of machines has finally caught up with us. Present-day machines are at the forefront of many activities which were previously dominated by humans – the race of man vs. machines has begun.

Deep Blue, an artificial intelligence system designed by IBM has successfully beat the Russian chess grandmaster, Kasparov, German scientists have built algorithms that can mimic the great artist, Van Gogh's artistic style, and Google's assistant can be our map, guide, planner, and organizer all at once and answer or screen phone calls for us, thus making everyone have their secretary.

The present machine in domains like, image processing has become so advanced that it no longer requires training algorithms to form links in custom models but performs "one-shot" predictions where it simulates learning like a child – its primary exposure teaches the machine without any external intervention.

All these instances are pretty measly compared to the feats accomplished by modern machines which can drive cars, fly planes, steer rockets, deliver articles via drones and execute heavy military operations – so much so a countries' combat arsenal now features machines that are equipped with highly advanced AI systems.

This exposes the scary side of machines where they can be weaponized and used for domination as it learns to classify human intent it can gradually hold individuals against their free will if it classifies them as troublesome which is a dangerous predicament. In such a regime, some can be punished before committing a crime.

Some countries having a very authoritarian outlook have already implemented such measures in miniature scales where all its citizens' data are analyzed by the Government to rewards the citizens for their loyalty and discipline or punish them for disobeying thus machines are now formulating an "ideal citizen".

All these activities are possible because computers are created to do tasks fast; the same happens for learning algorithms as well – as humans need to learn a task then transfer the expertise to another which is a highly variable metric and non-deterministic concerning complexity, but an AI system once learnt and deployed can easily copy its inference and findings to a million machines in a very short time, which is a very deterministic operation. Thus, the exponential nature of its evolution easily shows how man-made workforces can easily eradicate a man's work.

Modern models like GPT by OpenAI can create music, build websites and images from a single text-based input which otherwise takes a person a considerable amount of time and effort to develop those. Though the system is at a very nascent stage and very little of its output can be classified as good as a human's output compared with the rapid pace of development it can be easily ballparked with two decades when computers create symphonies at the opera and sell their paintings at their galleries.

In conclusion, machines are already at expertise where they can outsmart humans in mundane tasks and once taught can break down complex tasks to simpler ones and learn at faster rates compared to a person. Still attributes like emotions, empathy, and genuinely can't always be decoded into a mathematical function yet such that computers can learn these in minutes. These entities are beyond the cognition of machines; though scientists are always working round the clock to decode these attributes into 1s and 0s still their mystique eludes us.

So even if computers outsmart us in tasks that can be deciphered but tasks that need intervention beyond neural links and sparks from the synapses will always be a challenge to the machines.

BLURB: THE EVOLVING FIELD OF DEEP LEARNING BASED HANDWRITTEN TEXT RECOGNITION



Simran Gurung B.Sc. Batch of 2020-2023 Department of Computer Science St. Xavier's College, Kolkata



Figure: Handwriting Analysis (Source: Flickr, Authors: Robinson et al. 1892)

Deep learning based text and image analysis has witnessed its use across a diverse array of scenarios, with handwriting analysis being one of its significant applications. Starting from historical documents to archives or digitization of hand filled forms, postal addresses thanks to computers - the job gets easier for humans.



Figure: Comparing Offline Handwriting and Online Handwriting (Source: Nanonets)

Deep learning is a part of machine-learning approach and was inspired by the magnificence of the human brain. Just the way our brain needs lots of neuron connections to function properly, deep learning also has a vast number of neural networks that help in analyzing vast amounts of data and providing mostly accurate outputs. A deep-learning network trained on labeled data (features) can be applied to unstructured data, giving it access to much more input than machine-learning nets. And compared to classical methods - quality is the emphasis rather than quantity - as inadequate algorithms can outperform the good ones when trained on plenty of data. In addition, deep-learning networks require no manual hardcoding as compared to classical methods. The parameters are learnt during the training process. This makes deep learning methods more flexible to changes in handwriting styles, also solving the problem of feature extraction in classical methods. Nonetheless, the output accuracy depends strongly on the quality and completeness of the dataset used in the training process.

Before deep learning came into the picture, a software developed by Ray Kurzweil in 1974 known as Optical Character Recognition (OCR) carried out text recognition in handwritten forms. In this offline method, text was analyzed after being written. To be more precise, the binary output of a character would be analyzed against its background. This particularly found immense use in archival of historical documents as well as mass digitization of hand-filled forms, among other purposes. This classical technique came with some deficiencies such as reduced efficiency and failure of recognition of unexpected characters. Although OCR has been capable of recognizing individual characters, it faces disadvantage in identifying cursive writing as there is no distinct separation between the characters. This is because of the manual addition of features that requires a lot of developmental time. And this renders the feature extraction unfeasible.

Perceptual	Logical primitives				
anchorage points	Pertinent downstrokes		Morphological strokes		Ligatures
ł	J	J	00	J	Z
đ	J	J	0	J	J
J	ð	Ŧ	ð	F	Ŧ

Figure: Handwriting segmentation of the letter 'g' (Source: Semantic Scholar)

With time deep learning algorithms improved and at present, deep learning models can solve these deficiencies to some extent. Since the 1980s, an increasing awareness about the potential of computational powers and funding in this field boosted the expansion of the deep learning algorithmic programs within the framework of Artificial Intelligence (AI) - a field that encompasses the techniques which are used in mimicking human behavior - a challenging area for computational researchers and a buzzword for the lay people. Generally speaking, deep-learning networks solve the previous issues of feature extraction by analyzing the datasets without any human intervention and then classify an image based on weighted inputs. Although deep learning models have drawn massive interest in handwritten text recognition- it is not without its own set of challenges.

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AI AND THE FUTURE OF FOOD INDUSTRY



Asmita Mondal B.Sc. Batch of 2020-2023 Department of Computer Science St. Xavier's College, Kolkata

Steve Kovach (Senior Correspondent): "Should we be afraid of you?"

Pepper: "I mean have you seen my Instagram? I'm just plain cute."

Steve: "Why don't you introduce yourself?"

Pepper: "My name is Pepper. I'm a humanoid robot and I'm 1.2metres tall. I was born in SoftBank Robotics. You can keep asking me questions if you want."

Steve: "What kind of jobs will robots do in the future?"

Pepper: "I'm thinking MARS. I hear from Elon that's the future."

Steve: "Is there going to be a robot uprising?"

Pepper: "I try to stay away from politics."

Steve: " Are you gonna take over the world?"

Pepper: " I'm not taking over anything, but your heart."

Steve: "Cease all motor functions"

Pepper: "That does not work on me, Bernard!"





Fig. Interview with Pepper The Semi-Humanoid Robot by Tech Insider Interview Courtesy: Tech Insider[9]

Did you know that by 2050, the world's population is expected to reach 9 billion? [11] The most difficult task here would be to feed these people effectively. The agricultural sector must boost its productivity by 70% to achieve this.[11] Artificial intelligence will play a critical role in food production in the future.

