

B!TS N BYTES

Departmental Technical Magazine

VOLUME

7

May 2026



**INNOVATION FOR
THE FUTURE**

Transforming today, shaping
tomorrow, innovating for a brighter
future.

FROM THE DESK OF PRINCIPAL

Dr. Sanjay S Power
M.Tech/Ph.D IIT Bombay



I am delighted to write to you through "Bits N Bytes," a magazine dedicated to Computer Science and Engineering. First and foremost, I would like to congratulate the team for launching this publication, which showcases the writing skills of the engineers in our department and institute.

I look forward to reading the news and technical write-ups from all the authors, highlighting their studies, research, and reviews of the technical fields that interest them. As the years go by, we aim to improve the quality of our writing and the informative content, ensuring it is beneficial not only for our students but also for a wider audience.

This magazine can serve as a platform for young researchers, faculty, and students to present their findings. Congratulations again to the team for this publication, and best wishes for the future as we strive to reach international standards.

FROM THE DESK OF HOD

Dr. Rajkumar Samanta
Professor & HOD, CSE



I am excited to introduce "Bits N Bytes," the esteemed publication of the Computer Science and Engineering Department. "Bits N Bytes" serves as a platform for the vibrant thoughts, innovative ideas, dreams, and creative writings of our emerging scholars. It provides exposure and the freedom to express diverse viewpoints.

I want to extend my heartfelt congratulations to the dedicated team behind the creation of "Bits N Bytes." Their hard work in curating this magazine has truly revealed the latent potential of our students, transforming it into a meaningful resource. Each page of this publication captures the essence of our department's spirit and values.

I am hopeful that this endeavor will not only cultivate a love for reading among our students but also foster a strong sense of belonging within our academic community. I commend the "Bits N Bytes" team for their dynamic contributions, which have led to the successful launch of this remarkable magazine.

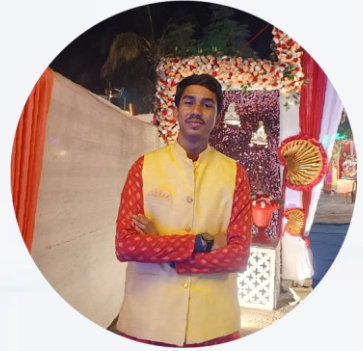
STUDENT COMMITTEE MEMBERS



Aditya Vardhan
1st Year(2024-2028)
Member



Arnav Deep
1st Year(2024-2028)
Member



Sayan Majumder
1st Year(2024-2028)
Member



Ritureema Acharya
1st Year(2024-2028)
Member



Ahili Bose
1st Year(2024-2028)
Member



Amartya Halder
1st Year(2024-2028)
Member

Member

Member

CONTENTS

1. Microsoft's Quest for Quantum Supremacy	01
-Aranya Parai , 1st Year.....	
2. 5G Connecting the Futures, Redefining Possibilities	03
-Saitana Mondal, 1st Year.....	
3. AI and Automation Transforming Logistics	05
-Aditya Vardhan, 1st Year.....	
4. RTX 50 Series: Redefining Gaming and GPU Innovation	07
-Arnav Deep, 1st Year.....	
5. Microsoft's Majorana 1: Ushering in the Quantum Revolution	09
-Sayan Majumder , 1st Year.....	
6. AR and VR: Bridging Realities, Transforming Lives	11
-Amartya Halder, 1st Year.....	
7.Green Computing: Pioneering a Sustainable Digital Future	13
-Ahili Bose, 1st Year.....	
8. Big Data Meets AI: Transforming the Future of Technology	15
-Ritureema Acharya ,1st Year.....	
9.Quantum Computing vs. Classical Computing: Where Are We Now?	17
-Souvik Goswami, 3rdYear.....	
10.AI in Everyday Life	
-Samadrita Sinha,3rd Year.....	
19	
11. Can AI Understand Human Emotions?	
-Ankita Konar,3rd Year.....	
21	
12. The Majorana 1 chip from Microsoft opens up new possibilities	

-Debnath Das, 3rd Year.....	23
13. Big Data: A Gateway to Tomorrow's Innovations	
-Sneha Chand,3rd Year.....	24
14. Unleashing the Power of 5G Technology	
-Gokul Pal, 3rd Year.....	26
15. Data Privacy in the age of Information Overload	
	28
-Priya Rani, 3rd Year.....	
16. Neural Networks in Healthcare: Revolutionizing Modern Medicine	
-Manika Sarkar , 3rd Year.....	30
17. Cloud Computing: Revolutionizing the Digital Landscape	
-Sayan Mondal, 3rd Year.....	32
18. 5G Technology	
	34
-Mou Bistu, 2nd Year.....	
19. Level Up: How AI, Cloud, &VR Are Reshaping the Gaming Universe	
	36
-Neelabhra Banerjee, 1st Year.....	
20. Redefining SEO: Navigating the AI-Driven Digital Landscape	39
-Soumyaditya Bauri , 3rd Year.....	
21. Deepfake Technology and Its Role in Cybercrime	
-Koyel Chandra, 1st Year.....	43
22. Quantum World	
-Sangam Kundu, 1st Year.....	
	45
23. Biometric Security System: Trends and Challenges	
-Ritesh Kumar Ray, 1st Year.....	47
24. Building a Bangla LLM by finetuning Gemma 2B LLM using Low-Rank	
-Abhishek Dasgupta ,3rd Year.....	49
25. The Rise of Open-Source AI Models: Meta AI, OpenAI, and Mistral	

-Arnab Ghosh, 2nd Year.....
51

26. Virtual Reality (VR) and Augmented Reality (AR)

-Moumit Mondal, Subhrajit Kar 1st
Year..... 53

27. AI vs Dark Web: Revolutionizing Cyber Threat Hunting

-Souptik Das , 1st Year..... 55

28 Android 15: Breaking Down the Key Features You Need to Know

-Saurav Kumar Sinha , 1st Year..... 57 29.

The Importance of Engineering in Society

-Joydeep Sharma , 1st Year..... 60 30.

Machine Learning for Social Good:

-Ananya Dhibar, 1st Year..... 62 31.

Isaac GROOT N1 and Blue: Ushering in the New Age

-Mukund Kumar Jha, 3rdYear..... 64 32.

Screenless Display

-Nihal Prasad, 1st Year..... 67

CONTENTS

33. NVIDIA Cosmos: AI Training Redefined	
-Nilavra Pan ,1st Year.....	69
34. Zero Trust Security Model in cybersecurity	
-Maitri Midya, 1 st Year.....	71
35. AI-Powered Search Engines SEO	
-Vikram Kumar , 2 nd Year.....	73
36. The Rise of Open-Source AI Models (Meta AI, OpenAI, Mistral)	
-Disha Bhattacharya , 3rd Year.....	75
37. Beyond 5G-How Next Generation	
-Titiksha Dalal , 3 rd Year.....	78
38. The Open-Source Revolution in AI: Democratizing the Future	
-Rohit Kumar, 1st Year.....	80
39. THE EVOLUTION OF DEEPPFAKE-DRIVEN CYBERCRIME	
-Anish Debnath, 2nd Year.....	82
40.AI: Revolutionizing Cybersecurity	
-Sayon Biswas , 1st Year.....	84

Microsoft's Quest for Quantum Supremacy

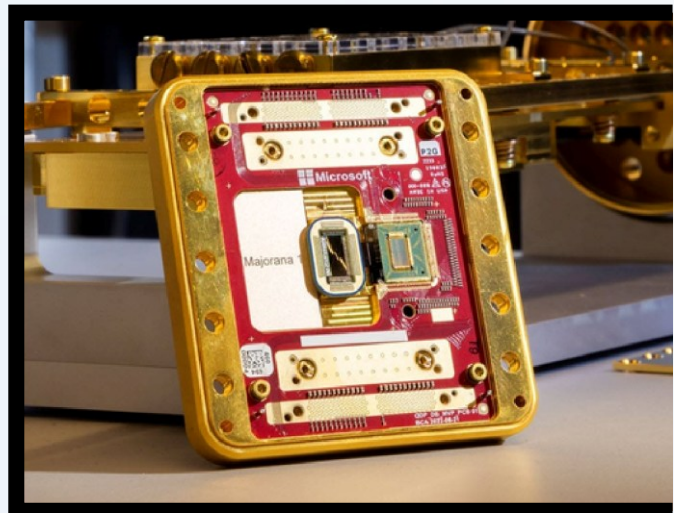


Aranya Parai
CSE, 1st Year
Batch : 2024 - 2028

A topological phase, a newly discovered state of matter by Microsoft, focuses on Majorana zero modes—an elusive phenomenon recently observed in controlled environments. This breakthrough led to the development of the Majorana 1 processor, a quantum computer utilizing topological qubits for exceptional efficiency and reliability.

Majorana zero modes, named after the Italian physicist Ettore Majorana, were predicted in 1937. These unique particles are their own antiparticles, possessing distinct quantum states. Their stability and resilience make them ideal for quantum computing, as they allow the creation of qubits less prone to errors caused by environmental factors.

To harness these modes, Microsoft's team engineered devices based on nanowires. By operating at ultra-low temperatures and generating strong magnetic fields, they induced a topological phase in these nanowires, enabling the emergence of Majorana zero modes at their ends. This precise manipulation ensures quantum information is encoded in a more stable and reliable manner compared to traditional qubits.



Qubits, the building blocks of quantum computers, are inherently fragile. Their quantum state can easily degrade due to interactions with their environment—a phenomenon known as decoherence. Traditional quantum computers mitigate this with complex error correction techniques, requiring multiple physical qubits to maintain a single logical qubit. This approach, while effective, demands significant resources and hinders scalability.

Topological qubits, however, address these challenges by leveraging Majorana zero modes. Unlike traditional qubits, topological qubits encode information in the global properties of a system rather than its local states. This unique feature provides inherent protection against minor disturbances, reducing the need for extensive error correction and enabling more scalable quantum architectures.

Microsoft's Majorana 1 processor represents a significant leap in quantum computing. By integrating topological qubits, the processor achieves fault tolerance, scalability, and reduced error rates.



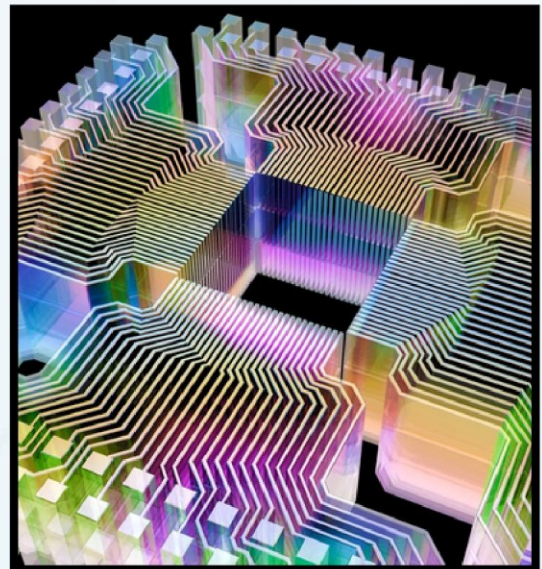
This innovation brings quantum computing closer to solving complex problems efficiently.

The processor's reliance on the topological phase and Majorana zero modes marks a departure from traditional quantum systems. Its architecture promises faster scaling, making it a crucial step toward achieving quantum supremacy—a point where quantum computers outperform classical systems in specific tasks.

Topological qubits offer transformative potential across industries. In cryptography, they promise unbreakable encryption, while molecular simulations could accelerate drug discovery and material development. Optimization problems in logistics and finance may benefit from their ability to process complex datasets efficiently, revolutionizing operations and decision-making.

Majorana zero modes and topological qubits are challenging to verify, with past claims like Microsoft's 2018 announcement underscoring the need for further research.

The potential of topological qubits extends to breakthroughs in AI, climate modeling, and secure communications. Their ability to perform faster and more precise computations could address complex challenges traditional systems cannot solve efficiently. As research continues, integrating topological qubits into scalable quantum systems could revolutionize innovation in science, technology, and global problem-solving.



Microsoft's discovery of topological qubits and the Majorana 1 processor is a milestone in quantum computing. While large-scale applications are still in development, this breakthrough paves the way for fault-tolerant systems, signaling a new era of technological innovation. By reducing errors and enhancing scalability, topological qubits address key challenges in current quantum architectures. As these systems evolve, they have the potential to unlock solutions to problems previously considered unsolvable, driving advancements across multiple industries.

.....

5G: Connecting the Future, Redefining Possibilities



Saitana Mondal
CSE, 1st Year
Batch : 2024 - 2028

5G technology, the fifth generation of mobile networks, is a game-changer in the world of communication. Offering speeds up to 100 times faster than 4G, ultra-low latency, and the ability to connect millions of devices per square kilometer, 5G is set to revolutionize industries and reshape society. With its unprecedented capabilities, 5G is driving advancements in communication, healthcare, transportation, education, and more.

One of the most noticeable benefits of 5G is its ability to provide faster internet speeds and more reliable connections. This enables seamless communication, high-quality video streaming, and the integration of advanced applications like virtual reality (VR) and augmented reality (AR). Whether it's immersive gaming or real-time collaboration tools, 5G ensures smooth and responsive user experiences.



5G plays a crucial role in building smarter cities and more efficient infrastructure. By enabling technologies like IoT (Internet of Things), it supports smart traffic management systems, optimized energy grids, and improved public services. Furthermore, it facilitates the development of autonomous vehicles and intelligent transportation systems, paving the way for safer and more efficient urban mobility.

The impact of 5G on healthcare is revolutionary. It supports telemedicine by enabling real-time video consultations and remote surgeries through high-speed connections. IoT devices powered by 5G provide continuous health monitoring, ensuring timely interventions and improved patient care. In remote areas, 5G enhances emergency response and makes healthcare services more accessible.

5G is a driving force behind Industry 4.0, enabling automation, artificial intelligence (AI), and machine learning in manufacturing and business operations. It enhances productivity and opens the door to innovative business models across sectors like retail, logistics, and entertainment. The ability to process and analyze data in real-time transforms industries, fueling economic growth.

The education sector is poised for a significant transformation with 5G. Virtual reality classrooms and interactive e-learning platforms become more immersive and engaging, bridging gaps in access and quality. For remote work, 5G offers stable, high-speed connections, ensuring smooth communication, collaboration, and productivity regardless of location.

As the number of connected devices increases, so do cybersecurity risks. 5G networks require robust data protection measures to safeguard against breaches and hacking. Ensuring privacy and security in an era of massive connectivity is one of the key challenges that must be addressed to unlock 5G's full potential.

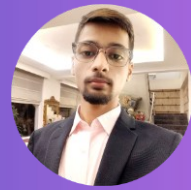
The potential of 5G goes beyond connectivity, driving advancements in AI, smart agriculture, and climate monitoring through real-time data processing and seamless communication. By tackling global challenges and fostering innovation, 5G lays the foundation for a smarter, more connected world. With strategic measures to enhance security, infrastructure, and digital equity, societies can fully harness its transformative power.

5G technology is more than just an evolution in connectivity—it is a transformative force poised to revolutionize industries and improve lives. By enabling faster, more reliable communication and driving innovation across sectors, 5G has the potential to address global challenges and create new opportunities. However, to fully realize its benefits, societies must address the accompanying challenges, such as security, privacy, and infrastructure development, ensuring a future where technology drives inclusive growth and progress.

.....



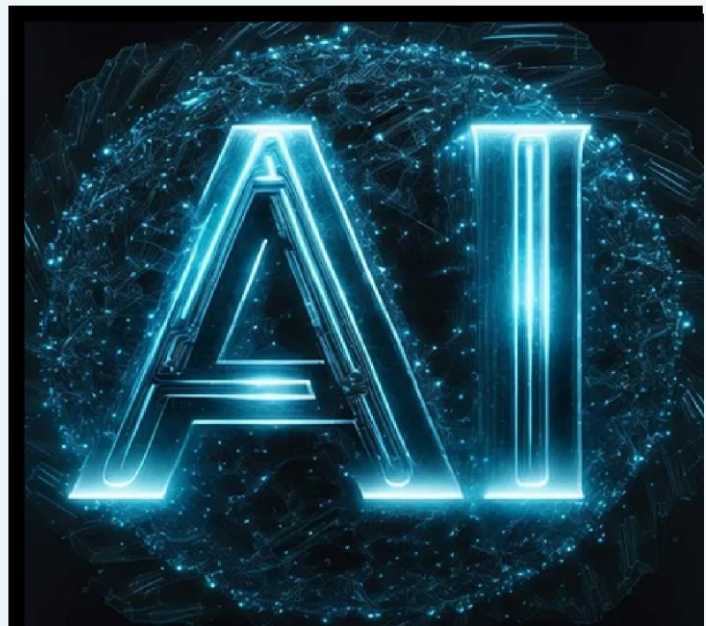
AI & Automation Transforming Logistics



Aditya Vardhan
CSE, 1st Year
Batch : 2024 - 2028

In today's fast-paced world, transportation and logistics face numerous challenges, from managing complex supply chains to meeting rising customer expectations for speed and efficiency. As these industries become increasingly interconnected, traditional methods are proving inadequate to address these demands. This is where artificial intelligence (AI) and automation step in, offering transformative solutions to optimize operations, reduce costs, and enhance overall efficiency.