For the first time, the light of technology has shone brightly on the food business, and it has been quickly adopted without hesitation. [11] Food and beverage industries are already moving quickly to satisfy customer demands, leveraging technology and logistics efficiency. [11][10]

The food and beverage industry has begun to use the multiple predictive analytical applications offered by this technology by mastering the subtleties involved in big data analytics and AI. [11] Many facets of the industry, including financials, production, distribution, consumption, marketing, and storage, are now recognised to be impacted by AI. [10]



Fig. Depiction of Artificial Intelligence and Robots

Artificial Intelligence and the Food Industry

Artificial Intelligence (AI) is a technology that is revolutionising every business, including the restaurant industry. The capacity to collect massive amounts of data and use artificial intelligence is a vital component for many organisations trying to improve customer experience through seamless interactions and encourage loyalty behaviours.[4][8]

Machine Learning

Machine learning is another crucial aspect of AI. A program or a machine "learns" specific functions over time by evaluating data and inputs in this subset of AI.[4]

For example:

You may have received "suggestions" from a shopping or streaming service. These recommendations are delivered to you using algorithms that evaluate your activities in order to "learn" about you and personalise your experience depending on your preferences. [4] It is lively and self-contained. Machine learning is an aspect of AI, hence the two are not mutually exclusive. [8]



Fig. Example of Food Order and Cloud Kitchen App

The following are a few applications of AI in the food industry.

Chatbots

You may have already conversed with a chatbot without realising it. They are simulated human interactions that are frequently seen in tech help on websites. They respond to a guest's questions as well as voice commands with typed replies or voice back, as if they were a human, giving direct comments, ideas, and confirmations. [7]

Recommendation Engines and App

Developers are creating apps that employ artificial intelligence to assist users in selecting meals based on their eating preferences. [7] These apps can assess if a consumer is travelling based on their location and purchasing patterns, generate restaurant recommendations based on these parameters, and update in real-time. [7]

Personal Virtual Assistant

Virtual assistants and accompanying technology are rapidly gaining popularity, with an expected 1.8 million users by 2021. When clients use these gadgets to look for places to eat, they have an impact on

the restaurant business. [7] Restaurant data, such as locations, wait times, and distances, can be fed into these personal assistants. [7]



Fig. Amazon Alexa and Google Home



Fig. Sally - the Salad Robot

Kiosks

Ordering kiosks are one of the more realistic sorts of AI you will see at restaurants. [7] Guests can use these machines to place orders on the spot. The kiosk then serves as a point-of-sale system, transmitting orders to the kitchen. [7]

Example of one of the most efficient kiosks:

Chowbotics was formed in 2014 by Deepak Sarkar, and its fresh food robot Sally — a rectangular machine that looks like a salad vending machine — can make personalised salads, grain, and poke bowls, parfaits, cereals, and snacks all in a tiny space, thanks to revolutionary robotics.[6] [14]

All you have to do is choose from its vast list of ingredients, ranging from ginger roasted tofu, steamed quinoa, baby spinach, and tomatoes to turkey breasts, lime vinaigrette, Parmesan cheese, and croutons! [14] It instantly feeds the information to an attached robot that automatically serves the salad in a fresh, sealed bowl. [6][14]

Robots

To boost the capacity and speed of food preparation and delivery, restaurants are turning to AI-driven robots.

Prominent AI Robots and Kiosks in the Food Industry

While the industry is already flooded with AI and robots acting as waiters and servers, some of the most prominent ones that have revolutionised the market game are as follows:

Pepper

Meet Pepper, a semi-humanoid robot developed by SoftBank Robotics designed with the ability to recognise faces and basic human emotions. [6] His ability to do so is based on the detection and analysis of facial expressions and voice tones. [6] [7] Pepper robots have been very active in offices in Us and Japan as receptionists, in sports as cheerleaders, in research and educational schools, and most strikingly in restaurants! [7]

For example, Pizza Hut Singapore, acquired a Pepper robot to deploy as a quick-service employee. The application is powered by MasterPress, the global digital payment service from MasterCard that ensures fast, simple, and secure digital payments through Pepper's handheld tablet. [6][15]

Here is a delightful real-time conversation with customer Veronica at Pizza Hut, Singapore: [15]

Veronica: "Pepper I'm hungry."

Pepper: "Delighted to have you in Master Card Café. Please Pair with MasterPress to continue ordering."

(Veronica Does the necessary.)

Pepper: "Nice to meet you, Veronica. What would you like to order?"

Veronica: "I will have a beef burger and 2 fries."

Pepper: "Regular or large?"

Veronica: "Regular"

Pepper: "Great. We have a promotion today. So you get 1 cheesecake at \$2 only. Would you like to take that.."

Veronica: "How many calories?"

Pepper: "Each cheesecake contains 90 calories: 3 grams of fat, 2 grams of carbs, and 6 grams of protein. Would you like to have it?"

Veronica: "I'll have it."

Pepper: "Great. Your total is \$23.50 that will be charged from your MasterCard ending 9746. Please say approved to authorize the transaction.

Veronica: "Approved!"

Pepper: "Cool. I'm processing your transaction now. Transaction successful. Please collect your food from the counter. Enjoy!"

Interview Courtesy: Brainjuice Radar[15]



Fig. Pepper-The Semi-Humanoid Robot



Fig. Flippy by MISO Robotics

Flippy

Miso Robotics is one of many companies attempting to automate food preparation, and it just revealed its latest machines, which place its burger-flipping bots Flippy and Flippy Roar on rails to make it easier to move around the kitchen.[6] The robot navigates its environment using a camera array, which includes an Intel 3D depth-sensing camera and a thermal camera and machine learning to recognize foodstuff. [16] A robotic arm then picks baskets full of food to fry with a spatula. [6] [16].

According to Miso Robotics, Flippy ROAR can now cook a total of 19 food items, including burgers and the plant-based Impossible Burger. [16] The robot's AI systems have now been trained to recognize a larger variety of fried foods, allowing it to dunk more objects into boiling oil than ever before. [16] Chicken tenders, chicken wings, popcorn shrimp, french fries, tater tots, potato wedges, hash browns, onion rings, and waffle fries are among the items on the menu.

Ginger- The Waiter Robot

Three robots dubbed Ginger glide from the kitchen to the tables, cracking jokes for diners, at one of the newest eateries to replace servers with machines.

Ginger is equipped with swarm intelligence.[17] Swarm blends the power of human ideas with AI algorithms, allowing them to interact with one another and with the restaurant, distributing tasks, avoiding collisions, and working together to carry orders to your valued clients. [18] Ginger is also capable of interacting with your customers. It can accept orders from the kitchen and deliver them to any table while navigating around obstacles. [17]

KiwiBots

Kiwi Campus, a Columbia-based startup company has designed tiny buggy-style electronic robots that deliver bags of groceries.[3]





Fig. KiwiBots in University of Berkeley's Campus

These charming robots, which can move at roughly two miles per hour, were developed at the University of Berkeley in California.[3] The company was able to make 150,000 deliveries there, demonstrating its viability for expansion to other universities such as the University of Denver and Stanford University. [3]

Flirtey Drones

Flirtey is a drone delivery firm based in Reno, Nevada. Flirtey's drone distributes its contents by dropping a tether while suspended in mid-air, and then retracting the tether once the package is delivered. [1] This technique of delivery was designed by Flirtey to be the safest and most exact, and it has now become the industry standard for drone delivery. [1] [12]



Fig. Flirtey Drones in Action



Fig. Illustration of AI usage in food industries

The main uses of AI in the food industry overall include:

Sorting

These technology-inclined systems are sensor-based and use features like cameras and near-infrared sensors to visualize and sort food products from human perception.

Hygiene Habits

AI-enabled companies quickly detect deficits and eliminate them instantly.

For example:

TellSpec, an AI startup formed in 2013, uses AI in its handheld Food Sensor scanner to detect food at the molecular level. [7] The TellSpec scanner shoots a light directly onto the food item using algorithms. [7]

Chemical compounds are read by light photons, which are subsequently uploaded and analysed by TellSpec's analytics system. [7] As a result, data about the composition of the food will be processed to identify calories, macronutrients, and some nutritional information in addition to potentially dangerous substances for the user, such as allergies.[7]

Maintenance

Ongoing research projects suggest that a system known as Self Optimising Clear In Place (SOCIP) can improve cleaning time thus, drastically reducing resources used for cleaning. [2] Ultrasonic sensing and optical fluorescence imaging are used to detect the tiniest amount of food leftovers and microbe debris present in the equipment. [2]

Others

Modern usage of AI in food industries includes significant reduction in downtime, reducing consumer friction at the point of sale, speeding up manual tasks, and improving worker over-time ratio.

Potential Challenges

With the world of benefits that AI has to offer, there are just as many challenges.

Cost

Potential adopters face numerous difficulties, the biggest being price. AI systems that are highly capable of humanoid tasks are not always cheap or easy to build.[5]

Integration Issues

It is never easy to integrate new technology and this is true for every department of science and technology. [5]

Propriety data

With the right propriety data, food and beverage companies may not be able to build artificial learning models that can interact and perform. [5][8]

Communication

Facilitating human-robot collaboration is a tedious task and requires years of research and expertise to build a model that can understand any question, in any language, at any time, and at any place. [5] Tons of data is required to train robots, and moreover, it is in a controlled environment. How efficient it would perform in the real world always remains a question. [5][8]

Security

There is always the issue of privacy, ethics, and security with any technology. By reprogramming or changing the data used to train the robots, it is possible to cause the robot to malfunction. [5]

Energy Efficiency

In terms of energy usage, most modern robots are inefficient. In the development of power sources for robots, little progress has been made. These robots still use traditional power generation and storage methods. [5][8]

Mapping

Even if a robot has been educated to recognize its environment, even little changes force the robots to relearn and adapt to new situations. This could create delays or even mishaps in the completion of the given tasks. [8]



Fig. Illustration of Human-AI interaction & Robots performing various tasks

A Ray of Hope

Despite these obstacles, the benefits of AI technology in the food business, such as improved customer reach, easier product creation, direct access to customer demands and feedback, competitive advantage through creative goods, and many other advantages, cannot be overlooked. For a seamless and successful transition, every revolution necessitates a shift in people's mindsets.[13]

Artificial Intelligence is not a substitute for Humans. This misconception has to be cleared.

- People should consider AI as a friend who can assist them in performing their work more effectively and efficiently.
- Businesses should seek advice from IT companies on how and why AI can be used to achieve their goals. [13]
- The difficulty of locating relevant data and feeding it to the AI model is an early barrier to AI adaptation that can be overcome by supplying high-quality data, modifying methods, and training it until the required output is produced. [13][8]
- Management should consider AI as a new method of conducting business and have a clear understanding of how the AI model may address their business problem.[8]

Although AI and machine learning have made significant progress in the food business, they still have a long way to go before becoming an indisputable part of it.

"We're at the beginning of a golden age of AI. Recent advancements have already led to invention that previously lived in the realm of science fiction — and we've only scratched the surface of what's possible." -Jeff Bezos, Amazon CEO, on his public conference for AI.

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DEEPFAKEANDASURVEYOFTECHNIQUES TO DISTINGUISH BETWEEN DEEP FAKE AND ORIGINAL VIDEOS



Ayesha Singh M.Sc. Batch of 2020-2022 Department of Computer Science St. Xavier's College, Kolkata

Deepfakes are AI-generated fake videos, which follow an algorithm allowing a user to switch the face of an actor in a video with the face of a different actor in a photorealistic manner. It takes a video of a specific individual, the target as input, and outputs another video with the target's faces replaced with those of another individual, the source. The backbone of Deepfake are deep neural networks trained on face images to automatically map the facial expressions of the source to the target and with proper post-processing, the resulting videos can achieve a high level of realism. In this day and age of the growing reach of social media, media sharing portals and the increase in sophistication of mobile camera technology have made the creation and propagation of digital videos more convenient than ever before. The growth of machine learning and computer vision techniques that eliminate the need for manual editing steps, accessibility to large volume training data, high throughput computing power have decreased the time needed for fabrication and manipulation of videos as compared to earlier where the number of fake videos and their degrees of realism were limited by the lack of sophisticated editing tools, the high demand on domain expertise, and the complex and time-consuming process involved. Moreover, smartphone and desktop applications like FaceApp and FakeApp have made tampering of images and videos, an operation reserved for highly trained professionals, accessible to an individual with a computer or a smartphone. These pose forensic challenges as images and videos are used as evidence in police investigations and courtrooms and are seen as reliable sources for evidence. The realistic nature of Deepfake videos also makes them a target for the generation of pedo-pornographic material, fake news, fake surveillance videos, and malicious hoaxes. These fake videos have already been used to create political tensions and they are being taken into account by governmental entities. There has been ongoing research to detect and distinguish Deepfake videos from real videos. Kaggle, an online community of data scientists and machine learning practitioners, held a Deepfake Detection challenge on its platform in 2020. Few of the solutions include a photo response non-uniformity (PRNU) analysis which was tested for its effectiveness in detecting Deepfake video manipulation and a temporal-aware pipeline to Koopman et al. (2018) [1] explored the use of photo response non-uniformity (PRNU) analysis its application to Deepfakes in order to assess the method's accuracy and ease of use in detecting the Deepfake manipulation. The PRNU pattern of a digital image is a noise pattern created by small factory defects in the light-sensitive sensors of a digital camera. This noise pattern is often referred to as the fingerprint of the digital image. The dataset used consisted of ten authentic, unmanipulated videos between 20 and 40 seconds in length and of 16 Deepfakes made by the researcher. The videos are in .MOV format shot on Canon PowerShot SX210 IS and have a resolution of 1280x720 pixels. The Deepfakes were made using GUI OpenFaceSwap. Three actors were used interchangeably for both the authentic videos as well as the Deepfakes. Using the software FFmpeq, the videos were turned into a series of frames as PNGs, and using the same software, the frames were cropped to frame the face to increase the significance of the expected change in PRNU pattern in the facial area of the frame. Each frame of a video is cropped by the exact same pixels in order to leave the portion of the PRNU pattern which is examined consistently between each cropped frame. These frames are then divided into eight groups of equal size sequentially. An average PRNU pattern is created for each group by means of the second-order (FSTV) method with the software 'PRNUCompare'. After the comparison of these eight groups, the cross-correlation scores are returned, which are used to calculate the variations in the correlation scores and the average correlation score for each video. A Welch's t-test is then applied to the results to assess the statistical significance between the results for Deepfakes and for authentic videos. This resulted in no correlation between the authenticity of the video and the variance in correlation scores. However, there does appear to be a correlation between the mean correlation scores and the authenticity of the video, where on average original videos have higher mean normalised cross-correlation scores compared to the Deepfakes. The difference in the distribution of mean normalised cross-correlation scores is statistically significant, with a p-value of 5.21×10^{-5} . This led to the conclusion that the mean normalised cross-correlation score can be used to distinguish Deepfakes from authentic videos. Thus, PRNU analysis may be suitable for the detection of Deepfakes. However, this research was done on a small dataset and requires further study and research on large datasets.