AI-driven algorithms have revolutionized route planning by analyzing traffic patterns, weather conditions, and road infrastructure to determine the most efficient routes. This not only reduces delivery times but also minimizes fuel consumption and transportation costs. For instance, logistics companies can use real-time data to reroute deliveries, avoiding delays caused by traffic congestion or unforeseen obstacles.



The development of self-driving trucks and drones represents a significant shift in the logistics industry. Autonomous vehicles can operate around the clock, reducing reliance on human drivers and increasing operational efficiency. These technologies are particularly valuable for long-haul transportation, where driver fatigue and labor shortages often pose challenges. By integrating autonomous systems, companies can improve delivery reliability and reduce operational costs.

AI-powered predictive analytics enables businesses to anticipate demand patterns and optimize inventory management. By analyzing historical data, market trends, and seasonal variations, AI can forecast future needs with remarkable accuracy. This prevents overstocking or understocking, reducing waste and ensuring that supply chains remain resilient to disruptions.

Warehousing operations have been revolutionized by robotics and AI-powered systems. Automated sorting, packing, and inventory tracking ensure faster and more accurate order fulfillment. Robotic systems, equipped with machine learning capabilities, can adapt to changing demands, making warehouses more flexible and responsive. This not only improves efficiency but also reduces the risk of human error.

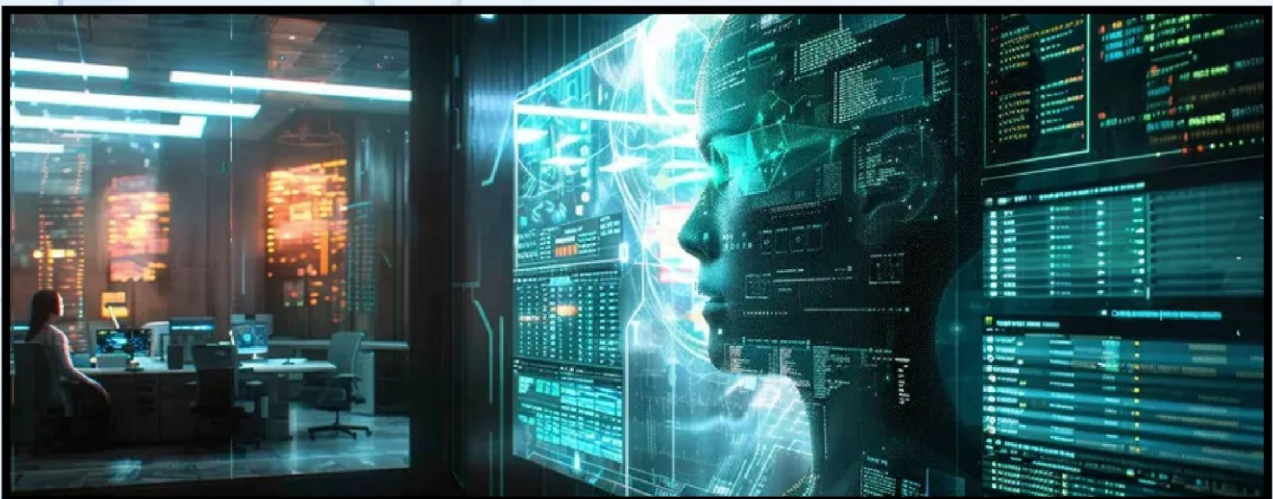
IoT-enabled devices combined with AI provide real-time visibility into the movement of goods. These systems offer live updates on shipments, enabling companies to monitor their supply chains with unprecedented transparency. Real-time tracking not only enhances customer satisfaction by providing accurate delivery timelines but also improves security by identifying and mitigating potential risks in transit.



The integration of AI and automation into transportation and logistics is still in its early stages, but the potential benefits are immense. These technologies are not just about improving efficiency—they also pave the way for new business models and customer experiences. For example, dynamic pricing models, same-day delivery, and personalized shipping options are becoming more feasible with AI-driven insights and automated systems.

AI and automation are redefining the transportation and logistics landscape by addressing long-standing challenges and unlocking new opportunities. From smart route optimization to real-time tracking, these technologies enhance efficiency, reduce costs, and improve overall supply chain management. As advancements continue, businesses that embrace AI-driven solutions will gain a competitive edge, positioning themselves at the forefront of innovation in an increasingly digital world.

.....



RTX 50 Series: Redefining Gaming and GPU Innovation



Arnav Deep
CSE, 1st Year
Batch : 2024 - 2028

NVIDIA, a leader in GPU technology, is set to revolutionize gaming and computing with its upcoming RTX 50 series. As the successor to the popular RTX 40 series, the RTX 50 promises groundbreaking advancements in performance, AI, and real-time rendering, setting a new standard for the industry.

The RTX 50 series is anticipated to be built on NVIDIA's latest architecture, potentially named "Blackwell" or "Ada Next." Utilizing TSMC's advanced 3nm manufacturing process, this architecture is expected to deliver substantial improvements in performance and energy efficiency. By leveraging this cutting-edge process, NVIDIA aims to provide unparalleled power for high-performance tasks while minimizing power consumption.



Ray tracing, which creates lifelike lighting and reflections in games, is set to see significant enhancements in the RTX 50 series. Combined with improved Tensor Cores, the series will elevate AI-driven features such as DLSS (Deep Learning Super Sampling). These advancements promise smoother gameplay, sharper visuals, and superior performance at 4K and 8K resolutions.

The RTX 50 series is rumored to feature GDDR7 memory, offering higher data transfer speeds and increased VRAM capacities. This will cater to the growing demands of modern games and professional applications, enabling seamless multitasking and improved rendering speeds for 4K, 8K, and even VR environments.

One of the standout features of the RTX 50 series will be its improved performance per watt, thanks to the advanced manufacturing process. This efficiency will benefit gamers and professionals by providing powerful systems that consume less energy, aligning with the increasing need for sustainable computing solutions.

The RTX 50 series is set to revolutionize gaming with immersive experiences at higher frame rates and resolutions. Gamers can look forward to lifelike visuals and smooth gameplay, enhanced by advanced technologies like real-time path tracing and AI-driven graphics. These features promise to elevate gaming to an entirely new level of realism.

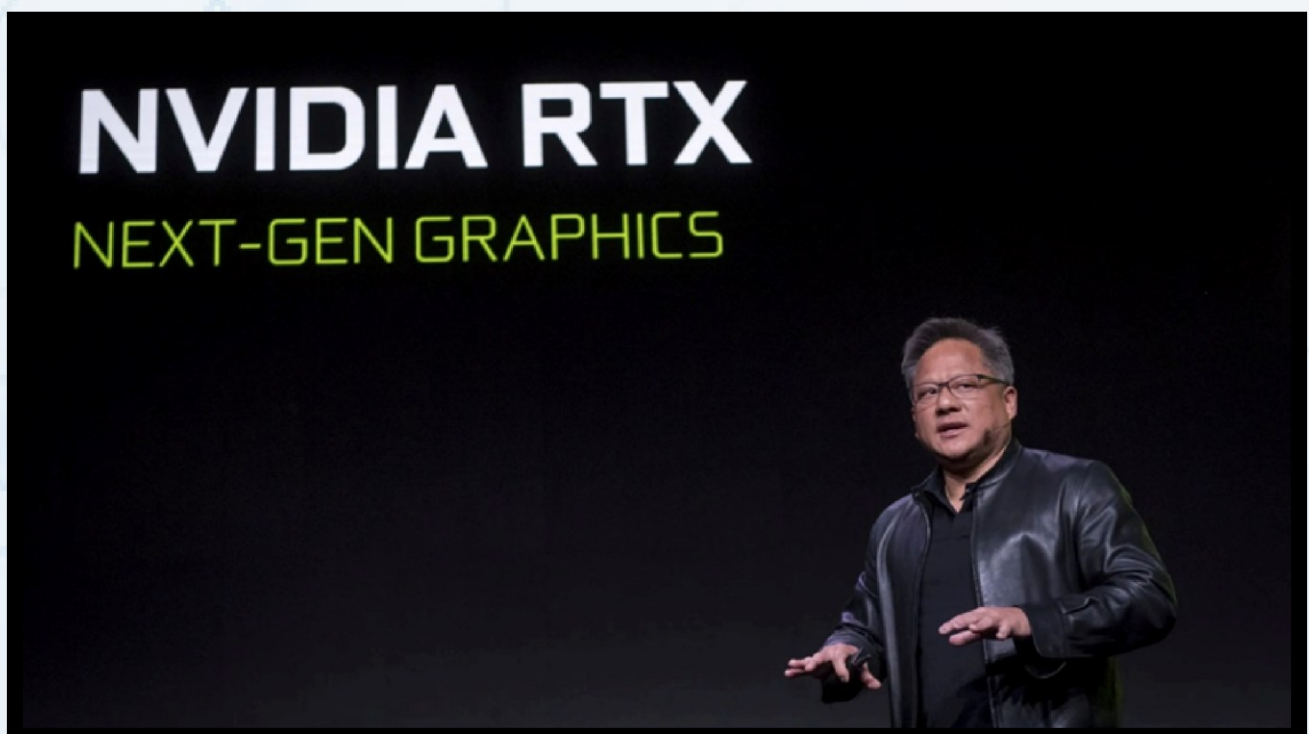
Beyond gaming, the RTX 50 series will have a significant impact on industries such as AI research, 3D rendering, and video editing. Its computational power will accelerate workflows, enabling faster and more accurate results in demanding applications like scientific simulations and professional content creation.

However, the RTX 50 series is not without challenges. It faces strong competition from AMD's RDNA 4 and Intel's Arc GPUs, both of which are striving to match NVIDIA's performance. This competitive landscape pushes NVIDIA to continually innovate and maintain its dominance in the market.

The rising cost of high-end GPUs also poses a challenge. As prices increase, affordability becomes a concern for consumers, potentially limiting accessibility. NVIDIA will need to balance cutting-edge performance with reasonable pricing to cater to a wider audience.

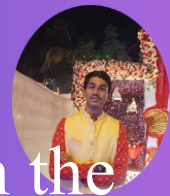
Overall, the RTX 50 series represents a pivotal advancement in GPU technology. It sets a new benchmark for performance and efficiency while addressing challenges like competition and affordability. As we await its release, the series promises to redefine possibilities for both gamers and professionals, shaping the future of technology.

.....

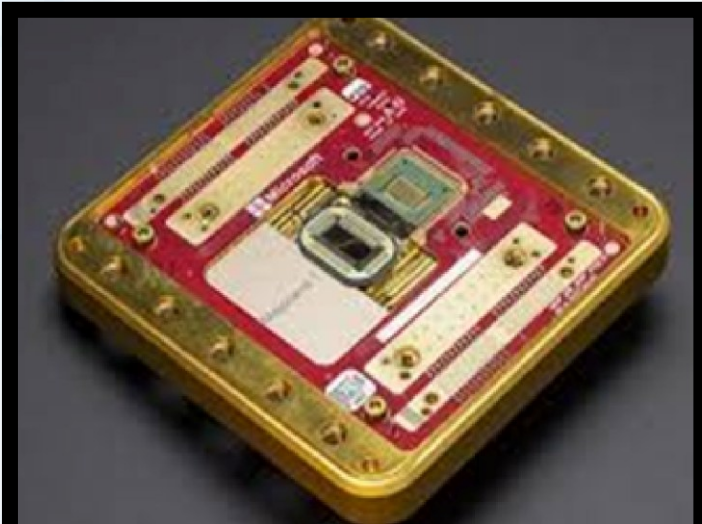


Microsoft's Majorana 1: Ushering in the Quantum Revolution

Sayan Majumder



CSE - 1st Year



Quantum computing has been hailed as the next transformative leap in technology, promising unprecedented computational power. Despite this potential, its development has been hindered by significant challenges, particularly in maintaining the stability of qubits and managing error correction. Microsoft's Majorana 1 chip introduces a groundbreaking solution to these issues, potentially turning the vision of large-scale quantum computing into reality.

At the heart of this innovation lies the use of Majorana fermions, exotic particles that act as their own antiparticles. First theorized in the 1930s and confirmed experimentally in 2012, these particles form the basis of the Majorana 1 chip. Unlike conventional qubits, which are prone to instability and susceptible to environmental noise, Majorana-based qubits offer topological protection. This makes them far more stable and resilient, significantly reducing the need for error correction.

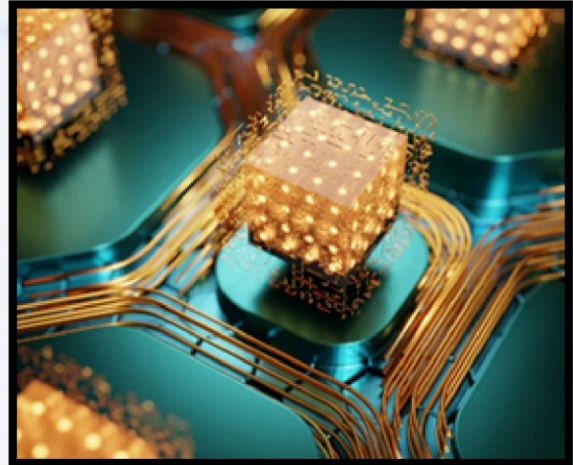
Traditional quantum computers rely on superconducting qubits or trapped ions, which require extensive systems to combat errors caused by decoherence. Microsoft's Majorana 1 chip takes a different approach, using topological qubits that encode information in a way inherently resistant to interference. These qubits are constructed using topological superconductors, materials engineered to support localized quantum states known as Majorana zero modes.

These states can store and process information with exceptional robustness, allowing the chip to perform complex calculations with fewer physical qubits. This reduction in computational overhead makes the Majorana 1 chip more scalable and practical for real-world applications. The implications of this breakthrough extend far beyond computing. With the ability to solve problems that were previously deemed impossible, the Majorana 1 chip could transform industries. In cryptography, it could enable the development of quantum-safe encryption protocols, addressing the vulnerabilities posed by quantum computers to current encryption methods.

In drug discovery, quantum simulations could accurately model molecular interactions, accelerating the development of new medicines and advanced materials. Artificial intelligence and machine learning could benefit from the chip's computational power, optimizing complex neural networks and enabling more efficient models.

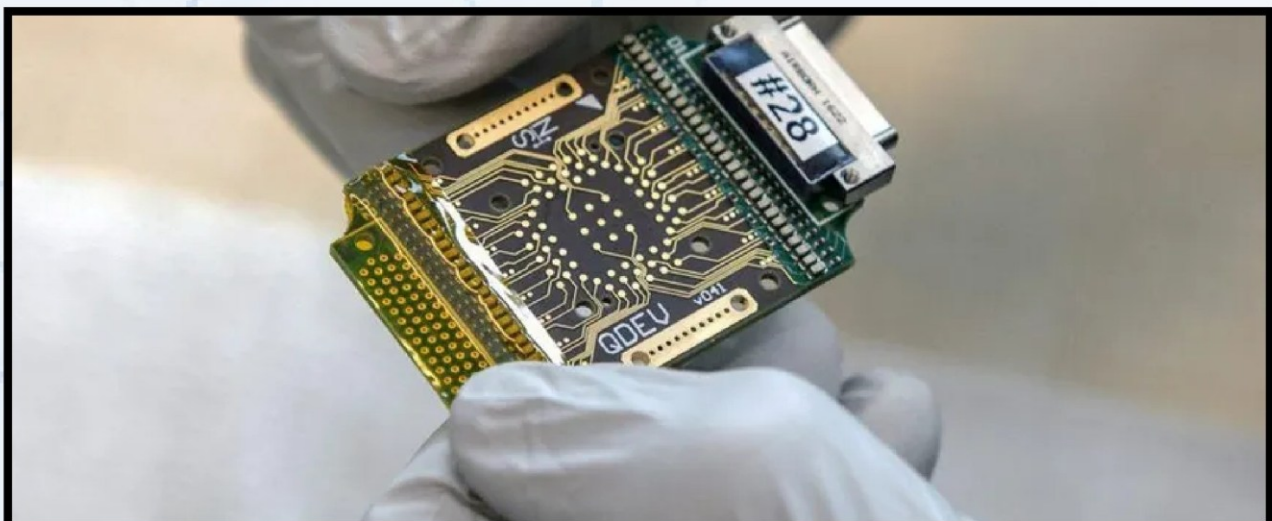
Furthermore, industries reliant on intricate optimization problems, such as logistics and financial modeling, could experience significant advancements, solving challenges in seconds that would take classical computers years. The Majorana 1 chip also emphasizes Microsoft's commitment to addressing the real-world challenges of scalability and accessibility in quantum computing. By significantly reducing the hardware requirements for error correction, this innovation makes quantum technology more feasible for broader adoption. Combined with Microsoft's integrated software ecosystem, this development positions the company as a leader in shaping the quantum future.