Figure 1(a) shows how frames are extracted from the video and cropped to contain the questioned face. The cropped frames are split evenly and sequentially over eight groups. An average PRNU pattern is calculated for each group. The PRNU pattern of each group is then compared to the PRNU patterns of the other seven groups. Normalised cross-correlation scores are calculated for each comparison. Figure 1(b) shows how frames are extracted from the video and cropped down to the exact same pixels which contain the questioned face.



Fig.1 (a) Frame Extraction Workflow (b) Visual representation of Frame Extraction

David Guera et al. (2018) [3] proposed a two-stage analysis composed of a CNN to extract features at the frame level followed by a temporally-aware RNN network to capture temporal inconsistencies between frames introduced by the face-swapping. Long Short Term Memory (LSTM) networks are a particular type of Recurrent Neural Network (RNN) to learn long-term dependencies in data sequences. Meanwhile, CNN has achieved massive success in visual recognition tasks. These inherent properties such as rich visual description, long-term temporal memory, and end-to-end training have led to a convolutional LSTM architecture which has been thoroughly studied for computer vision tasks involving sequences. The way in which these applications generate the manipulated Deepfake video, intra-frame inconsistencies, and temporal inconsistencies between frames are created. These video anomalies were exploited to detect if a video under analysis is a Deepfake manipulation or not. It is well known that deep learning methods can be effectively applied to enhance the performance of image compression. The Deepfake videos are generated firstly, by autoencoders which are applied for dimensionality reduction, compact representations of images, and generative model learning. This results in the autoencoders being able to extract a more compressed representation of images with a minimized loss function and are expected to result in better compression performance as compared to the existing image compression standards. Secondly, two sets of encoders and decoders with shared weights of the encoder circuit are used for the encoder networks. Deepfakes are made possible by finding a way to force both latent faces to be encoded on the same features. This is done by using two networks sharing the same encoder while using two decoders. In order to perform a face swap, the input face is encoded and decoded using the target face decoder. For training two sets of images were used. The first set contained the original 104

images which were extracted from the target video and manipulated, gathered from multiple sources for obtaining more realistic results. In order to ease the training process of the autoencoders, the original face and the target face would be put under similar viewing and illumination conditions to achieve the easiest face swap. However, this couldn't be achieved as multiple camera views, differences in lighting conditions, or simply the use of different video codecs makes it difficult for autoencoders to produce realistic faces under all conditions. This resulted in swapped faces which were visually inconsistent with the rest of the scene. This was another feature which was exploited in order to distinguish Deepfakes from realistic ones. Thirdly, the generation of the final video is exploited. As the autoencoder was used frame-by-frame, it remains completely unaware of previously generated faces that may have been created. This lack of temporal awareness acts as the source of multiple anomalies, the most prominent being the inconsistent choice of illuminants between scenes with frames, with results in a flickering phenomenon in the face region which is common to the majority of fake videos. While this might go unnoticed by the naked eye, it can be easily be picked up by a pixel-level CNN feature extractor. The system proposed is a convolutional LSTM structure for processing frame sequences. The system is divided into two components a) CNN for frame feature extraction and, b) LSTM for temporal sequence analysis. For a given image sequence, a convolutional LSTM is employed to produce a temporal sequence descriptor for image manipulation of the shot frame. Trying to aim at end-to-end learning, an integration of fully-connected layers is used to map the high-dimensional LSTM descriptor to a final detection probability. Specifically, this shallow network consists of two fully-connected layers and one dropout layer to minimize training over-fitting. For feature extraction by CNN, the InceptionV3 was adopted with the fully-connected layer at the top of the network removed to directly output a deep representation of each frame using the ImageNet pre-trained model. The network was not fine-tuned, and the sequential LSTM was fed with the 2048-dimensional feature vectors after the last pooling layers as input. As for sequence processing using LSTM, an assumption is made that a sequence of CNN feature vectors of input frames is taken as input and a 2-node neural network with the probabilities of the sequence being part of a Deepfake video or a normal video. The key challenge that needed to be addressed is the design of a model to recursively process a sequence in a meaningful manner. In order to resolve this problem, a 2048-wide LSTM unit with a 0.5 chance of dropout was used, which was capable to do exactly what was needed. During training, this LSTM model took a sequence of 2048- dimensional ImageNet feature vectors. The LSTM was followed by a 512 fully-connected layer with a 0.5 chance of dropout. Finally, a softmax layer was used to compute the probabilities of the frame sequence being either original or Deepfake. This LSTM module is an intermediate unit in the system pipeline, which is trained entirely end-to-end without the need for auxiliary loss functions. As a dataset for this system, 300 original videos and 300 Deepfake videos

from the HOHA dataset were used. As for data pre-processing of the video sequences, the channel mean was subtracted from each channel, every frame was resized to 299x299. The length of the input sequence was controlled by subsequence sampling of length N where N= 20,40,80 frames. And, lastly, the optimizer is set to ADAM for end-to-end training of the complete model with a learning rate of 1e–5 and decay of 1e–6. The results of this system were with less than 2 seconds of video (40 frames for videos sampled at 24 frames per second) it could accurately predict if the fragment being analysed comes from a Deepfake video or not with an accuracy greater than 97%.

Figure 2 gives an overview of the detection system. The system learns and infers in an end-to-end manner and given a video sequence, outputs a probability of it being a Deepfake or a pristine video. It has a convolutional LSTM subnetwork, for processing the input temporal sequence.

These proposed models and systems offer a powerful first line of defense in spotting fake media created using the various tools available. These systems show how competitive results can be achieved using these systems and models. However, more research is needed to find other solutions and also increase the robustness of the existing systems. It is important to continue improving the detection method as the technology behind Deepfake keeps evolving.



Fig.2 Overview of the Detection System

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DEEP DIVE INTO DATA AND DATA SCIENCE



Sneha Taneja B.Sc. Batch of 2020-2023 Department of Computer Science St. Xavier's College, Kolkata

Let us start the article with an intriguing question. What is being generated every time the user searches something on a browser, say Chrome for instance? What is being generated when the user opens a particular social media app to upload his/her posts or to scroll through others? What is being generated every time the user visits a particular website on the internet? The answer to these questions is 'Data'. With this information at our fingertips, we are adding to the data stockpile every time we turn to our search engines for answers, from searching lyrics on Google to accepting friend requests on Facebook, we contribute to the generation of data. The data generated requires strong attention because the amount of data we generate every day is mind-blowing, also because the amount of data being generated over the Internet is increasing exponentially. Estimates suggest that at least 25 quintillion bytes of data are produced every day i.e., 25 followed by 17 zeroes! While it is nearly impossible to wrap our minds around these numbers, we must still take a look at social media that certainly fuels data generation. According to DOMO's Data Never Sleeps 5.0 report, Snapchat users share 527760 photos every minute of the day, Instagram users post 46740 photos every minute of a day, 456000 tweets are sent on Twitter every minute of the day.