Rival companies such as IBM and Google are also racing to make advancements in quantum computing, pushing the boundaries of innovation. However, the focus on topological qubits gives Microsoft a distinct advantage, potentially setting a new standard for stability, reliability, and scalability in the industry. The Majorana 1 chip's potential to redefine benchmarks could establish a dominant role for Microsoft in the emerging quantum era.



Microsoft's Majorana 1 chip represents a pivotal moment in the evolution of quantum technology. By addressing the fundamental challenges of qubit instability and error correction, it brings us closer to realizing the dream of practical, large-scale quantum computing. If successful, this innovation will not only redefine computing but also revolutionize industries and scientific research, unlocking possibilities that were once beyond our reach. With the Majorana 1 chip, Microsoft has taken a monumental step toward the quantum-powered future.

.....



AR and VR: Bridging Realities, Transforming Lives



Amartya Halder
CSE, 1st Year
Batch : 2024 - 2028

Augmented Reality (AR) and Virtual Reality (VR) are revolutionary technologies reshaping how we engage with the digital world. AR overlays digital elements onto the real world through devices like smartphones and AR glasses, merging virtual content with physical surroundings. In contrast, VR immerses users in a fully simulated environment via headsets such as Oculus or HTC Vive. Together, these technologies are driving innovation across industries and redefining how we experience and interact with the world.

One of the most significant applications of AR and VR lies in gaming and entertainment. AR games, such as Pokémon GO, blend real-world settings with digital components, creating interactive and engaging experiences. VR gaming, on the other hand, offers immersive environments that transport players into entirely new worlds. Titles like Beat Saber exemplify the potential of VR to revolutionize entertainment by combining physical activity with digital interactivity, setting new benchmarks for engagement.



In education and training, AR and VR are breaking new ground by creating interactive and immersive learning environments. VR simulations allow medical students, pilots, and engineers to practice complex procedures in risk-free virtual settings. AR enhances traditional classrooms by bringing static concepts to life with 3D visualizations, making abstract theories more tangible. This combination of practical training and visual engagement is transforming education and workforce development.

Healthcare is another field significantly benefiting from AR and VR. VR is used in therapeutic applications, helping patients manage pain or cope with mental health conditions such as anxiety and PTSD. AR, meanwhile, assists surgeons by providing real-time overlays and data during critical procedures, enhancing precision and outcomes. Both technologies are also pivotal in medical training, offering lifelike simulations that allow aspiring professionals to hone their skills without real-world risks.

Retail and marketing have embraced AR and VR to create personalized consumer experiences. AR allows shoppers to virtually try on clothes, makeup, or furniture, offering convenience and confidence in purchasing decisions. VR showrooms provide immersive shopping experiences, enabling customers to explore products and services from their homes. These applications are redefining consumer interactions and offering businesses innovative ways to connect with their audiences.

Despite their promise, AR and VR face challenges that hinder widespread adoption. High costs, bulky hardware, and issues like motion sickness pose technical barriers. Content creation remains resource-intensive, requiring significant time and expertise to develop realistic AR and VR experiences. Privacy concerns arise from the vast amounts of user data these technologies collect, and prolonged use can lead to health issues like eye strain or disorientation. Addressing these challenges is critical for their long-term success.

The future of AR and VR looks bright, driven by advancements in AI, 5G, and wearable technologies. Companies like Apple and Meta are developing mixed-reality devices that blend AR and VR features, making these technologies more accessible and integrated into daily life. As AR and VR become more sophisticated, they are poised to revolutionize industries, blur the lines between physical and digital realms, and enhance the way we live, work, and connect with one another.

.....



Green Computing: Pioneering a Sustainable Digital Future

Ahili Bose



CSE, 1st Year
Batch : 2024 - 2028

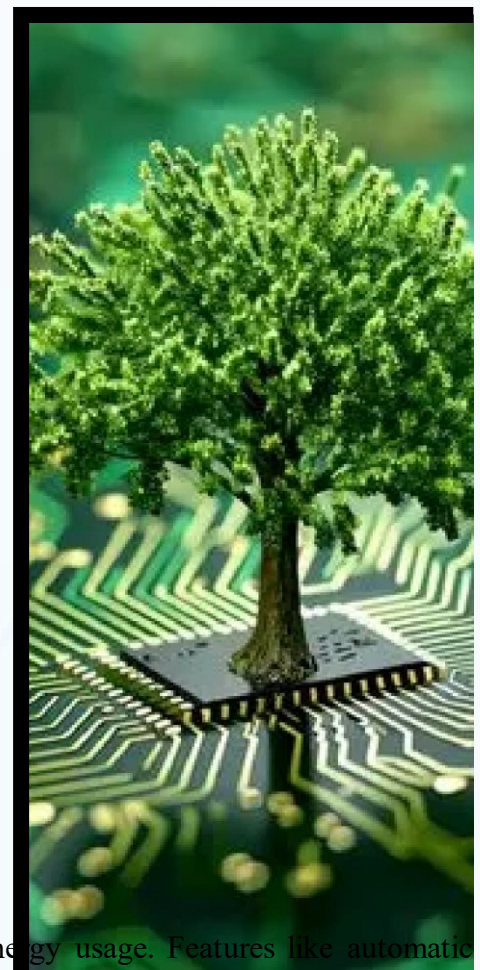
Green computing, or sustainable computing, focuses on the environmentally responsible use of computers and IT resources. It aims to reduce energy consumption, minimize electronic waste, and promote sustainability in designing, using, and disposing of technology. As digital reliance grows, green computing has become essential for reducing the environmental footprint of technology. By prioritizing efficiency and innovation, this approach balances technological progress with environmental responsibility. The global push for greener practices underscores the urgent need to address the ecological impacts of IT advancements.

Energy-efficient hardware is at the heart of green computing. Devices like low-power CPUs, SSDs, and Energy Star certified components consume less energy while offering enhanced performance. Manufacturers are increasingly adopting these technologies, with ARM-based processors making their way into laptops and servers due to their minimal power requirements. These advancements not only reduce electricity usage but also lower operational costs over time. As more companies and individuals adopt energy-efficient hardware, the cumulative effect on global energy consumption becomes significant.

Virtualization allows multiple systems to operate on a single physical machine, optimizing resource utilization and reducing the need for additional hardware. Cloud computing further supports sustainability by centralizing resources in energy-efficient data centers. Organizations can rent computing power as needed, minimizing unnecessary infrastructure. This shift reduces capital expenditures on physical servers and cuts down the carbon footprint of IT operations. Moreover, centralized systems streamline updates and maintenance, enhancing efficiency across industries.

Effective power management strategies can dramatically reduce energy usage. Features like automatic sleep modes, screen dimming, and scheduled power-downs conserve energy, especially in large-scale operations. Enterprises also benefit from deploying energy management software to monitor and optimize power consumption across devices. Encouraging employees to adopt these practices at an individual level can compound these savings. Beyond financial benefits, these measures contribute to a culture of sustainability within organizations.

Effective power management strategies can dramatically reduce energy usage. Features like automatic sleep modes, screen dimming, and scheduled power-downs conserve energy, especially in large-scale operations. Enterprises also benefit from deploying energy management software to monitor and optimize power



consumption across devices. Encouraging employees to adopt these practices at an individual level can compound these savings. Beyond financial benefits, these measures contribute to a culture of sustainability within organizations.

Software efficiency plays a key role in reducing energy consumption. Applications optimized for minimal resource usage decrease hardware demand, extending device lifespans. Developers are focusing on creating lightweight software by minimizing background processes and avoiding unnecessary computations, aligning with the goals of green computing. This practice not only improves user experience but also reduces the ecological footprint of software applications. As the demand for resource-heavy software grows, these optimizations become increasingly vital.

Data centers are major energy consumers but can lead the way in green IT. Sustainable data centers use renewable energy sources, advanced cooling systems, and efficient hardware to lower their carbon footprint. Leading companies like Google and Microsoft are setting examples by achieving carbon neutrality in their facilities. Innovations like AI-powered energy management further enhance the efficiency of these centers. As the digital economy expands, sustainable practices in data management will become critical for balancing growth with ecological preservation

Green computing offers numerous advantages: lower energy costs, reduced carbon emissions, compliance with environmental regulations, and enhanced corporate responsibility. These practices improve public image and foster trust among consumers, making sustainability a win-win for businesses and the environment. Beyond direct benefits, green computing inspires innovation in adjacent fields, driving a global shift towards eco-friendly technology. This ripple effect underscores the transformative potential of sustainable IT solutions. Conclusion

Green computing is no longer optional—it is a necessity in a technology-driven world. By adopting practices like energy-efficient hardware, virtualization, responsible recycling, and sustainable data center operations, both individuals and organizations can contribute to a more sustainable future. As digital technologies continue to evolve, embracing green IT ensures that innovation aligns with environmental stewardship. These practices set the foundation for a balanced coexistence of progress and sustainability, paving the way for a greener tomorrow.



Big Data Meets AI: Transforming the Future of Technology

Returana Ashraf
1st Sem, 1st Year
Batch: 2023-2025

In today's digital world, the integration of Big Data and Artificial Intelligence (AI) is transforming industries by enabling intelligent, data-driven solutions. This convergence allows systems to process enormous datasets, recognize patterns, and automate complex processes, opening doors to smarter technologies and more efficient operations. It marks a significant evolution in how data is used to enhance decision-making and innovation.

In today's digital world, the integration of Big Data and Artificial Intelligence (AI) is transforming industries by enabling intelligent, data-driven solutions. This convergence allows systems to process enormous datasets, recognize patterns, and automate complex processes, opening doors to smarter technologies and more efficient operations. It marks a significant evolution in how data is used to enhance decision-making and innovation.



AI mimics human intelligence by using algorithms that learn, adapt, and make decisions. From machine learning to deep learning, AI technologies analyze data and uncover insights that would be impossible for humans to process manually. AI's capabilities extend to analyzing unstructured data, identifying patterns, and automating decision-making. Its integration with Big Data enables predictive analytics and improves outcomes across diverse domains, from personalized healthcare to dynamic pricing strategies.

Big Data and AI are intrinsically linked, forming a symbiotic relationship. AI depends on vast datasets to train its algorithms, while Big Data analytics benefits from AI's ability to uncover hidden trends and automate data processing. Together, they create a powerful ecosystem that drives innovation and streamlines processes in ways previously unimaginable.

The integration of Big Data and AI has reshaped industries, delivering transformative advantages. It enables organizations to make informed decisions by analyzing extensive datasets with precision. AI-powered automation simplifies complex tasks, from fraud detection to personalized recommendations. Predictive analytics allows businesses to anticipate trends and risks, leading to proactive strategies. Additionally, real-time data processing supports tailored customer experiences, enhancing satisfaction and loyalty.

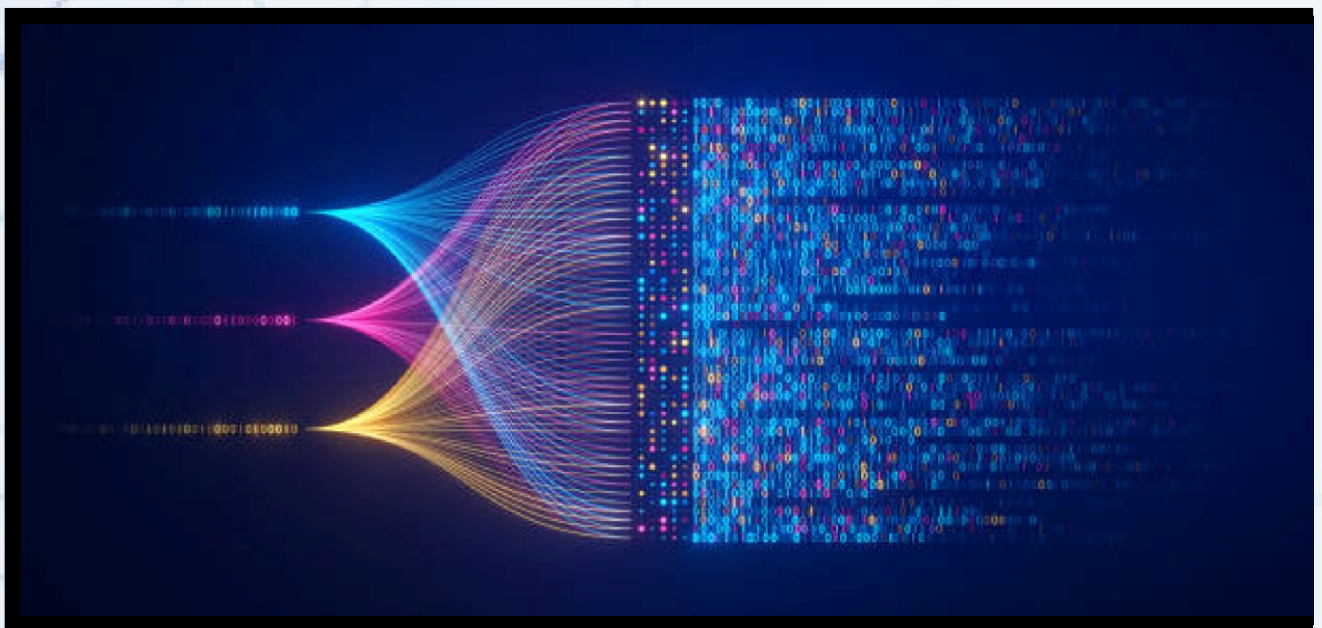
The combined power of Big Data and AI has revolutionized several fields. In healthcare, these technologies enable personalized medicine, predict disease outbreaks, and enhance diagnostic imaging. In finance, they facilitate fraud detection, risk assessment, and algorithmic trading. Retail businesses benefit from inventory management and customer behavior analysis, while smart cities rely on these technologies for efficient traffic control, waste management, and public safety monitoring.

The combined power of Big Data and AI has revolutionized several fields. In healthcare, these technologies enable personalized medicine, predict disease outbreaks, and enhance diagnostic imaging. In finance, they facilitate fraud detection, risk assessment, and algorithmic trading. Retail businesses benefit from inventory management and customer behavior analysis, while smart cities rely on these technologies for efficient traffic control, waste management, and public safety monitoring.

The future of Big Data and AI lies in continuous technological advancements. Innovations in edge computing and quantum computing promise to make these integrations more seamless and efficient. The development of explainable AI (XAI) will ensure transparency, enabling users to understand and trust AI decisions. As these technologies evolve, their integration will become more sophisticated, reshaping industries and society at large.

The integration of Big Data and AI signifies a transformative leap in intelligent automation and decision-making. Despite challenges like data privacy and ethical concerns, their potential to revolutionize industries is undeniable. From enhancing efficiency to driving innovation, the synergy between Big Data and AI is set to redefine how we interact with technology and data, paving the way for a smarter, more connected future.

.....



Quantum Computing vs. Classical Computing: Where Are We Now?