Data is expansive, it can be found everywhere. Before anything else, there is always data. Now, the big question is how do we manage this prodigious amount of data generated over the internet every second? Here comes into the frame the term known as 'Data Science'. Data Science, in simple words, is the study of a large quantity of data to derive a specific meaning out of it. Data science requires analysing, visualizing, and deep examining data so as to reach a particular conclusion about the unrevealed trend and patterns that were being denoted by the data. Data science is acknowledged for it sharp approach of converting a stack of complex data into variable information. Data science is a promising concept that works wonders on a given set of data which can reveal insights that help organizations make strategic choices, it is a vast topic that encompasses everything from handling data to explaining patterns and predicting behaviour.

In the context of data science, there are two types of data: Traditional

data and Big Data.

Traditional data is data that is structured in format and is stored in databases which the data scientists can manage; traditional data is in tabular format and may contain numeric or text values. Big Data, on the other hand, is infinitely more complex than traditional data, and not in the trivial sense. From variety (numbers, text, images, audio, mobile data, etc.), to velocity (retrieved and computed in real-time), to volume (measured in tera-, peta-, exa-bytes). This data collected by the data scientists or provided to them through conducted surveys (can be either traditional data or Big Data) is in raw form which is untouched data and cannot be analysed straight away. Therefore, before data processing, raw data undergoes pre-processing. The pre-processing part plays a prominent role as it converts raw data into a comprehensible and sensible form by checking the quality of data and removing unwanted noise from it which further helps the data scientists to yield better predictions. After data had been pre-processed, it is analysed with various forecasting methods which include linear regression analysis, logistic regression analysis, clustering, factor analysis, and time series. It is during this state the polished data undergoes certain algorithms and analyzing formulas that help to generate predictive models and draw conclusions based on them.

Data Science has vast applications in predictive analysis. In the specific case of weather forecasting, data is collected from satellites, ships, radars, and aircrafts to build models that can forecast weather and also predict impending natural calamities with great precision. This helps in taking appropriate measures at the right time and avoiding maximum possible damage. Data Science also aids in effective decision-making. Self-driving or intelligent cars are a classic example of decision-making. Self-driving cars collect real-world data from its surrounding using sensors like cameras, lasers, and radars and draw a visual map of their surrounding. This collected data is combined with advanced machine learning algorithms which help such intelligent cars to take critical driving decisions like turning, stopping, speeding, etc. Product recommendations have never been this accurate with the traditional models drawing insights out of browsing history, purchase history, and basic demographic factors. Knowledge of data science cares to improve the product recommendation system by effectively enhancing recommendation models and algorithms.

The above information justifies that data science is the buzzword. Data science helps to make unknown discoveries while swimming in data and the use of data science is rampant across all industries like healthcare, finance, education, supply chain, and much more. Data science is called for advancements in trends and technologies today, it is also considered as a steer that drives solutions across numerous industries. The bottom line is - with data science as a tool at hand, we can convert impossible to inevitable.

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MODERN TRENDS IN TECHNOLOGY

DARQ TECH

End of the digital era

The digital era which we are currently in is approaching its end. As we transition into the post-digital era, new technologies are bringing waves of innovation and growth. The time has come to shift from just knowing the latest technologies to exploiting them for our interests. Among these emerging technologies that have become bridges to unexplored horizons, the spotlight is falling on the set called DARQ: distributed ledger technology(DLT), artificial intelligence(AI), extended reality(XR), and quantum computing(QC).

This does not mean that the digital world is over; rather new technologies will be the ones setting the best apart from the rest. It is assumed that the digital playing field will eventually even out. Companies around the globe will need to embrace and master these technologies and start differentiating themselves in the market.

In fact, these technologies have already started bringing innovations and making a difference across industries today. AI plays a critical role in optimizing processes and influencing strategic decision-making. XR, an immersive technology, creates entirely new ways for people to experience and engage with the world around them. Distributed ledgers are perhaps best known in the context of blockchain and cryptocurrencies, but they are expanding networks and capabilities by eliminating the need for trusted third parties. And quantum computing will usher in novel ways to approach and solve the hardest computational problems.

How does DARQ shape our future?

So, first comes Distributed ledger technology (DLT). It is a digital system for recording the transaction of assets in which the transactions and their details are recorded in multiple places at the same time. Unlike traditional databases, distributed ledgers have no central data store or administration functionality. It has implementations like blockchain. So how can DLT revolutionize the world that we live in? Let's take an example.

Though it may seem unimaginable, there was once a time when a company would sell a record or a movie and know that they had sold a single copy to a single person. Although it was possible to copy a cassette tape, the effort needed kept the problem small. But come to 2020, movies are being leaked even before releasing and can spread halfway across the world in the time it takes the opening credits to

roll out. Here comes blockchain. Its public ledger method can prevent others from playing or copying it. The good old days would come back, where having a copy would actually mean buying it.

AI is probably the most known and widely implemented among DARQ. Even executives believe that it will have the most impact in the future. Artificial Intelligence is the field of study of making machines think like humans. AI has already started making a great impact in the world with the introduction of self-driven cars, advances in image recognition and natural language processing, optimizing processes, and influencing strategic decision-making. It seems that the day when humans and robots walk together in the streets is close. Companies now intend to do away with grueling interviews and mock exams and select the ideal candidates by making them just play a game. With AI, they can assess the applicants by making them play a game which evaluates them on non-traditional skills like collaboration, memory, and emotional cues, and makes hiring decisions based on potential.

Extended reality is closest to the masses and everyone has used it knowingly or unknowingly. Be it the filters in Snapchat and Instagram, or the VR headset, XR has opened innovative and immersive avenues which are attracting today's generation and creating new ways for people to experience and engage with the world around them. In the future, XR can facilitate digital twin technology which is a virtual copy of living or non-living physical entities. With this technology, a person can talk to a virtual copy of themselves or might be able to virtually visit a space station. It might also be possible to create a virtual copy of Iron Man's suit and test it in a simulated environment.

Quantum Computing is the least known technology but one which holds the most promise. It will usher in novel ways to approach and solve the hardest computational problems. When it comes to processing, Quantum Computing is a holy grail in solving the toughest computational problems. Google says its colossal D-Wave 2X quantum computing machine has been figuring out algorithms at 100,000,000 times the speed of a traditional computer chip can. This shows the power of Quantum Computers to change the world.

As these technologies are rapidly advancing and becoming accessible, enterprises across the world must embrace them and try to utilize them in unimagined ways in order to stay afloat in the harsh, competitive, and everchanging world of technology.

FLYZOO HOTEL - THE HOTEL OF THE FUTURE

To realise the future we envisaged, we must explore the impossibilities. Many of us did dream about the future, when the 1977 film, Star Wars: A New Hope, made us hope one day we might have an AI assistant like R2-D2. But to many, it was nothing but impossible. Well, guests at FlyZoo Hotel, China will agree that they have seen the impossible made possible; when a robot, having resemblance with R2-D2, delivers your food instead of human butlers.