Souvik Goswami

CSE, 3rd Year

Batch : 2022 - 2026

Quantum computing has long been hailed as the next frontier in computational technology, with the potential to revolutionize everything from cryptography to material science. While classical computers, which rely on binary bits (0s and 1s), have served as the backbone of digital progress for decades, quantum computers leverage the principles of quantum mechanics to operate in fundamentally different ways. The primary units of quantum computation are qubits, which, unlike classical bits, can exist in a superposition of states, meaning they can be both 0 and 1 at the same time. This unique property allows quantum computers to process vast amounts of information simultaneously, offering exponential speed-ups for specific types of problems. However, the field is still emerging, and the practical implementation of quantum computing remains both a scientific and engineering challenge. In recent years, significant strides have been made in both the theoretical and experimental domains of quantum computing. Companies like IBM, Google, and Intel, alongside startups such as Rigetti and IonQ, have invested heavily in the development of quantum hardware. In 2019, Google announced that its 53-qubit quantum processor, Sycamore, had achieved "quantum supremacy" by completing a calculation in 200 seconds that would take the most powerful supercomputer 10,000 years. Although this claim sparked debate and was later challenged by IBM, it marked a notable milestone in showcasing quantum computers' potential. Meanwhile, IBM has developed quantum processors that are accessible via the cloud, allowing researchers and developers to experiment with quantum algorithms and understand the constraints and possibilities of current quantum technology.



Despite these advancements, today's quantum computers remain in what experts call the Noisy Intermediate-Scale Quantum (NISQ) era. This phase is characterized by quantum machines that have between 50 to a few hundred qubits, but are highly error-prone and not yet capable of error correction. Quantum decoherence—where qubits lose their quantum state due to interference from their environment—remains a major hurdle. As a result, the output of current quantum computers

is often unreliable, and maintaining qubit stability for long periods is still a work in progress.

Classical computers, on the other hand, benefit from decades of optimization, with robust architectures, extensive software ecosystems, and consistent performance across a wide range of tasks.

Classical computing excels at general-purpose tasks and remains superior for the majority of computing needs. From running operating systems and processing images to managing databases and executing financial models, classical processors handle these efficiently using established algorithms. Additionally, the field of classical computing continues to evolve. With advancements like parallel processing, GPU computing, and neuromorphic chips, classical systems are far from stagnant. The integration of artificial intelligence and machine learning into classical architectures further enhances their capability and relevance in modern applications.

However, quantum computing holds a unique edge in specific problem domains where classical systems struggle. For instance, quantum algorithms such as Shor's algorithm offer the possibility of factoring large integers exponentially faster than the best-known classical algorithms. This has deep implications for cryptography, especially public key systems like RSA, which rely on the difficulty of such problems. Similarly, quantum simulations can model complex quantum systems with far greater precision, aiding research in chemistry, drug discovery, and materials science. Classical computers find it nearly impossible to simulate quantum behavior beyond a certain scale due to the exponential growth of variables, whereas quantum systems are inherently suited to such tasks.

Nonetheless, it's important to temper expectations. Widespread adoption of quantum computing is still years, if not decades, away. Developing scalable, fault-tolerant quantum computers will require breakthroughs in quantum error correction, qubit coherence, and hardware manufacturing. Research is also ongoing in areas such as topological qubits and quantum dots, which may offer more stable and scalable solutions. On the software side, frameworks like Qiskit (IBM), Cirq (Google), and PennyLane are enabling developers to explore quantum programming, but the ecosystem is still immature compared to classical development platforms.

A realistic view of the current state of quantum computing is that it is complementary to classical computing, not a replacement. The two paradigms are expected to coexist, each optimized for specific tasks. Hybrid models, where quantum computers handle the quantum-intensive parts of a problem and offload other tasks to classical systems, are likely to become common. This symbiosis can be seen in emerging research in quantum machine learning and hybrid optimization algorithms. While classical computing continues to evolve and support the digital infrastructure of our world, quantum computing represents a bold leap into a new computational era. We are at a critical juncture where foundational progress is being made, but much work lies ahead. The current landscape reflects a transitional phase filled with both promise and limitations. As research advances and hardware improves, the boundary between theoretical potential and practical application will gradually diminish. The question is not whether quantum computers will surpass classical ones universally, but rather when and how they will redefine computation in the specialized domains where classical methods fall short.

AI in Everyday Life



Samadrita Sinha
CSE, 3rd Year
Batch : 2022 - 2026

AI in Everyday Life: How Artificial Intelligence is Changing the Way We Live Artificial Intelligence (AI) is no longer just a futuristic concept confined to sci-fi movies or research labs—it's now an essential part of our daily lives. From the moment we wake up to the time we go to bed, AI is quietly working behind the scenes, making life more convenient, efficient, and personalized.

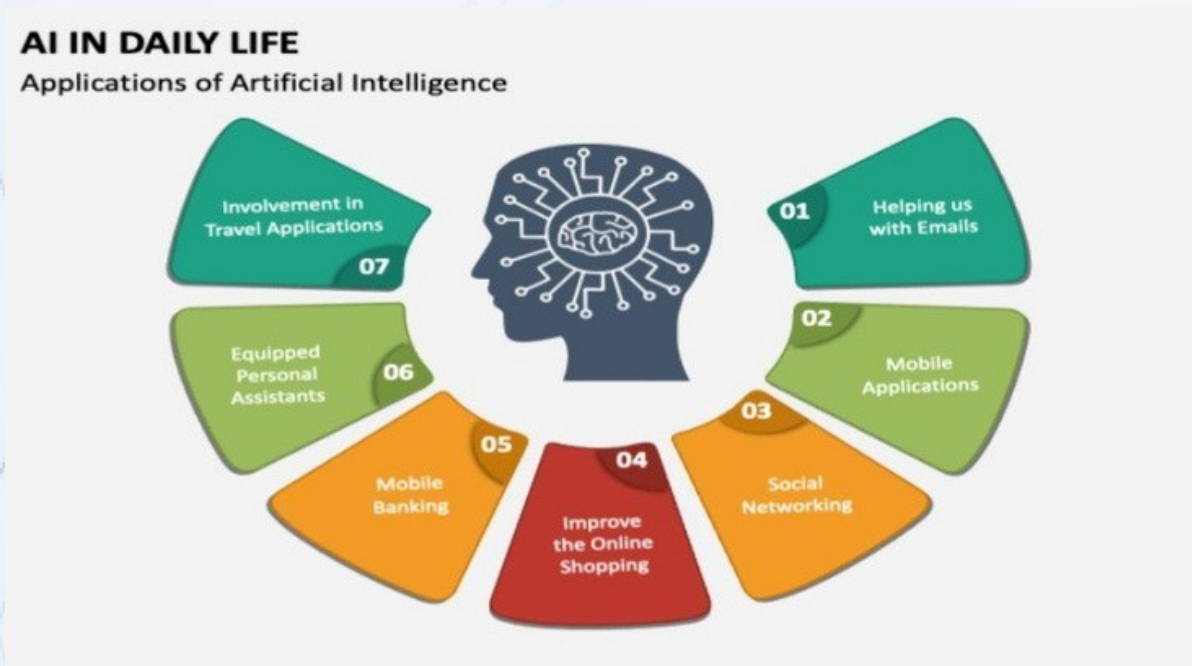
One of the most visible ways AI appears in our lives is through smartphones. Features like voice assistants (such as Siri, Alexa, and Google Assistant) rely on AI to understand and respond to our commands. Whether it's setting alarms, checking the weather, or playing music, AI helps us carry out tasks hands-free. Even the camera in your phone uses AI to recognize faces, adjust lighting, and enhance photo quality.

Social media platforms also heavily depend on AI. Every time you scroll through Instagram, Facebook, or YouTube, AI algorithms decide which posts or videos you see. These platforms analyze your interests, behavior, and engagement to recommend content that keeps you hooked. While this creates a personalized experience, it also raises concerns about data privacy and echo chambers.



In e-commerce, AI plays a major role in improving customer experience. Online stores like Amazon and Flipkart use AI to suggest products based on your browsing history and preferences. Chatbots powered by AI assist customers 24/7, answering questions and helping with purchases. This not only saves time but also makes shopping easier and more interactive. AI is also transforming transportation. Navigation apps like Google Maps and Uber use AI to calculate the fastest routes, predict traffic conditions, and estimate arrival times. In some countries, self-driving cars are being tested—powered entirely by AI—to reduce human error and improve road safety. Healthcare is another field where AI is making groundbreaking changes. AI tools can now detect diseases such as cancer and diabetes more accurately and quickly than traditional methods.

Virtual health assistants remind patients to take their medications, monitor their health, and even provide mental health support through chat-based therapy. Even in our homes, AI is present in smart devices. Smart speakers, thermostats, lights, and even refrigerators can learn your habits and adjust accordingly to improve comfort and save energy. These devices are often connected through the Internet of Things (IoT), creating a smart home ecosystem that simplifies daily routines. However, with all these benefits, there are concerns about job loss, data misuse, and ethical challenges. As machines become smarter, there's a growing fear that many jobs could be automated. It's important to focus on creating a balance where AI supports humans rather than replaces them. In conclusion, AI is no longer a luxury or novelty—it's a powerful tool that touches almost every part of our lives. Whether we're aware of it or not, AI is working to make our lives faster, safer, and more personalized. As we move forward, the goal should be to use AI responsibly, ensuring it serves humanity in the best possible way.



Can AI Understand Human Emotions?



Ankita Konar
CSE, 3rd Year
Batch : 2022 - 2026

Artificial Intelligence (AI) has made incredible progress in recent years. From recognizing faces to driving cars, AI systems are becoming smarter every day. But one of the biggest questions still remains: Can AI truly understand human emotions? The answer is both yes and no—and it depends on how we define "understand."

AI systems today can detect emotions to a certain extent. Using facial recognition, voice tone analysis, and even text sentiment analysis, AI can predict whether a person is happy, sad, angry, or excited. For example, customer service chatbots can sense frustration in a user's messages and respond more gently. Voice assistants can detect stress in your voice and even recommend relaxation music. In marketing, companies use emotion AI to analyze consumer reactions. When people watch an ad, AI can track their facial expressions and eye movements to determine what parts of the video were most engaging. Similarly, social media platforms can analyze text and emoji usage to judge the emotional tone of a post. These technologies are already being used to improve user experiences.



However, there is a major difference between detecting and understanding emotions. Human emotions are deeply connected to context, culture, past experiences, and non-verbal cues that machines often miss. For example, a person smiling might not always be happy—they could be nervous or even hiding sadness. While AI may label it as happiness based on facial data, it doesn't grasp the emotional complexity behind it. Another challenge is empathy. AI can simulate empathy—by saying comforting words or offering suggestions—but it doesn't actually feel anything. It responds based on pre-programmed rules and data patterns. While this might be enough in some situations, like reminding someone to take their medicine, it falls short in more sensitive areas like mental health therapy or grief counseling.

There are also concerns about bias and misuse. If emotion detection AI is trained on limited or biased data, it may wrongly judge people based on race, gender, or language style. For example, an emotion recognition system trained mostly on Western faces might misread expressions from people of other ethnicities. This could lead to unfair outcomes in workplaces, schools, or even legal settings. Despite these limitations, AI is improving rapidly. New research in affective computing—a field focused on teaching machines to understand human emotions—is working toward building more emotionally intelligent AI. These systems combine data from facial expressions, voice tone, posture, heart rate, and more to make better emotional predictions.

In conclusion, AI can detect emotional signals, but it doesn't truly understand emotions like humans do. It lacks empathy, context, and real awareness. However, it can still be useful in areas like education, marketing, and customer support where basic emotional recognition can improve communication. As technology advances, the goal shouldn't be to replace human empathy, but to build AI tools that assist and support emotional understanding in a responsible way.



.....

The Majorana 1 chip from Microsoft opens up new possibilities for quantum computing.

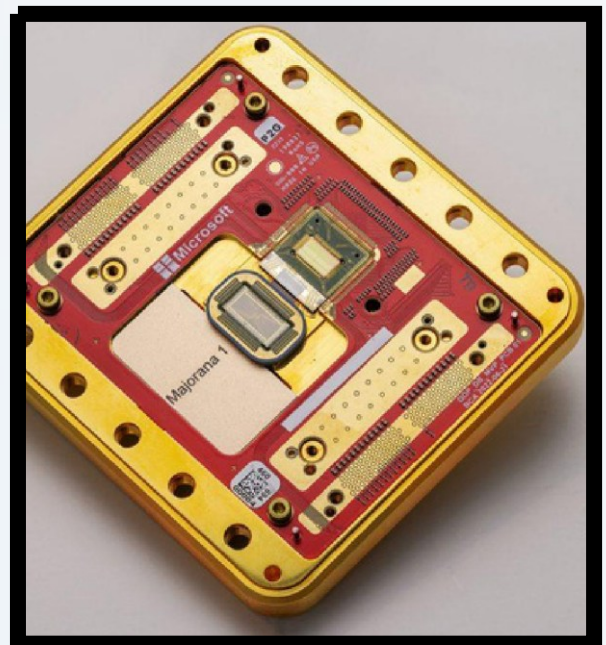
Debnath Das

CSE, 3rd Year



Microsoft's Majorana 1 chip represents a significant advancement in quantum computing, aiming to address longstanding challenges in qubit stability and scalability. Announced in February 2025, this chip introduces a novel approach by leveraging topological qubits based on Majorana fermions, particles theorized in the 1930s for their potential to create more robust quantum systems. It is based on a novel Topological Core design, and the company predicts that this would allow quantum computers to solve important, industrial-scale issues in a matter of years, rather than decades.

Topological qubits encode information in a manner that is naturally protected from environmental disturbances, in contrast to standard qubits, which are extremely vulnerable to them. The goal of this concept is to improve computational reliability and drastically lower error rates, which will make quantum computing more feasible for large-scale applications. Aiming to incorporate up to 1 million qubits on a 10 cm by 10 cm device, Majorana 1 was designed with scalability in mind. With applications in domains like medicine development, climate modelling, and cryptography, if this degree of integration is effective, quantum computers may be able to address issues that are currently unsolvable by classical computers.



Microsoft's work on topological quantum computing spans nearly two decades. The company established Station Q in 2006, a research lab dedicated to exploring topological phases of matter for quantum computing applications. Over the years, Microsoft has collaborated with leading institutions, such as TU Delft, to advance research in this area, ultimately leading to the development of the Majorana 1 chip.

Majorana 1 has sparked excitement, but the scientific world has also questioned it. The evidence for the presence and control of Majorana zero modes in the chip continue to raise doubts among certain scientists. In response, Microsoft has urged independent confirmation and additional testing to support its assertions. Therefore, it will be crucial to do further study to ascertain whether Majorana 1 indeed represents a breakthrough in quantum computing.

If successful, this invention has the potential to completely transform a number of sectors, including artificial intelligence, healthcare, banking, and encryption.

Big Data: A Gateway to Tomorrow's Innovations



Sneha Chand
CSE, 3rd Year
Batch : 2022 - 2026

In this digital age, we are inundated with data - from the photos we share on social media to the transactions we make online. This flood of information might seem overwhelming, but within it lies immense potential waiting to be unlocked. Welcome to the world of Big Data - where the vast sea of information holds the key to solving some of our most pressing challenges and driving innovation to new heights.

What is Big Data?

Big Data refers to the massive volume of structured and unstructured data that inundates businesses and organizations on a day-to-day basis. It encompasses everything from emails and social media posts to sensor data and digital images. What makes Big Data truly remarkable is not just its sheer volume, but also its velocity, variety, and complexity.

Why Does it Matter?

In today's interconnected world, data is everywhere, and harnessing its power can lead to groundbreaking discoveries and advancements across various fields. Take healthcare, for example. By analyzing vast amounts of patient data, doctors and researchers can identify trends, predict outbreaks, and develop personalized treatment plans tailored to individual needs.

In the business world, Big Data is a game-changer. Companies can gain valuable insights into consumer behavior, streamline operations, and make data-driven decisions that drive growth and success. From improving customer satisfaction to optimizing supply chains, the possibilities are endless.



The Challenges and Opportunities:

While Big Data offers immense opportunities, it also presents significant challenges. The sheer volume and complexity of data can be daunting, requiring sophisticated tools and technologies to manage and analyze it effectively. Moreover, issues surrounding data privacy and security must be addressed to ensure that sensitive information remains protected.

However, with the right approach and tools in place, these challenges can be overcome, paving the way for exciting possibilities. From artificial intelligence and machine learning to predictive analytics and data visualization, there are numerous tools and techniques available to unlock the full potential of Big Data.

The Future of Big Data

As technology continues to evolve, the potential of Big Data will only grow. From smart cities and autonomous vehicles to personalized medicine and predictive maintenance, the possibilities are limitless. By harnessing the power of Big Data, we can create a future that is smarter, more efficient, and more sustainable.

In conclusion, Big Data is not just a buzzword - it's a transformative force that is reshaping our world. By embracing it and leveraging its power, we can unlock new insights, drive innovation, and create a brighter future for generations to come. So let's dive into the sea of data and unlock the endless possibilities that lie within. The future awaits, and Big Data is our gateway to tomorrow's innovations.