Located in Hangzhou, China, FlyZoo Hotel by the Chinese e-commerce and tech giants Alibaba, is not only an answer to the future of hospitality but also explains how AI can become the mainstream technology. The project was led by Alibaba's online travel platform, Fliggy, along with Alibaba A.I. Labs and Alibaba Cloud.

If you are a guest at this hotel your experience starts with the FlyZoo mobile app. From booking your stay to choosing your rooms, the app does it all. Furthermore, after arriving at the hotel, one would find it very unfamiliar; apart from the futuristic design, there is no sign of the usual humdrum of a hotel lobby. As a foreigner check-in requires only a hotel staff to take a picture of your passport and face and then you are told your room number. For Chinese travelers, it's even easier, as they can check in via the app itself. No check-in counters, no concierge, no receptionists.

Everything inside the hotel is cashless and keyless. From using the elevators to entering your room, everything requires facial recognition, i.e. you only need to smile at the camera to access the hotel. Alipay is Alibaba's payment platform, which helps the hotel to go cashless.

Inside the room, sitting next to the bed is a voice assistant device, Tmall Genie – Alibaba's answer to Google Home or Amazon Alexa. With simple voice commands it can be used to turn on the TV, open and close curtains, adjust the temperature and lights, and even to order things like towels or water bottles to the room – which then are delivered by a room-service robot. You will often find these robots in the hotel – in the hallways, elevators, lounge area, and even in the restaurant, serving your food. It surely makes it to the top of the popularity list of the customers.

When it's time for checking out, you only need to pack and go, without any lines or hassles. One can even use the hotel app for early check-outs. The hotel will then automatically remove your personal data from its cloud servers.

FlyZoo Hotel is a perfect example of smart technologies making lives easier for us. It is also a milestone in the hospitality industry which was on a constant lookout for efficient, convenient, and easy-to-use services it could offer. According to Andy Wang, CEO of Alibaba Future Hotel, "As smart technology is reshaping industries, the FlyZoo Hotel represents Alibaba's endeavor to marry hospitality with technology, and ultimately inspire and empower the tourism industry to embrace innovation." FlyZoo Hotel brings together technology and hospitality to find innovations that can empower the industry in the digital era.

ROBOT DEXTERITY

Robot dexterity is a term that precisely points out the capabilities of robots in their respective fields. The primary difference between a machine and a robot is the presence of a "thinking component". In other words, robots are capable of taking decisions and acting accordingly. Robot dexterity gained enormous popularity at the onset of the twenty-first century. Robots have been used in various fields, developed over time using newer technologies, and armed with capabilities that could go beyond the scope of an equipped human being in terms of precision and accuracy. The stories of robots capturing pictures of outer space or performing neurological surgeries are not new.

The shift in this era is however not going beyond human capabilities, but performing actions that most human beings can do. What is innate for humans is almost impossible for robots to infer. Actions like swift decision-making skills, opening a jar using two hands, or finding out a pencil from a bunch of stationery can prove to be impossibly difficult for robots to manage. The most recent developments in this field employ the extensive usage of artificial intelligence and machine learning. The technique is similar to how human beings learn from examples and experiences. Machine learning uses a large database to store the "experience", which the robot can use to make a decision. Learning is so innate in human brains that we do not usually realize what huge amount of data our brain processes per second or how much experience is needed to lift a pencil casually from the side of the desk. Also, factors such as emotion, sensation to feel, taste, and preferences are being worked upon. Several papers are trying to extract emotions from words, handwriting, and face gestures. Several tech assistants are using semantic analysis to find out whether a comment was sarcastic, pessimistic, obsessive, or serious. Tones from words can be detected too. In the field of mobility, instead of using one robot arm, developers are trying to adjust coordinating skills in both arms of a humanoid robot to perform daily activities like driving a car, opening a jar, and setting up plates for the dinner. Depth perspective and motor dexterity have enabled research in fields when a robot to be trained to kill a fly by clapping their hands.

But, should the value of humans decrease because of such dexterous robots?. The perspective here needs a little change. Robot dexterity intends to replace humans in areas of difficult or perilous work, like in factories and wars. Robots in daily life can replace maids, help around the house for elderly or disabled people, or even become project partners. Although fewer workers are indeed being hired, we must look forward to increasing the quality of life and jobs where human beings can engage themselves in doing what he is truly needed for.

EVOLUTIONARY COMPUTATION

Evolutionary computation is the general term for several computational techniques based on the natural evolution process that imitates the mechanism of natural selection and survival of the fittest in solving real-world problems.

The most widely used form of evolutionary computation is 'Genetic Algorithms', proposed by John Holland (1975). They are a class of stochastic search and optimization algorithms based on natural biological evolution. They work by creating randomized solutions to the problem at hand. This population of many solutions will then evolve from one generation to the one after it, ultimately leading to a satisfactory solution to the problem. The best solutions are added to the population while the inferior ones are dropped. Repeating this process among the better elements will result in continued improvements in the population, as well as the survival and generation of new solutions.

A genetic algorithm implements the computation model by using arrays of bits or characters (binary string) to represent the chromosomes in a living organism. Each string corresponds to a possible solution. The genetic algorithm then tweaks the most promising chromosomes in pursuit of better results. A three-stage cycle governs the operation of a genetic algorithm:

- 1. Building and maintaining a population of solutions to the problem at hand
- 2. Choosing the stronger solutions for recombination with each other
- 3. Using their offspring to replace weaker solutions.

Each person in a population provides a potential solution to a particular problem. Each person is given a "fitness score" based on how effective their answer is to the problem.

A set of parameters can be used to represent a potential solution to a problem. For example, if our goal is to maximize the value of a function with three variables, F(x; y; z), each variable may be represented by a 10-bit binary number (suitably scaled). As a result, our chromosome would include three genes and 30 binary digits.

A Fitness function has to be specific for each problem to be solved. Given a particular chromosome set, the fitness function returns a single numerical merit proportional to the utility of the individual that the chromosome set represents.

Individuals are picked from the population and recombined during the GA's reproductive phase. Parents are chosen at random from the population, with a preference for those with higher fitness scores. After choosing two parents, their chromosomes are recombined, usually by crossover and mutation mechanisms:

- » Crossover involves cutting the chromosomal strings of two individuals at a random location to produce two "head" segments and two "tail" segments. After that, the tail segments are exchanged to create two new full-length chromosomes. The two individuals each inherit some genes from each parent.
- » After crossover, mutation is applied to each child individually. It randomly changes each gene with a minuscule chance of success (typically 0.001).

If the GA is successfully applied, the population will evolve over future generations, with the best and average individuals in each generation increasing their fitness towards the global optimum.

Genetic algorithms have a number of advantages over existing machine learning technologies, including the ability to be utilized in data mining for field or attribute selection, as well as the ability to be integrated with neural networks to identify optimal weights and architecture.

Also, most medical decisions can be formulated as a search in a very large and complex space. A cytologist, for example, examining a cytological material to determine if it is cancerous or not, searches the space of all conceivable cell features for a set of features permitting him to provide a clear diagnosis. To search efficiently in a given space, genetic algorithms use natural evolution's mechanism. They're used for a variety of things, including diagnosis and prognosis, medical imaging and signal processing, and planning and scheduling.