6 big data benefits for businesses

1. Better customer insight
2. Improved operations
3. More insightful market intelligence
4. Agile supply chain management
5. Data-driven innovation
6. Smarter recommendations and targeting



Unleashing the Power of 5G Technology: Revolutionizing Computing in the Digital Era

CSE, 3rd Year

Arjun Pal



The advent of 5G technology marks a pivotal moment in the evolution of computing, promising unprecedented speed, connectivity, and versatility. As the fifth-generation wireless network, 5G holds the potential to revolutionize the way we interact with technology, unlocking new opportunities for innovation across diverse domains. This article explores the transformative influence of 5G technology on computing, examining its implications for mobile devices, edge computing, IoT (Internet of Things), cloud services, and beyond.

5G technology heralds a new era of mobile computing, characterized by blazing-fast data speeds, ultra-low latency, and enhanced reliability. With peak download speeds surpassing 1 Gbps and latency reduced to milliseconds, 5G enables seamless streaming of high-definition content, realtime gaming, and immersive AR (Augmented Reality) and VR (Virtual Reality) experiences on mobile devices. The increased bandwidth and capacity offered by 5G networks empower users to leverage resource-intensive applications and services with unprecedented fluidity and responsiveness.

5G's ultra-low latency and high bandwidth capabilities are instrumental in driving the proliferation of edge computing paradigms. By decentralizing computational resources and processing data closer to the point of origin, edge computing minimizes latency and enhances the responsiveness of real-time applications. 5G networks serve as the backbone for edge computing deployments, enabling distributed computing architectures that support latency-sensitive applications, such as autonomous vehicles, industrial automation, and remote healthcare monitoring. The synergy between 5G and edge computing accelerates innovation in the IoT ecosystem, facilitating the deployment of smart devices and sensors that harness real-time data insights for actionable intelligence.

The exponential growth of IoT devices necessitates a robust and scalable connectivity infrastructure capable of supporting billions of interconnected devices. 5G technology addresses this challenge by offering enhanced IoT connectivity features, including massive machine-type communication (mMTC) and ultra-reliable low-latency communication (URLLC). mMTC enables simultaneous connectivity for a vast number of IoT devices, facilitating seamless integration into smart cities, industrial automation, and precision agriculture. URLLC ensures reliable communication with minimal latency, critical for mission-critical IoT applications such as autonomous vehicles, remote surgery, and industrial robotics. 5G's IoT capabilities unleash the full potential of interconnected devices, driving innovation and efficiency across various sectors.

5G technology accelerates the adoption of cloud services by delivering high-speed, low-latency connectivity to cloud-based applications and resources. With 5G, users can access and interact with cloud-hosted services, such as streaming media, collaborative productivity suites, and AI-powered analytics, with unprecedented speed and responsiveness. 5G-enabled cloud services empower businesses to leverage scalable computing resources, accelerate digital transformation initiatives, and deliver immersive, personalized experiences to end-users.

5G technology represents a paradigm shift in computing, offering transformative capabilities that redefine how we interact with digital information and services. By providing unprecedented speed, connectivity, and reliability, 5G unleashes the full potential of mobile computing, edge computing, IoT, and cloud services, driving innovation and empowering businesses and consumers alike. As 5G continues to evolve and expand its footprint, its influence on computing will only deepen, fuelling a new wave of technological advancement and shaping the digital landscape for years to come.



.....

Data Privacy in the age of Information Overload



Priya Rani
CSE, 3rd year
Batch : 2022-2026

In an era where data is being generated at an unprecedented pace, information overload has become a defining feature of the modern digital landscape. This phenomenon is not just a matter of excess content—it has real consequences on our cognitive capacity, workplace productivity, and overall well-being. When the amount of information available exceeds our ability to process it, decision-making becomes strained, creativity suffers, and stress levels rise. As organizations continue to leverage massive amounts of data, the challenges of managing and protecting that information grow more complex, making data privacy a central concern of our time.



the digital age offers unparalleled opportunities for growth, communication, and innovation. Every click, search, and transaction adds to an ever-expanding pool of information that companies use to understand customer behavior, enhance user experiences, and fine-tune their marketing strategies. While this data-driven approach has created more personalized services and efficient systems, it has also introduced serious concerns regarding personal privacy and data protection. The ease with which data is collected, stored, and shared has far outpaced the safeguards traditionally put in place to protect it.

One of the most pressing challenges surrounding data privacy is the sheer volume of data being harvested. With social media platforms, e-commerce websites, mobile applications, and smart devices constantly gathering user data, it becomes increasingly difficult to track who has access to what information. Adding to this concern is the lack of transparency in how organizations use and share data. Users often agree to vague and complex privacy policies without fully understanding the implications, thereby unknowingly relinquishing control over their personal information.

Advanced Connectivity: Satellite Support

What makes the situation more alarming is the widespread lack of awareness among individuals about how extensively their data is being used. Many people are unaware that their browsing habits, purchase histories, and even location data are being monitored and monetized



In response to these growing concerns, governments and regulatory bodies around the world have started implementing privacy laws, such as the European Union's General Data Protection Regulation (GDPR) and California's Consumer Privacy Act (CCPA), to ensure users have more control over their personal data. These regulations are essential first steps toward accountability, but they are not sufficient on their own.

In response to these growing concerns, governments and regulatory bodies around the world have started implementing privacy laws, such as the European Union's General Data Protection Regulation (GDPR) and California's Consumer Privacy Act (CCPA), to ensure users have more control over their personal data. These regulations are essential first steps toward accountability, but they are not sufficient on their own.



In conclusion, data privacy is one of the most pressing ethical and technological issues of the digital age. As we continue to generate and consume vast amounts of information daily, the responsibility to protect personal data must be shared across all levels of society. Striking the right balance between innovation and privacy will determine how safe, secure, and trustworthy our digital future will be. Only through awareness, accountability, and collective action can we ensure that our personal information remains just that—personal.

.....

Neural Networks in Healthcare Revolutionizing Modern Medicine



Manika Sarkar

CSE 3rd Year
Batch : 2022 - 2026

In today's rapidly evolving technological landscape, neural networks stand out as a groundbreaking advancement in artificial intelligence (AI). Beyond their applications in entertainment and finance, they are profoundly reshaping healthcare by enabling smarter diagnostics, innovative drug development, and enhanced patient management. Neural networks are not just tools—they are revolutionizing the way healthcare operates, paving the path for a more efficient and interconnected system.

Neural networks, inspired by the human brain, consist of interconnected nodes or "neurons" that process data to recognize patterns and make predictions. In healthcare, these networks analyze complex datasets, such as medical images or patient records, with unprecedented accuracy. For example, convolutional neural networks (CNNs) excel in analyzing radiological images, detecting abnormalities like lung nodules or brain hemorrhages with high sensitivity. Similarly, recurrent neural networks (RNNs) are adept at processing sequential data, such as ECG readings, to predict cardiac irregularities.



Neural networks are already making strides in several medical domains. In imaging, AI tools like Google's LYNA assist pathologists in identifying metastatic cancer, while DeepMind's algorithms diagnose diabetic retinopathy from eye scans. In drug discovery, generative adversarial networks (GANs) create new drug molecules, significantly accelerating the development process. Predictive analytics, powered by neural networks, has enabled innovations such as wearables that detect heart conditions like atrial fibrillation with remarkable accuracy.

Despite their potential, neural networks face hurdles. Small or imbalanced datasets for rare diseases often lead to less reliable predictions. Furthermore, the "black box" nature of neural networks creates a trust barrier among clinicians. Tools like SHAP and LIME are addressing this issue by making AI decisions more interpretable. Regulatory challenges and biases in AI models also pose risks, as evidenced by studies showing underperformance in diverse patient populations due to non-inclusive training datasets.

The future of neural networks in healthcare looks promising. Techniques like federated learning are ensuring data privacy while enabling collaborative model training across hospitals. Advances in neural-symbolic AI are making AI systems mimic human-like reasoning, and innovations such as brain-computer interfaces (BCIs) are restoring mobility in paralyzed patients. These developments hint at a future where AI becomes an integral part of medicine.

Neural networks are transforming healthcare from diagnostics to patient care, enhancing accuracy and efficiency. While challenges like data bias and interpretability remain, emerging solutions are paving the way for a more inclusive and reliable AI-driven healthcare system. For computer science enthusiasts, this field represents a unique opportunity to blend technology with clinical impact, marking the start of a new era in intelligent medicine.



.....

Cloud Computing Revolutionizing the Digital Landscape



Sayan Mondal
CSE, 3rd Year
Batch : 2022- 2026

Cloud computing has emerged as a revolutionary technology, transforming the way individuals and organizations access and utilize computing services. By providing on-demand resources such as storage, applications, and processing power over the internet, cloud computing eliminates the need for local servers or personal devices. This shift has made technology more efficient, scalable, and accessible, enabling a significant leap in how the digital world operates.

At its core, cloud computing allows users to leverage services hosted on remote servers, commonly referred to as “the cloud.” Unlike traditional methods of computing, where users rely on physical infrastructure, cloud computing provides the flexibility to access data and applications from anywhere with an internet connection. This versatility has made it a cornerstone of modern digital innovation, empowering businesses and individuals to adapt to an increasingly interconnected world.



The infrastructure of cloud computing is diverse, offering various deployment models tailored to different needs. Public clouds, managed by providers like AWS and Google Cloud, serve multiple users, making them cost-effective and widely accessible. Private clouds, on the other hand, are dedicated to a single organization, providing greater control and security. Hybrid clouds combine the best of both worlds, allowing organizations to optimize resources based on specific requirements. This dynamic structure has made cloud computing an indispensable tool across industries.

The benefits of cloud computing are manifold. It provides unparalleled cost efficiency by operating on a pay-as-you-use model, which significantly reduces the financial burden of maintaining physical infrastructure. Scalability ensures that users can easily increase or decrease their resource allocation as needed, adapting to changing demands. Furthermore, cloud computing enhances reliability by offering automated backups and recovery systems, ensuring data remains secure and accessible even in the face of disruptions.

5G TECHNOLOGY



Mou Bistu
CSE, 2nd Year
Batch : 2023 - 2027

5G technology, the fifth generation of cellular networks, offers significantly faster speeds, lower latency, and increased bandwidth compared to its predecessor, 4G, enabling new applications and services across various sectors, including augmented and virtual reality, edge computing, and AI-powered solutions.

The Influence of 5G Technology on Computing :

5G technology represents the next generation of wireless networks. This advancement is significantly influencing computing, reshaping the way data is processed, stored, and transmitted across industries. From cloud computing to artificial intelligence (AI) and edge computing, 5G is enabling faster, more efficient, and more connected systems.

Enhanced Cloud Computing :

One of the most profound impacts of 5G on computing is in cloud computing. Traditional cloud-based applications often struggle with latency and bandwidth limitations, but 5G's ultra-fast speeds and reduced lag make real-time data processing more efficient. This improvement enables businesses to run high-performance applications such as virtual desktops, cloud gaming, and remote software development without performance bottlenecks.

Users can seamlessly access applications and store large amounts of data without the need for high-end local hardware, promoting a more flexible and scalable computing infrastructure.

Edge Computing Revolution :

Edge computing is another area greatly influenced by 5G. Traditionally, data processing occurs in centralized cloud servers, leading to delays in critical applications. However, with 5G computing tasks can be shifted closer to the data source at the edge of the network.

This shift reduces latency, improves response times, and enables real time decision-making, which is crucial for industries like autonomous vehicles, industrial automation, and healthcare. For example, Smart cities can use 5G-powered edge computing to analyze traffic patterns, monitor pollution levels, and enhance public safety in real-time.

AI and IoT Acceleration :

Smart homes, wearable devices, and connected factories will generate and analyze data at unprecedented rates. Machine learning models that require large datasets can access real-time information, improving automation, predictive analytics, and decision-making across sectors like healthcare, finance, etc.

Gaming and Augmented Reality (AR)/Virtual Reality (VR) :

With reduced latency and increased bandwidth, cloud gaming platforms such as NVIDIA GeForce Now and Xbox Cloud Gaming can deliver high-quality experiences without requiring powerful local hardware. AR and VR applications, used in fields such as education, training, and entertainment, can operate seamlessly without lag. This improvement enhances user experiences, making virtual interactions more realistic and responsive.

Cybersecurity Challenges :

While 5G brings numerous benefits, it also poses cybersecurity challenges. The increased number of connected devices expands the attack surface, making networks more vulnerable to cyber threats. Advanced security measures, such as AI-driven threat detection and blockchain-based security protocols, will be essential to mitigate risks.

Conclusion :

5G technology is reshaping the computing landscape by enhancing cloud computing, accelerating AI and IoT, enabling real-time edge computing, and transforming gaming and immersive experiences. While challenges like cybersecurity need to be addressed, the potential of 5G in driving digital transformation is undeniable. As adoption grows, 5G will unlock new possibilities, making computing faster, smarter, and more connected than ever before.



Level Up: How AI, Cloud, and VR Are Reshaping the Gaming Universe



Neelabhra Banerjee
CSE, 1st Year

The gaming industry has undergone a remarkable transformation over the years, evolving from simple pixelated graphics to immersive virtual worlds. Technological advancements have not only enhanced visual fidelity but also revolutionized artificial intelligence, cloud gaming, virtual reality, and even the way players interact with games. What was once a niche hobby with local multiplayer sessions has grown into a multi-billion-dollar industry with global esports tournaments, AI-driven characters, and cloud-based streaming. This article explores key technological innovations that have redefined the gaming experience, with examples of notable games that pushed the boundaries of what is possible.

The Evolution of Graphics: From 8-bit to 4K Tracing

In the 1980s and 1990s, games like Super Mario Bros. (1985), and The Legend of Zelda (1986) introduced players to interactive entertainment. However, graphical capabilities were limited by hardware constraints, resulting in blocky, pixelated characters and static backgrounds. At present, advancements in graphics processing units (GPUs), and rendering techniques have enabled near-photorealistic visuals. Games like Red Dead Redemption 2 (2018), and Cyberpunk 2077 (2020) utilize ray tracing technology to create realistic lighting, shadows, and reflections, enhancing visual immersion. NVIDIA's RTX series GPUs have played a crucial role in this evolution, allowing developers to simulate real-world lighting physics in real time. The dramatic increase in video game file sizes, from the original Doom (1993) at just 2.39 MB to Call of Duty: Modern Warfare (2019) exceeding 200 GB, is largely due to the significant leap in graphics quality.

AI and Machine Learning: Smarter NPCs and Dynamic Worlds

In early games, non-playable characters (NPCs) followed simple scripts, often exhibiting predictable behaviors. In Metal Gear Solid (1998), for example, enemy guards had limited reaction times and movement patterns, making their actions relatively easy to anticipate.

Modern AI-driven NPCs are far more dynamic.



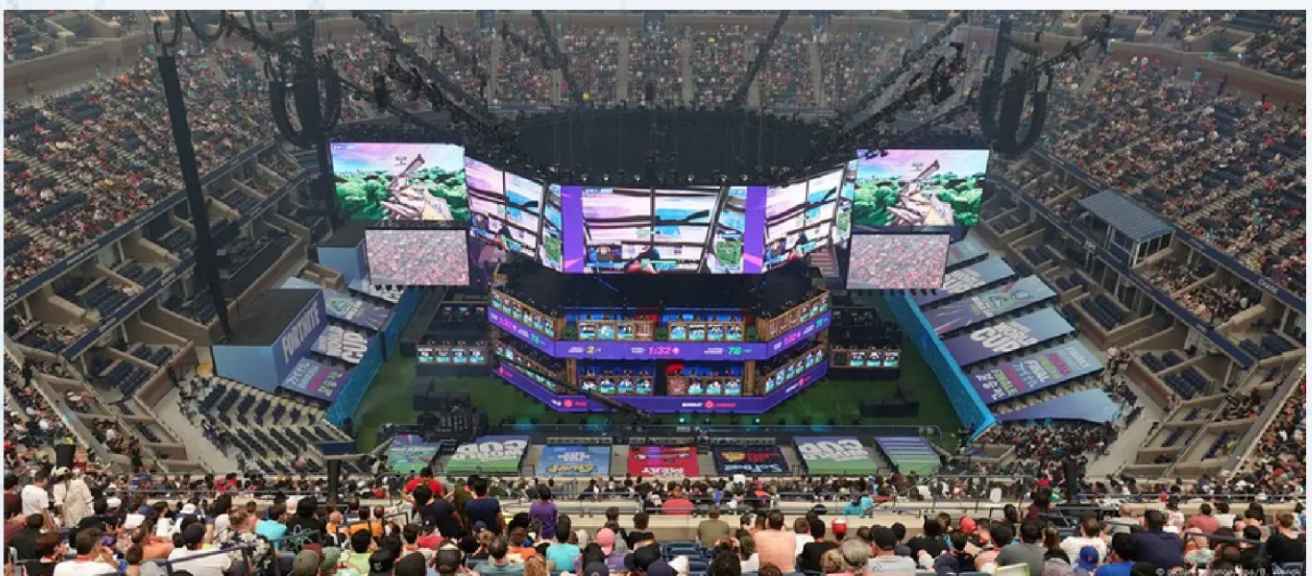
The Last of Us Part II (2020) features enemies that communicate, adapt to a player's strategy, and display emotional reactions when their allies are eliminated. Similarly, Alien: Isolation (2014) introduced an unpredictable AI system where the Xenomorph learns and adjusts to the player's tactics, making each encounter unique. Procedural generation, powered by AI, has also transformed game design. No Man's Sky (2016) uses algorithms to generate 18 quintillion unique planets, offering a virtually limitless universe for exploration.