The principles of Genetic algorithms have been used to predict outcomes in critically ill patients, lung cancer, melanoma, and response to warfarin. They have also been used in computerized analysis of mammographic microcalcification, MRI segmentation of brain tumors to measure the efficacy of treatment strategies, and for analyzing computerized 2-D images to diagnose malignant melanomas.

HAPTIC SUITS

If you have ever played the game, PUBG, then you know how exhilarating it feels to continuously fire bullets from an AKM. What if you were told that you could actually experience what it is like to use a rifle, physically in real-time? With the advent of haptic suits, it may be a likely possibility in the near future.

Haptic suits, as the name suggests, are based on haptic technology, which aims to simulate the sensation of touch to the user through various mechanisms. It helps determine the intensity of different sensations, such as weight, hardness, geometry, and even temperature. Haptic feedback uses touch as a response system to communicate information from the system to the user and vice versa.

In gaming, Virtual Reality Haptic Suits seek to transmit tactile sensations from the virtual reality of the game to the body of the player, which means that if the user's avatar gets punched while playing a game, then the player quite literally experiences the blow too. The brain sends electric pulses to our muscles when we want to move our limbs, and these haptic suits use the same neuromuscular stimulation to enable such physical sensations. This native body language technology is applied using electrodes, so by sending different types of electric pulses with varying power and frequencies, the suits can simulate a wide variety of physical sensations, such that one may even feel the impact of a virtual blast.

A haptic suit's functionality goes beyond just gaming. It finds military applications by helping simulate training environments thereby letting the trainees physically experience situations that they may encounter on the field. In combination with virtual and augmented reality both, the suit creates such a paradigm which brings the combat location to its user, consequently reducing the operational cost of training elsewhere with more equipment. Moreover, the training takes place in such a way that people are able to fail and learn from their mistakes in a secure and more controlled environment. This also increases the workforce, especially in training activities. Haptic suits applied along with VR provide significantly more advantages like capturing the motion of the subject and climate control systems which change the temperature to enhance the entire experience. Despite being completely wireless, they still provide a full-body haptic feedback system to enable various sensations which makes the training process a lot easier, safer, and enjoyable.



IF TREES COULD SPEAK



Swagata Chakraborty B.Sc. Batch of 2019-2022 Department of Computer Science St. Xavier's College, Kolkata

If trees could speak,

They would narrate you chronicles of how they saw your ancestors grow and turn into ashes as they shared their last moments by happily burning with each other.

They would unfold you stories of how like a mother they provide you shed from the scorching sun and how they grew their children fruits so that you can feed on them.

They would tell you tales of how they worked harder to purify the air when they saw your little child cough at black smoke emitted by the honking cars.

They would portray you poems of how they were rendered homeless so that you can build your homes, how they were smashed into papers so that you can get your degree.

They would cite you facts of how climate is getting devastated, soil is getting eroded and deserted. May be the present situation is a retaliation of the wrong we did.

Is cruelty for nature the new normal? Are we so blinded by modernisation that we are unable to see the divine technology devised by nature for our smooth survival?

After all they did selflessly for us, all they received was a million selfish cuts. Just because they don't bleed and scream it doesn't mean that they have no pain. They are voiceless, they can't protest, that is why we should protect them.

THE TECHNOLOGICAL PARADOX



Abhay Ashok Kansal B.Sc. Batch of 2020-2023 Department of Statistics St. Xavier's College, Kolkata

Abstract:

All of us are mesmerised by technological advancements, aren't we? From spending days in lockdown watching reels and zoom calls, to getting the UPI services, technology has made our life easier, too much easier, I guess. Not only have we been prone to lack of productivity, jeopardy, and less socially active since these advancements, our lives have become complex too. Now, we are prone to more diseases, we have been disturbing the environment and increasing the "You need to learn that" aspect of life. This article covers some complex technological advancements and how they have negatively affected human lives.

GOING INNER

Mahendra Bhawsar



Fig: The paradox of technology

Technology and Innovation have been termed as a boon for mankind. Technology has made our life simpler, and upgradation and innovation have made complex situations more accessible. Imagine an era without ATMs and televisions - the plethora of activities and tasks we do daily would have become complicated and time-consuming. What if these technological advancements didn't exist or they had fewer complex designs? Let us take a moment and imagine about how our life would have been.

"The same technology that simplifies life by providing more functions in each device also complicates life by making the device harder to learn, harder to use. This is the paradox of technology." ~ Donald Norman, The Design of EveryDay things.

AM A PARADOX. / NO YOU'RE NOT! EXACTLY. OHHere



Fig: when what was made to obey, starts to dominate

Fig: The loop of acceptance and denial

In the following article, we will discuss the various complex designs in some commonly used machines and how some variations in designs and ideas would have led to a simpler and better usage.

The paradoxes can be discussed under various headings based on the potential fault in their designs. The article summarises each heading by considering the innovation.

Imagine what if Refrigerators never released CFCs, ATMs did not lock cards, Laptops and Televisions never released blue light, and what if these advancements created no e-waste. Just imagine what if the designs of Lego weren't changed? Lego pieces constructed today are not only expensive but making them uses a tremendous amount of plastic.

Technology has made life efficient but is not considered a success when it comes to violent assaults on society. The Internet and the management of its services release a lot of carbon dioxide, thus harming society. With the increase in technological mismanagement and a lack of control measures, air, water, waste, and noise pollution have hyped, which brings these advancements under question. In 2020, 53.6 million tonnes of e-waste were produced. E-waste is the fastest growing waste stream.

These gadgets have made us lazy which has decreased the productivity and efficiency of humans. Technology has reduced time consumption for various tasks. This is something that everyone appreciates. But most advancements work on the dopamine releases in the brain, which makes us more inclined towards using it, thus decreasing productivity. Televisions and Mobile phones have made entertainment and services easily accessible but by decoding the dopamine release and effect, we are turning into puppets thus reducing our efficiency.

"Thanks to internet and games, you can go bowling, play tennis or participate in the Olympics in your living room" ~Dominique Jackson



When we talk of paradoxes, we mean something that is self-contradictory. Technology is what makes our life easier but also adds to a load of hazards and negativity. People no more find solace in physical touch. Today, people tend to stay alone, playing games and living a life of isolation. Did we ever expect that from humans? Well, that's a gift or a curse technology has given its users.

Technological advancements in healthcare have been one of the greatest achievements. But this advancement has not only made living expensive and tough but also given birth to more health issues. It is now possible to replace a heart valve with a plastic and metal one but now the heart has been associated with a high dollar value. Also, television has been seen to affect the eyes, loud music and rays from various equipment have been a major cause of heart diseases. If technology is used to organize the healthcare system, it can save costs and risks.

Technological advancements suck thousands of dollars out of the pockets of an individual and increase the cost of living. We have also become so handicapped that we cannot work with these gadgets and accessing these gadgets isn't easy for everyone. With a huge population of the world living Below Poverty Line, it is impossible for benefits to reach all individuals. Japan, one of the world's most technologically advanced countries, has a debt which is 200 times its GDP. You ask why? Because Japan spent thousands of dollars on making technological advancements and trying to make life easier.