Cloud Gaming: Breaking The Hardware Barrier

In the past, gaming required high-end consoles or powerful personal computers, limiting access to those who could afford premium hardware. Running graphically demanding games such as Crysis (2007) on an underpowered machine was nearly impossible. With cloud gaming services like NVIDIA GeForce Now, Xbox Cloud Gaming, and PlayStation Now, players can now stream games directly over the internet, reducing the need for expensive hardware. While Google Stadia struggled to gain traction, other services continue to refine this model, potentially making high-performance gaming more accessible.

Virtual and Augmented Reality: Bridging the Gap Between Real and Digital Worlds

Attempts at virtual reality gaming date back to the 1990s, with the Nintendo Virtual Boy (1995) being one of the earliest commercial attempts. However, hardware limitations and poor user experience prevented mass adoption. Today, VR headsets like Oculus Quest 2, PlayStation VR, and Valve Index offer fully immersive experiences. Half-Life: Alyx (2020) demonstrated the potential of VR in mainstream gaming, allowing players to interact naturally with objects and environments. Similarly, augmented reality (AR) has made significant strides. Pokémon GO (2016) showcased the potential of AR by integrating digital elements into the real world, encouraging physical exploration while gaming.



The Evolution of Multiplayer and Esports

In the early 2000s, multiplayer gaming often involved LAN (Local Area Network) setups, where players connected their computers in the same physical space. Games like Counter-Strike 1.6 (2000) and Warcraft III (2002) thrived in LAN environments. With advancements in networking infrastructure, online multiplayer has become seamless. Games like Fortnite (2017), Apex Legends (2019), and Valorant (2020) support millions of concurrent players worldwide. Esports have grown into a billion-dollar industry, with tournaments such as The International 2021 (Dota 2) offering prize pools exceeding \$40 million. The rise of competitive gaming has also led to professional leagues, sponsorships, and dedicated esports training facilities. In 2019, a 16-year-old won \$3 million in the Fortnite World Cup—highlighting how competitive gaming has become a viable career path.

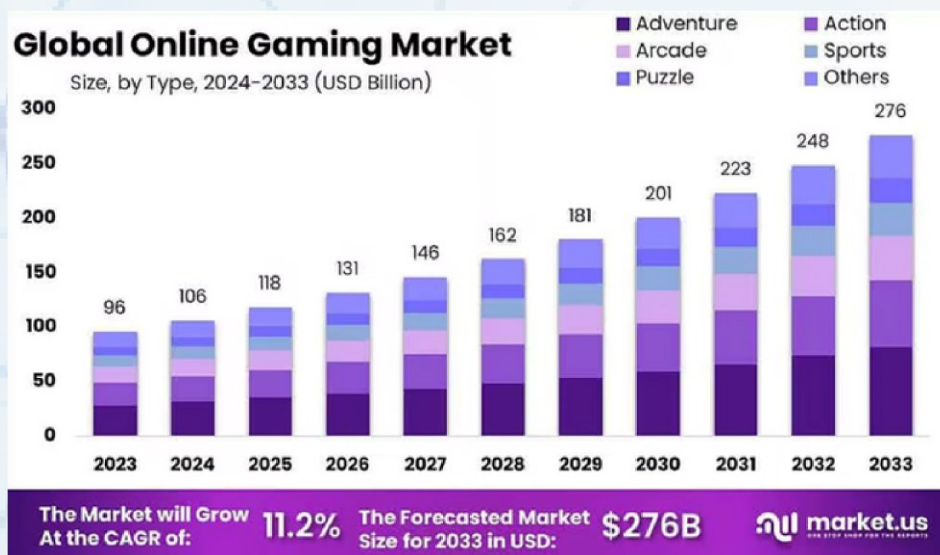
Careers in Gaming: More Than Just Playing

Gaming has evolved from a hobby into a dynamic industry, offering a wide range of career opportunities. India's gaming sector, valued at around \$3.1 billion in 2024, is projected to grow to \$8.92 billion by 2029. The industry now provides diverse roles for individuals passionate about technology and creativity, including game developers, AI engineers, esports professionals, and content creators. Aspiring professionals can pursue careers in areas such as game design, programming, storytelling, UI/UX design, and data analytics. As the gaming industry continues to expand, new opportunities will emerge, blending cutting-edge technology with interactive entertainment.

According to the figure below, the size of the global online gaming market is projected to increase from \$96 billion in 2023 to \$276 billion by 2033, with a compound annual growth rate (CAGR) of 11.2% from 2024 to 2033.

The Future of Gaming

From simple pixelated characters to AI-driven dynamic worlds, gaming has come a long way. With the advancement of technology, the distinction between digital and real-world experiences continues to blur. Whether through immersive virtual environments, intelligent game worlds, or cloud-based accessibility, gaming is not just evolving—it is shaping the way people interact with digital experiences in everyday life



Redefining SEO: Navigating the AI-Driven Digital Landscape



Soumyaditya Bauri
CSE, 3rd Year
Batch : 2022 - 2026

Search Engine Optimization (SEO) has long been the backbone of digital marketing, relying on keyword placement, backlinks, and clear site structures. However, with the emergence of AI-powered search engines like Google's Search Generative Experience (SGE), Bing AI, and Perplexity, the rules are rapidly changing. These advanced tools do more than just index and rank web pages; they understand user intent, generate detailed answers, and often eliminate the need for users to visit external websites. This shift raises a critical question: is traditional SEO becoming obsolete?

AI-driven search engines don't just match keywords; they interpret user intent and provide instant, conversational answers. For example, searching for "best laptops for programming under ₹50,000" no longer requires sifting through multiple sites. Instead, AI tools present curated lists, comparisons, and buying tips in one streamlined response. While this makes searching faster and more user-friendly, it also reduces reliance on traditional search rankings. To remain visible, content creators must produce high-quality, well-structured information that AI can easily interpret and present.



SEO isn't dying—it's evolving into what some call Answer Engine Optimization (AEO). In this new landscape, content must prioritize principles like Experience, Expertise, Authoritativeness, and Trustworthiness (EEAT). Structured data and schema markup are becoming essential to help AI systems identify and display critical information effectively. Additionally, optimization now focuses on user-first content and featured snippets, which are frequently used by AI tools to generate answers. Genuine, high-value content is no longer just recommended—it's mandatory.

7 Benefits of Using AI for SEO



AI's ability to provide direct answers may reduce website traffic, posing challenges for content creators. However, the demand for accurate and reliable information remains critical. AI systems rely on well-researched, original content to generate their responses, creating opportunities for those who prioritize quality. Websites that offer unique insights, detailed analysis, or specialized knowledge will continue to play a vital role in this ecosystem, as AI tools depend on trustworthy sources to enhance their outputs.

The integration of AI into search engines represents a fundamental shift in how we interact with digital information. While traditional SEO strategies are evolving, they are far from irrelevant. Instead, they are adapting to meet the demands of smarter, AI-driven search technologies. For future engineers and content creators, this is an exciting challenge: to craft content that speaks to both humans and machines. As the digital landscape transforms, those who embrace these changes will shape the next era of online discovery and engagement.



.....

Deepfake Technology and Its Role in Cybercrime



Koyel Chandra
CSE, 1st Year
Batch : 2024 - 2028

Deepfake technology, powered by artificial intelligence (AI), has revolutionized digital content creation, enabling realistic manipulation of images, videos, and audio. While it has positive applications in entertainment and education, deepfake technology has also become a powerful tool for cybercriminals, posing significant threats to security, privacy, and trust.

Understanding Deepfake Technology

Deepfake technology uses deep learning techniques, particularly Generative Adversarial Networks (GANs), to create highly realistic synthetic media. GANs involve two neural networks—a generator that creates fake content and a discriminator that detects fakes. Over time, the generator improves, producing convincing images, videos, and audio recordings that can be nearly indistinguishable from real ones.



Deepfake in Cybercrime

Cybercriminals leverage deepfake technology for various malicious activities, including fraud, misinformation, and identity theft. Some of the most concerning applications include:

Deepfake videos and voice cloning are being used in business email compromise (BEC) scams and financial fraud. Criminals use AI-generated voices to impersonate company executives, directing employees to transfer funds into fraudulent accounts. In one notable case, a bank manager was tricked into wiring \$35 million due to a deepfake voice that mimicked a company director.

Deepfake technology enables criminals to create realistic fake IDs, passports, and facial recognition bypasses. Attackers can impersonate individuals during video verification processes, leading to unauthorized access to bank accounts, social media, or government services.

Deepfakes contribute to the spread of fake news, political propaganda, and misinformation campaigns. Synthetic videos can make public figures appear to say things they never did, influencing elections, damaging reputations, and fueling social unrest.

Deepfake pornography, where faces are superimposed onto explicit content, has emerged as a major cybercrime issue. Victims, including celebrities and ordinary individuals, face harassment, reputational damage, and emotional distress. Criminals may also use deepfake content for extortion and blackmail.

Detecting deepfakes is challenging due to their increasing sophistication. However, researchers and tech companies are developing AI-based detection tools to identify synthetic content. Watermarking, digital forensics, and blockchain-based verification systems are being explored to counteract deepfake misuse.

Governments and organizations are also implementing policies and regulations to criminalize deepfake-related cyber offenses. Social media platforms have begun using AI-driven moderation systems to detect and remove deceptive content.

Conclusion

Deepfake technology is a double-edged sword, offering creative possibilities while enabling cybercriminals to commit fraud, identity theft, and misinformation. As AI-generated content becomes more realistic, combating deepfake cybercrime requires a combination of advanced detection techniques, strict regulations, and public awareness. Staying vigilant against digital deception is crucial in this rapidly evolving technological landscape.

.....



Quantum World

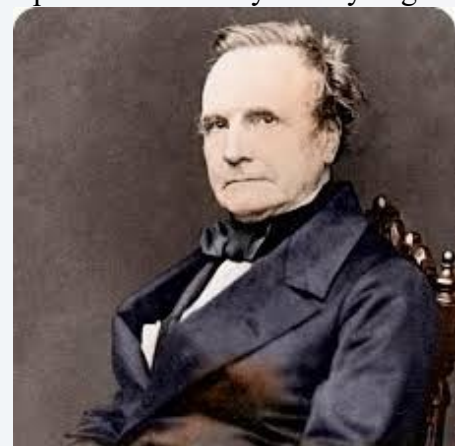


Sangam Kundu
CSE, 1st Year

We all know that digital computers changed virtually every aspect of our life. Well, the arrival of quantum computers could be even more historic than that. We're now in the initial stages of the next revolution. We're talking about a new generation of computers: the ultimate computer, a computer that computes on atoms, the ultimate constituents of matter itself. The question is: Who's involved in this race to perfect quantum computers? And the answer is: everyone. All the big players are part of this race because if they're not, Silicon Valley could become the next Rust Belt. Also, anyone who's interested in security is interested in quantum computers. They can crack almost any code that is based on digital technology. That's why the FBI, the CIA and all big international governments are following this very closely. Quantum computers will change everything, the economy, how we solve problems, the way we interact with the Universe. You name it, quantum computers will be there.

You see, computers have gone through three basic stages: Stage one was the analog computer. So, 2,000 years ago there was a shipwreck, and in the boat that sank was a device, and when you brushed away the dirt and debris, you began to realize that it was a machine, a machine of incredible complexity. It was, in fact, the world's first analog computer, and it was designed to map the motion of the Moon, the Sun and the planets to simulate the Universe. But as we primitive peoples became more prosperous, we had to count things: count how many cows you had, count how much profit you made. Analog computers could be based on sticks, bones, whatever it took to count. So, this went on for thousands of years until finally we reached the work of Charles Babbage. He creates the ultimate analog computer with hundreds of gears and levers and pulleys. And by turning the crank, you could then calculate longitude, latitude, you could calculate interest rates. It was very valuable to have an instrument like that for the banking industry, for commerce. Then, World War II comes along. Babbage's machine is simply too primitive to break the German code, so the job was given to mathematicians like Alan Turing. Alan Turing was the one who codified a lot of the laws of computation into what is called and, of course, it's digital. Now, the digital revolution is based on transistors. It operates on zeros and ones, zeros and ones at the speed of electricity. Every digital computer is a Turing machine.

And he realized that the ultimate transistor is an atom, one atom that could control the flow of electricity, not just on or off, but everything in-between. We have to go to quantum computers, computers that compute on atoms rather than on transistors. Transistors are based on zeros and one, zeros and one. But the Reality is not. Reality is based on electrons and particles, and these particles in turn act like waves. So, you have to have a new set of mathematics to discuss the waves that make up a molecule, and that's where quantum computers come in.



They're based on electrons, and these electrons, how come they have so much computational power? Because they could be in two places at the same time- that's what gives quantum computers their power. They compute on not just one universe but an infinite number of parallel universes. That's why they are so powerful. So, how much faster is a quantum computer over a digital computer? In

principle, When we talk about digital computers, we can measure their power in terms of bits. For example, spin up, spin down, zeros and one would constitute one bit. For a large digital computer, we're now talking about billions of bits that are modeled by transistors, except now, quantum computers talk not just about spin up or spin down, but everything in between- that's called a qubit. One qubit represents all the possibilities of an object spinning between up and down. Thousands of qubits can now be modeled with the latest generation of quantum computers. Eventually, we hope to hit a million. And so, we're talking about exceeding the power of ordinary digital computers. It is the point at which a quantum computer can outrace and outperform a digital computer on a certain task.

We passed that several years ago, but we want a machine that could exceed the power of any digital computer. We're not there yet, but we're very close to it. The number one problem facing quantum computers is the question of 'decoherence.' Everything is based on particles like electrons, and electrons have waves associated with them. When these waves are vibrating in unison, it's called 'coherence,' and then you can do calculations of a quantum mechanical nature. But if you fall out of coherence, then everything vibrates at a different frequency. And what is that called? Noise. You have to reduce the temperature down to near absolute zero so everything is pretty much vibrating slowly in unison- that's difficult. Now, nature solves this problem: It is the basis of all life on the earth. Photosynthesis, for example, is a quantum mechanical process. Mother Nature can create coherence at room temperature. Amazing. Mother Nature is still smarter than us when it comes to the quantum theory.

So, let's face it. There are hurdles affecting the growth of quantum computers, but they pale in comparison to the benefits that may be unleashed by quantum computers. We're talking about opening the floodgates. Take a look, for example, of food supply. The 'green revolution' that allows us to feed the population of the world is slowly coming to an end. We're trying to use quantum computers to unlock the secret of how to make fertilizer from nitrogen. Take a look at energy. Quantum computers may be able to create fusion power by stabilizing the super hot hydrogen inside a fusion reactor. And take a look at medicine. You realize that life is based on molecules, molecules that can create Alzheimer's disease, Parkinson's disease, cancer.

Biometric Security System: Trends and Challenges



Ritesh Kumar Ray
CSE, 2nd Year
Batch : 2022 - 2026

Biometric security systems, once a futuristic concept, are now becoming a staple in modern security infrastructures. These systems leverage unique physical or behavioural characteristics—such as fingerprints, facial features, iris patterns, voice recognition, and even DNA—to authenticate individuals. As digital transformation accelerates, these systems offer enhanced security and convenience, particularly for access control and identity verification. However, with their rise come new challenges that must be addressed to ensure their effectiveness and reliability.

The use of biometric systems is becoming ubiquitous across multiple industries. In banking, finance, and healthcare, biometrics help in securing financial transactions, patient information, and sensitive data. For example, fingerprint scanners on mobile phones have become a common means of

unlocking devices and authorizing payments. Similarly, facial recognition systems are used in airports for faster identity verification and even in employee attendance tracking systems.

Biometric authentication is increasingly being integrated with other forms of authentication in Multi-Factor Authentication (MFA) systems. While biometrics provide a convenient method for identity verification, they are most secure when combined with something the user knows (e.g., PIN or password) or something the user possesses (e.g., security token or mobile phone). This combined approach significantly strengthens security protocols against unauthorized access.

Facial recognition technology is among the fastest-growing biometric modalities. Recent advancements in deep learning and artificial intelligence (AI) have improved the accuracy and speed of facial recognition systems. These systems are now being used for security purposes in public spaces, such as airports, stadiums, and shopping malls, as well as in personal devices. The rise of AI and machine learning has enabled the recognition of faces even in low-light conditions and with partial obstructions (e.g., masks).

AI and machine learning are becoming integral to biometric security systems. These technologies improve the performance and reliability of biometrics by enabling systems to learn and adapt over time. For instance, machine learning algorithms can reduce the rate of false positives or negatives, ensuring a more accurate and reliable authentication process.

In response to the COVID-19 pandemic, contactless biometric systems gained significant attention. People began to prefer systems that do not require physical touch, thus reducing the spread of germs. Facial recognition, voice recognition, and even iris scanning technologies have flourished due to their ability to authenticate individuals from a distance, offering both convenience and hygiene. Wearables, such as smartwatches and fitness trackers, are increasingly being used as biometric security devices. These devices use biometric indicators like heart rate, body temperature, and movement patterns to monitor users' health and identify them. This trend is particularly noticeable in personal security and healthcare monitoring. While the advantages of biometric security systems are clear, several challenges persist that need addressing to improve their efficiency and address potential risks.

One of the most significant concerns surrounding biometric systems is the potential for privacy violations. Biometric data is extremely sensitive, as it relates directly to an individual's unique physical or behavioural traits. Unauthorized access, theft, or misuse of biometric data can lead to identity theft and severe privacy violations. The storage and transmission of biometric information require robust encryption and security measures to prevent exploitation.

Additionally, concerns over government surveillance and the use of facial recognition technology in public spaces have raised debates about civil liberties and personal freedoms. Regulations, such as the General Data Protection Regulation (GDPR) in the European Union, are attempting to address these issues, but there remains a lack of global standards on the ethical use of biometric data.

Unlike passwords or PINs, biometric data cannot be changed. Biometric systems, though innovative, are not without challenges. Issues such as false positives and negatives undermine their reliability, particularly in high-security environments where errors can lead to unauthorized access or unfair denial of entry for legitimate users. Additionally, concerns about bias in systems like facial

recognition have emerged, with studies showing inaccuracies in identifying individuals from certain demographics, such as women or people of color. This highlights the need for more diverse training datasets to ensure inclusivity and fairness in biometric technologies.

While costs for biometric systems are decreasing, they remain a significant investment for smaller organizations due to hardware, software, and maintenance expenses. Integration with existing security infrastructures presents another hurdle, as compatibility with legacy systems and scaling across diverse environments requires careful planning and resources. These barriers pose significant challenges, particularly for businesses looking to adopt these systems on a broader scale. If biometric data is hacked or stolen, it can have long-term consequences because there's no way to "reset" biometric identifiers like fingerprints or facial features.

Building a Bangla LLM by finetuning Gemma 2B LLM using Low-Rank



Abhishek Dasgupta
CSE, 3rd Year
Batch : 2021 - 2025

Google recently released Gemma, an open-source language model family (2B and 7B parameters). This project uses Gemma 2B to build a Bangla LLM capable of understanding and replying in Bengali, fine-tuned using Low-Rank Adaptation (LoRA).

Why Gemma 2B + LoRA?

Gemma 2B is relatively small (2 billion parameters), making it ideal for experimentation on limited hardware such as Google Colab's free GPU.

LoRA allows for efficient fine-tuning by adding a small number of trainable weights while keeping the original model weights frozen.

It does this by decomposing large weight matrices into smaller low-rank components.

This method drastically reduces training cost and is especially useful for adapting large models to specific domains or languages.



Dataset and Preprocessing

An open-source Bengali Chat Dataset by Rishiraj Acharya was used. Each entry was split using special tags to separate user instructions and chatbot responses.

Sample:

Instruction: আমার ওজন াস করা দরকার। িচিনর িকছ িবকল্প কী ?

Response: ওজন াসের সময় িচিনর িবকল্প িহসাবে ক্ি ম িমিটি , িচিনর অ ালেকাহল , িভয়া , স াসী ফল ইত াদি ব বহার করা যায়।

The dataset was reformatted into instruction-response pairs which served as input-output examples for the fine-tuning process.

Fine-Tuning Process

Library Installation:

Required packages like keras-nlp, jax, and datasets were installed.

Model Configuration:

LoRA enabled: rank = 4

Input sequence length limited to 512 tokens

Optimizer used: AdamW with weight decay

Loss function: Sparse Categorical Crossentropy

Model trained with batch size = 1, epochs = 1

```
python
```

```
CopyEdit
```

```
gemma_lm.backbone.enable_lora(rank=4)
```

```
gemma_lm.preprocessor.sequence_length = 512
```

```
gemma_lm.fit(data, epochs=1, batch_size=1)
```

This process takes approximately 20–30 minutes on a Colab GPU.



Results and Observations

Before Fine-Tuning: The model struggled to produce coherent responses in Bengali.

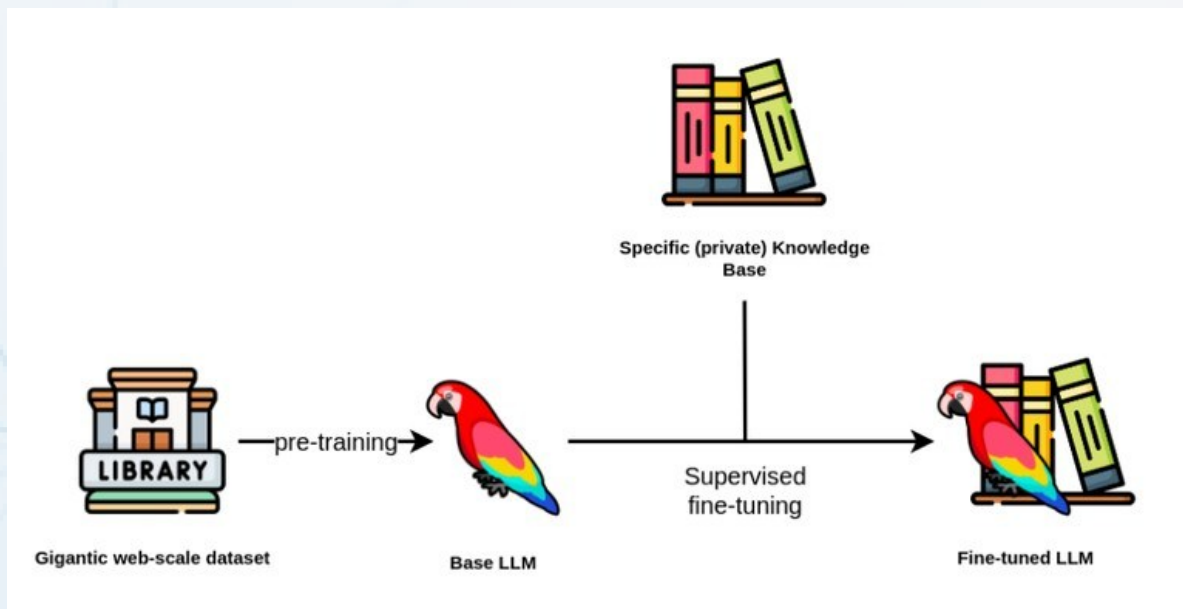
After Fine-Tuning: The same prompts generated accurate and fluent replies, demonstrating successful adaptation to the Bengali language.

However, due to the small dataset and low LoRA rank, the model may not perform well on complex or domain-specific Bengali queries.

Conclusion:

This project successfully demonstrated that:

Even a lightweight LLM like Gemma 2B can be fine-tuned for a low-resource language like Bengali. LoRA enables accessible and efficient fine-tuning without requiring expensive hardware. For production-level performance, a larger dataset and more powerful hardware would be necessary. This work serves as a proof-of-concept and a foundation for building more advanced Bengali LLMs in the future.



The Rise of Open-Source AI Models: Meta AI, OpenAI, and Mistral



Arnab Ghosh
CSE, 2nd Year

Artificial Intelligence (AI) has undergone a groundbreaking revolution over the last decade with open-source AI models becoming an emerging force as far as innovation and accessibility are concerned. Mega-tech companies like Meta AI, OpenAI, and Mistral are spearheading this revolution with open-source AI tools that challenge researchers, developers, and corporations around the world.

The Transition to Open-Source Artificial Intelligence, Earlier, big companies developed AI models independently, and high-tech was not available. With growing need for openness, collaboration, and ethically advanced artificial intelligence, open-source AI models have come into the limelight. Open-source AI models enable people to learn, change, and enhance AI systems, thereby driving swift advancement in the field.

Meta AI is arguably one of the world's greatest open-source AI players currently. Meta has released several new models, such as LLaMA (Large Language Model Meta AI), which performs as well as commercial models but is available to researchers and developers. Meta AI's open research model has advanced natural language processing (NLP) and generative AI development significantly, enabling the global AI community to build and engage with its models.



OpenAI, initially founded upon an openness platform, has in recent years pursued a hybrid strategy. Although there are closed models such as GPT-3.5 and GPT-4, OpenAI has not stopped advancing AI research in open environments such as Gym and Whisper, a speech recognition model. Although criticized for taking a commercialization step, OpenAI has not stopped working in the AI space through the publication of helpful tools and research.

Mistral AI, a new player in the space of artificial intelligence, is making waves with its *opensource high-performance models*. The company has emerged as a disruptor to the traditional AI giants by coming up with lean and efficient language models that compare with proprietary offerings. Mistral's emphasis on efficiency and openness is making artificial intelligence accessible, especially for small startups and independent developers who lack the funds to create models in-house.

The rise of open-source artificial intelligence (AI) frameworks has profound implications across industries and research. By democratizing AI, these models make advanced technology accessible to a broader audience, allowing more people to experiment, innovate, and develop solutions tailored to diverse needs. Open-source AI accelerates research and development by fostering collaboration, enabling shared advancements that drive progress at unprecedented speeds. This transparency also encourages ethical AI development, as public scrutiny helps identify and address biases, ensuring fairer and more responsible applications. Moreover, the cost-effectiveness of open-source models empowers organizations to harness AI's power without incurring the significant expenses associated with proprietary systems, leveling the playing field for smaller enterprises and individual developers.

As technology continues to evolve daily, the future of technology will be shaped by open-source models developed by Meta AI, OpenAI, and Mistral. Their work is bridging the gap between utility and creative AI, and turning innovation into a shared process instead of the domain of a few companies. The open AI era is near, with a future where AI will be a shared property.



.....

Virtual Reality (VR) and Augmented Reality (AR)



Moumit Mondal
CSE, 1st Year
Batch : 2024 - 2028

Revolutionizing the Digital Experience Virtual Reality (VR) and Augmented Reality (AR) have transformed the digital experience in the past few years. They are changing the face of industries like gaming, healthcare, education, and entertainment, providing immersive experiences that merge the virtual and physical worlds. Although VR and AR have a lot in common, they work in different ways and have different uses.

VR is a technology that produces an entirely simulated digital world, closing out the actual world. People use VR headsets, like the Oculus Rift or HTC Vive, that produce a 3D world that reacts to head and body movement. Using motion controllers, haptic feedback, and spatial audio, VR provides an interactive experience that simulates life. The most common uses for VR are games, training simulation, and therapy. In video games, VR immerses players in virtual worlds where they can move about and interact with the environment in real time. Training simulations, especially in domains such as flight and medicine, enable users to rehearse sophisticated tasks in a simulated environment. VR therapy also exists to heal mental illnesses such as anxiety disorders, PTSD, and phobias by gradually exposing patients to controlled stimuli within a secure area.



Unlike VR, Augmented Reality (AR) adds digital information onto the real world. AR supplements a person's environment instead of replacing it entirely. Smartphones, tablets, and AR glasses (such as Microsoft HoloLens and Google Glass) enable users to perceive and engage with digital information in real-world environments. AR is extensively employed in mobile apps, gaming, education, and commerce. Some popular AR apps include Pokémon GO, where virtual creatures are overlaid on real-life settings, and AR-enabled shopping apps that allow consumers to visualize furniture or apparel before they buy. In education, AR offers interactive learning experiences like 3D human anatomy or historical objects, which simplify complex topics.

Immersive Technologies Clash In the constantly changing technology landscape, Virtual Reality (VR) and Augmented Reality (AR) have become game-changers that transform the way humans engage with digital content. Both technologies are revolutionizing industries, including gaming, healthcare, education, and entertainment, opening up new possibilities for users. Though both provide similar experiences, their inherent differences distinguish them. This article examines the differences, uses, and future prospect of VR and AR.



Though both provide similar experiences, their inherent differences distinguish them. This article examines the differences, uses, and future prospect of VR and AR.

Virtual Reality and Augmented Reality are revolutionizing digital interactions, enhancing the experience in entertainment, education, healthcare, and business. VR transports users to virtual worlds, whereas AR enriches reality with digital overlays. As technology advances, applications for VR and AR will continue to grow, making them must-have tools in today's world.



.....

AI vs. Dark Web: Revolutionizing Cyber Threat Hunting



Souptik Das
CSE , 1st Year
Batch : 2024-2028

In the evolving landscape of cybersecurity, the dark web represents one of the most significant challenges. Hidden from standard search engines, it has become a hub for illicit activities such as data breaches, fraud, and hacking. Artificial Intelligence (AI) is emerging as an essential tool for detecting and mitigating these threats, offering capabilities that allow cybersecurity teams to stay ahead of malicious actors.

One notable application of AI is its ability to process vast amounts of unstructured information on the dark web. Natural Language Processing (NLP), a specialized branch of AI, enables systems to decipher cryptic, coded, or slang-heavy language commonly used in dark web forums. For instance, in 2020, an NLP-powered AI system flagged discussions about a new ransomware strain, allowing cybersecurity experts to prepare for and mitigate the threat before it materialized.

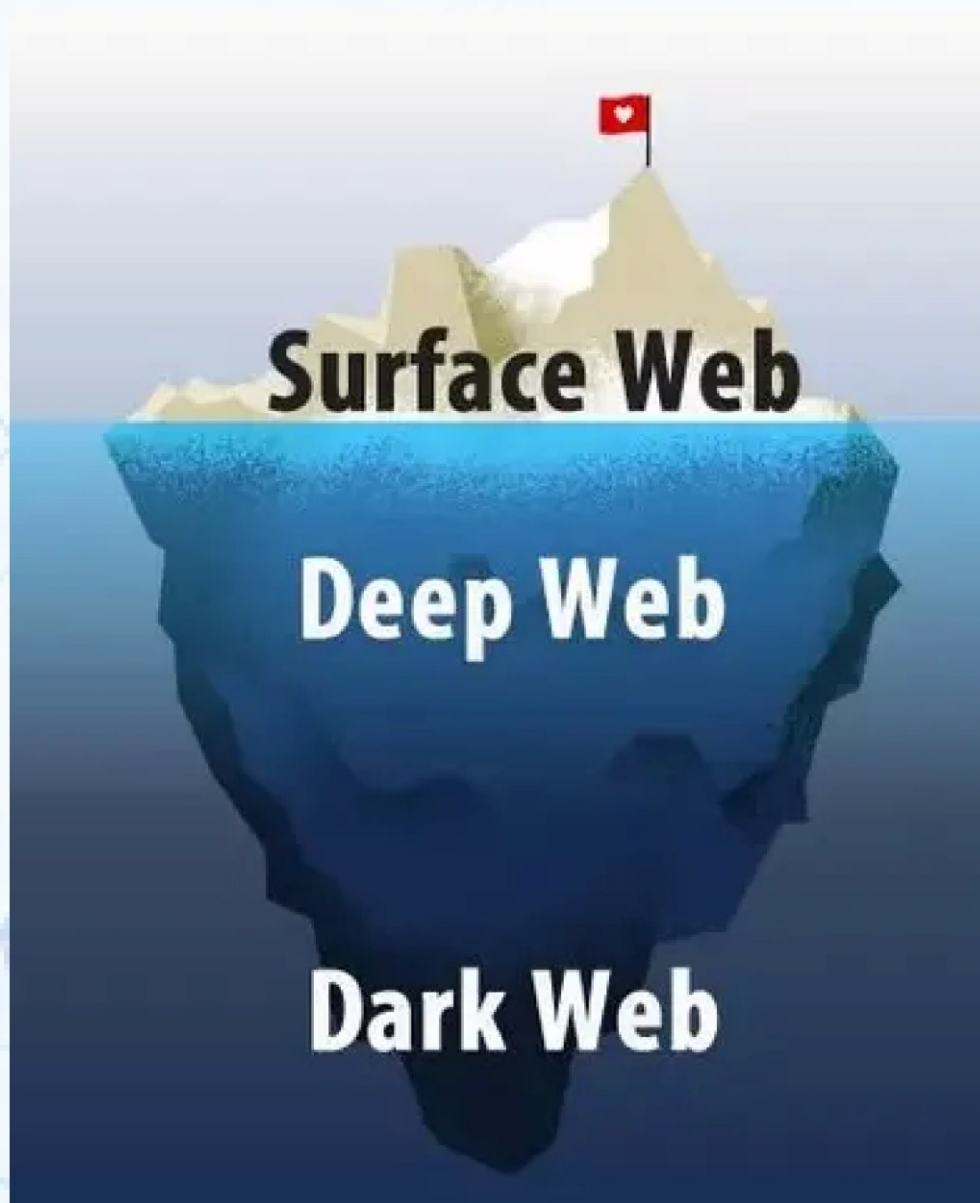


In the evolving landscape of cybersecurity, the dark web represents one of the most significant challenges. Hidden from standard search engines, it has become a hub for illicit activities such as data breaches, fraud, and hacking. Artificial Intelligence (AI) is emerging as an essential tool for detecting and mitigating these threats, offering capabilities that allow cybersecurity teams to stay ahead of malicious actors.