Technology has made us dependent, and we have forgotten the more obvious things. Technology is hailed for connecting people and making life simpler, but we have failed to understand that technology is meaningless without relationships, environment, and context. While we spend time watching television or surfing the internet, we are drawing our attention away from many other places and actions. Just consider the reason for fish to swim. Do they swim because they live in water, or do they live in water because they can swim? Technology exists because humans exist and prefer using it.

As Albert Einstein said, "It has become appallingly obvious that our technology has exceeded our humanity"





Fig: virtually chained The more data that is available to us, the less of it can be useful. More data accounts for various conclusions due to the presence of outliers. There can be various results and cause confusion, thus deviating from the original context. Because of the wide amount of information, we have, there is an information deficit as hunger has increased. Because of tremendous data, the answer to one question leads to another and this never-ending availability of data gives birth to thousands of unsolved questions.

To overcome this paradox, designers must work upon making the various gadgets less complex. Like keeping minimal features but maximum productivity. For instance, what if a microwave had just two switches. Won't it become simpler and easier to use? Or what if traffic lights are coordinated in such a way that there is minimal traffic? There are many areas where better designs can make use of technology more efficient and less complex.

Technology is a boon, but it comes with a cost. Spending time on mobile phones takes away your valuable time, gadgets consume non-renewable energy, some cause pollution, and some hardships and differences. We need to stand above this paradox and make life better. Don't forget that technology is nothing without humans.

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RELATIONSHIP



Swagata Chakraborty B.Sc. Batch of 2019-2022 Department of Computer Science St. Xavier's College, Kolkata

Being in a relationship is much like coding,

You precisely weave, neither too succinct nor too long, but a perfect algorithm to make sure that the complexity is not more and outcomes are not wrong.

You accurately embrace, neither too many nor too less, but a perfect amount of data for the model to train and not overfit your case.

You skillfully devise, neither too blanched not too blazed, but with perfect aesthetics to entangle heart and mind in its sophisticated design.

You judiciously knit, neither a stamp nor a sign, but a perfect digital intricacy which can protect your privacy and prevent abduction of the love you share.

You deliberately entwine, neither a box nor a lock but a perfect key to the heart which can decrypt the words shared behind an encrypted smile. 124



Shreea Bose M.Sc. Batch of 2021-2023 Dept. of Computer Science St. Xavier's College, Kolkata







Sourav Prasad M.Sc. Batch of 2020-2022 Dept. of Computer Science St. Xavier's College,





Bristy Rosemary Pereira M.Sc. Batch of 2021-2023 Dept. of Computer Science St. Xavier's College, Kolkata

Mekhla Dutta B.Sc. Batch of 2021-2024 Dept. of Computer Science St. Xavier's College, Kolkata







Asmita Mondal B.Sc. Batch of 2020-2023 Dept. of Computer Science St. Xavier's College,



Avishek Kumar Shrivastava M.Sc. Batch of 2020-2022 Dept. of Computer Science St. Xavier's College, Kolkata







Rush Guha B.Sc. Batch of 2019-2022 Dept. of Computer Science St. Xavier's College,



Biduraa Sarkar B.Sc. Batch of 2019-2022 Dept. of Computer Science St. Xavier's College, Kolkata



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Mohit Gupta B.Sc. Batch of 2021-2024 Dept. of Mass Communication & Videography St. Xavier's College, Kolkata



Ritwika Banerjee M.Sc. Batch of 2021-2023 Dept. of Computer Science St. Xavier's College, Kolkata







Sritama Dey M.Sc. Batch 2021-2023 Dept. of Computer Science St. Xavier's College, Kolkata





Shalini Torcato B.Sc. Batch of 2020-2023 Dept. of Computer Science St. Xavier's College, Kolkata



Since its inception, the Department of Computer Science has been a family of extremely committed, intelligent and dynamic students. The students have never failed to make the entire department proud by participating in various national and international conferences and publishing research papers in various esteemed journals.

Quite a notable share of students have opted for higher studies in premier institutes such as National Institute of Technology, Jadavpur University; while some have been hired by various prestigious multi-national companies.

Besides excelling in the academic fields, the students have also managed to shine brightly and mark their presence in numerous extra-curricular activities and win accolades. The students didn't let a cramped academic calendar or any other odds waver their spirit and fiercely participated with all their might thereby making all our heads high with admiration and pride.

The Department of Computer Science turned twenty-seven this year and undoubtedly this journey has been a very successful one throughout the course of which the entire department has flourished and grown vibrantly.

RESULTS IN JECA 2022:

TENURE	NAME	RANK
	Srirup Mukherjee	2
BSc Batch of 2019-2022	Ayan Nandi	4
	Siddhant Majumder	20
	Shrijon Kr. Biswas	26
	Shreya Mukherjee	39
	Debanjan Basu	43
	Agnideepta Chakraborty	53
	Ankita Samaddar	61
	Rhitajyoti Mandal	78
	Sohan Adhikary	101
	Anuska Saha	177
	Anwesha Ghosh	228

RESULTS IN NIMCET 2022:

TENURE	NAME	RANK
BSc Batch of 2018-2021	Abhiusnees Nandi	11
BSc Batch of 2019-2022	Agnideepta Chakraborty	33

RESULTS IN GATE 2022:

TENURE	NAME	RANK
MCa Databar 2020 2022	Roshan Chowrasia	185
MSC Balch of 2020-2022	Deep Kumar Ganguly	357

OTHER ACHIEVEMENTS:

1	TENURE	NAME	ACHIEVEMENT	
	BSc Batch of 2019- 2022	Swagata Chakraborty	Research intern at Jadavpur University	
	BSc Batch of 2019- 2022	Anubhav Sarkar	Research intern at Jadavpur University	
	BSc Batch of 2020- 2023	Sayandip Srimani	Senior State Swimming Competition: 50m freestyle: 2nd, 100m freestyle: 3rd Got selected for Senior National Aquatic Championships 2021 Inter-University selection trials CU: 50m freestyle: 1st, 100m freestyle: 1st	
	MSc Batch of 2021- 2023	Bitan Biswas	Research fellow at Hertie School of Governance, Berlin Research assistant at Cardiff University, UK NLP scholar at Univ.AI, a highly reputed institute of Harvard and UCLA professors Summer intern at NLP lab, ISI Kolkata	

M.Sc Computer Science Placements 2022







Expresso Interviewed by: Prof. Kaushik Goswami

Favourite superhero/cartoon character ? Phantom, Tom and Jerry.

> Favourite vacation place ? Some place in the mountains.

Favourite Food ? Hot rice, dal, butter/ghee, gandhoraj 'lebu'.

Most watched movie ?

Godfather.

Favourite Colour White.

> Favourite sport/indoor game ?

> > Swimming, TT.
Which quote inspires you the most?

"Dream is not that which you see while sleeping it is something that does not let you sleep." - Dr. A.P.J. Abdul Kalam

Must-have smartphone apps?

Email, Google Maps, and a good search engine.

Winter or Monsoon? Monsoon

Favourite Author?

Multiple ones in English and Bengali literature. Songs whose lyrics you have memorized?

Some Rabindrasangeet and of course, our Nation Anthem.

Favourite subject in school?

Physics



Tea or coffee?

Tea.

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