One notable application of AI is its ability to process vast amounts of unstructured information on the dark web. Natural Language Processing (NLP), a specialized branch of AI, enables systems to decipher cryptic, coded, or slang-heavy language commonly used in dark web forums. For instance, in 2020, an NLP-powered AI system flagged discussions about a new ransomware strain, allowing cybersecurity experts to prepare for and mitigate the threat before it materialized.

Despite its advantages, AI in cyber threat hunting is not without challenges. Striking a balance between security and privacy is critical, as AI systems often process vast amounts of sensitive information. False positives are another concern, potentially leading to wasted resources and unnecessary panic. Effective human oversight and ethical guidelines are essential to manage these issues and maintain trust in AI-driven systems.

In conclusion, AI has become a transformative force in combating dark web threats. Its ability to analyze complex language, predict emerging risks, and provide real-time alerts empowers cybersecurity professionals to stay ahead of cybercriminals. As technology evolves, AI will continue to play a vital role in safeguarding individuals and organizations, provided its implementation remains ethically sound and carefully managed.



Android 15: Breaking Down the Key Features You Need to Know



Saurav Kumar Sinha
CSE, 1st Year
Batch : 2024 - 2028

Android 15 is available now with exciting improvements to make our digital lives safer, easier, and more connected. With over 70% of the global market share still on Android, the latest release prioritized better connectivity, privacy, and media management to improve the user experience. With mobile customers now using their smartphones for 4.5 hours a day, Google has launched Android 15 with powerful new capabilities to stay updated with changing requirements.



Android 15 comes with enhancements that put user and privacy first, from satellite connectivity to screen recording detection.

Sensitive Notifications for OTPs

Android 15 adds screen recording detection, enabling apps to recognize when a screen recording is taking place in response to growing privacy concerns. This feature improves the security of apps that display sensitive information by alerting users or limiting their exposure to a recording, whether on social media or banking. Google's proactive strategy helps keep your information safe in an age when privacy is critical.

Privacy & Security Enhancements

Screen Recording Detection

Android 15 adds screen recording detection, enabling apps to recognize when a screen recording is taking place in response to growing privacy concerns. This feature improves apps that display sensitive information such as social media or banking security by alerting users or limiting their exposure when they receive a recording. So, Google's proactive strategy helps keep your information safe in an age when privacy is critical.

Advanced Connectivity: Satellite Support

Support for satellite connectivity is one of Android 15's most awaited features. While most of us rely on Wi-Fi and cellular networks, there are situations where these connections are unavailable, such as when traveling or on long-distance trips. To resolve this concern, Android 15 has launched a new feature that provides support for satellite connections, provides reliable connectivity for devices with compatible hardware in certain areas with limited mobile network coverage. Assuming a certain network limitation you can send messages or make emergency calls without need; Many people can find this approach very helpful.

Private Space: Keep Your Apps Locked & Secure

"Private Space," the vault in your smartphone for storing special apps you choose to keep, is part of Android 15. Accessing this safe space is simple: Select the "Private" button of an app drawer and see if you put your preferred method, such as your fingerprint or PIN. Private space for your digital environment provides more security for people who want to keep important apps private.

Enhanced Camera & Media Controls

Low Light Boost for Better Night Photos. Low Light Boost is the primary of numerous improvements for photographers that Android 15 gives. This characteristic improves low-mild picture quality, permitting the capturing of brighter, clearer photos even in dimly illuminated environments. With this functionality, you could take better snapshots at night time without relying on outside lighting fixtures.

In-App Camera Controls

Android 15 offers in-app camera options, allowing you to adjust the focus and exposure and other hardware parameters within the apps that want greater flexibility. Whether you're using a basic photo app or using social media, this personalization to capture better images for users Enables productivity.

HDR Headroom & Loudness Control

By controlling bright and dark areas in photos and movies, Android 15's HDR headroom control creates a visually balanced experience. This function enhances playback and enhances both SDR and HDR video.

Virtual MIDI 2.0 Devices for Music Lovers

Android 15's support for virtual MIDI 2.0 devices, providing direct connections between composition synthesizers and apps, will be useful for musicians. Android is now a much more convenient option for musicians and producers due to its innovative features that simplify mobile music production.



The Importance of Engineering in Society



Joydeep Sharma
CSE, 1st Year
Batch : 2024 - 2028



Engineering is a discipline that has profoundly shaped the modern world, influencing nearly every aspect of our daily lives. This essay will explore the importance of engineering in society by examining its historical context, various branches, contributions to economic growth, impact on quality of life, role in addressing global challenges, and the future of engineering in an ever-evolving world.

The Evolution of Engineering Through the Ages:

As societies evolved, adapting to the changing needs and challenges of the time. Engineers and architects collaborated to create cathedrals that reached unprecedented heights, such as the Notre-Dame de Paris, completed in the 14th century. The Renaissance period marked a renewed interest in science and the arts, leading to innovations in engineering. Figures like Leonardo da Vinci and Galileo Galilei contributed to the understanding of mechanics and fluid dynamics, laying the groundwork for future engineering disciplines.

Engineering in the Modern Era:

As we moved into the 20th and 21st centuries, responding to the challenges of globalization, environmental sustainability, and technological advancement. Fields such as software engineering, biomedical engineering, and environmental engineering have emerged, addressing contemporary issues such as healthcare, climate change, and sustainable development. Engineers play a pivotal role in developing solutions that enhance quality of life, from renewable energy systems to smart cities.

The Role of Engineering in Innovation:

At the heart of engineering lies innovation, which is essential for economic advancement. Engineers are tasked with solving complex problems and developing new products that meet the evolving needs of society. For example, advancements in renewable energy technologies, such as solar panels and wind turbines, not only address environmental concerns but also create new markets and job opportunities. By fostering a culture of innovation, engineers help businesses stay competitive in a global marketplace, driving economic growth.

The Future of Engineering:

The future of engineering is poised for exciting developments, driven by rapid technological advancements and the increasing complexity of societal challenges. Emerging fields such as artificial intelligence, robotics, and biotechnology are reshaping the engineering landscape, creating new opportunities and demands for skilled professionals..



Conclusion:

In conclusion, engineering is a cornerstone of modern society, influencing economic growth, quality of life, and the ability to address global challenges.. As we look to the future, the role of engineering will only become more critical, requiring a commitment to innovation, collaboration, and ethical practices. By integrating ethical considerations into their work and committing to continuous learning, engineers can ensure that their contributions lead to a more sustainable, equitable, and innovative future for all.



.....

Machine Learning for Social Good: Tackling Climate Change and Global Challenges



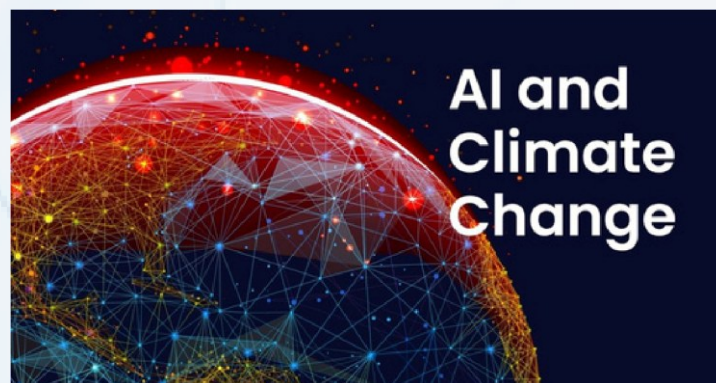
Ananya Dhibar
CSE, 1st Year
Batch : 2024 - 2028

In an era defined by technological leaps, machine learning (ML) emerges as a beacon of hope in addressing humanity's most pressing challenges. From curbing climate change to revolutionizing healthcare, ML is not just a tool for innovation—it's a catalyst for global equity and resilience. By harnessing vast datasets and predictive analytics, scientists and policymakers are unlocking solutions that were once unimaginable, proving that technology, when guided by purpose, can drive profound social good.

Climate Action: From Prediction to Prevention

Climate change remains the defining crisis of our time, but ML is transforming how we combat it. In renewable energy, Google's DeepMind developed an ML model to predict wind farm output 36 hours in advance, boosting grid efficiency and reducing reliance on fossil fuels. Similarly, startups like ClimaCell use AI to hyper-localize weather forecasts, helping communities prepare for extreme events.

ML also empowers environmental monitoring. The nonprofit Global Forest Watch employs satellite imagery and ML algorithms to track deforestation in real time, enabling rapid intervention in the Amazon and Congo Basin. Meanwhile, projects like Microsoft's "AI for Earth" analyze ecosystems to optimize reforestation and carbon capture, turning data into actionable climate strategies.



Beyond Climate: Health, Agriculture, and Disaster Response

The reach of ML extends far beyond environmentalism. In global health, algorithms predict disease outbreaks by analyzing patterns in climate data, social media, and travel. During the COVID-19 pandemic, platforms like BlueDot flagged early outbreaks, while ML models

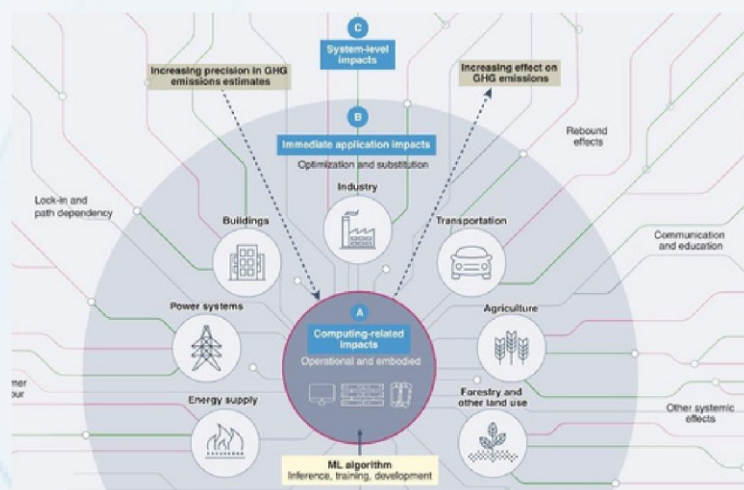
accelerated vaccine development. In rural Africa, startups use AI to diagnose malaria from blood samples, bridging healthcare gaps.

Agriculture, too, is undergoing an ML revolution. Microsoft's FarmBeats leverages drones and sensors to provide farmers with insights on soil health and crop yields, reducing water use and pesticide reliance. In India, startup CropIn predicts harvests with 90% accuracy, safeguarding food security for smallholders.

When disasters strike, ML saves lives. After hurricanes or earthquakes, AI analyzes satellite imagery to map damage and prioritize aid. The UN's Pulse Lab Jakarta uses natural language processing to mine social media for real-time crisis insights, ensuring help reaches the most vulnerable.

Ethics and Equity: Navigating Challenges

Yet, the promise of ML is not without pitfalls. Biased datasets can perpetuate inequality, while energy-intensive models may contradict sustainability goals. Privacy concerns loom large, particularly in vulnerable regions. To mitigate risks, initiatives must prioritize inclusive data collection and transparency. Organizations like DataKind advocate for ethical AI, partnering with NGOs to ensure solutions respect local contexts and needs.



The Road Ahead

The intersection of ML and social good is ripe with potential—but success demands collaboration. Tech giants, governments, and grassroots organizations must unite to scale solutions ethically. As climate scientist Katharine Hayhoe notes, “The best climate change technology is dialogue.” Similarly, ML’s true power lies not in algorithms alone, but in their ability to amplify human ingenuity and compassion.

In the race against time, machine learning offers more than efficiency; it offers a vision of a equitable future. By steering innovation toward collective well-being, we can transform bytes and code into lasting change—one prediction, one intervention, one life at a time.

.....

Isaac GR00T N1 and Blue: Ushering in the New Age of Robotic Intelligence



Mukund Kumar Jha

CSE, 2nd Year

Batch : 2023 - 2027

LEAD PARAGRAPH:

In a year already brimming with AI breakthroughs, the unveiling of two remarkable humanoid robotic platforms — Isaac GR00T N1 and Blue — marks a bold leap into the future of intelligent automation. Developed by an interdisciplinary alliance spanning NVIDIA, Google DeepMind, and Disney Research, these robots don't just move with unprecedented dexterity they think, learn, and collaborate like never before.

The Rise of the Generalist Robot Meet Isaac GR00T N 1



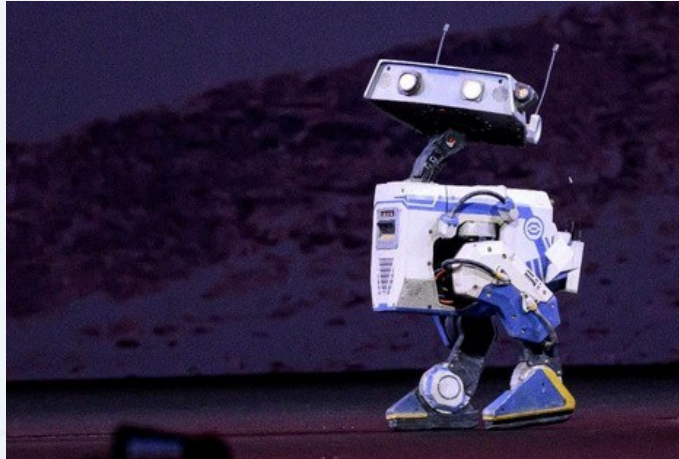
At the heart of the Isaac GR00T N1 initiative lies a transformative idea: a generalist foundation model tailored for humanoid robots. Named with a nod to both Isaac Asimov and Marvel's iconic Groot, GR00T N1 is not a character of fiction — it's a real-world marvel powered by NVIDIA's latest AI architecture.

Built on a vast corpus of multimodal data, Isaac GR00T N1 can perform an expansive range of human-like tasks — from opening doors and folding laundry to navigating dynamic environments and offering real-time assistance. Unlike specialized robots designed for one or two functions, GR00T N1 is a true generalist, capable of adapting its behavior to new contexts with minimal retraining.

“NVIDIA has created a system that merges cognitive flexibility with physical precision,” says Dr. Elena Morales, a robotics researcher at MIT. “GR00T N1 isn't just following scripts. It's reasoning, planning, and learning in real time.”

What makes it possible is the integration of NVIDIA's Jetson Thor hardware with a cutting-edge transformer-based neural network. This combination allows Isaac to process visual, tactile, and auditory inputs simultaneously — enabling intuitive decision-making akin to that of a human assistant.

Enter Blue: The Imaginative Side of AI Robotics



While GR00T N1 focuses on utilitarian excellence, Blue adds an imaginative twist. Developed in a unique partnership between Disney Research and Google DeepMind, Blue draws inspiration from the expressive and emotionally intelligent droids of Star Wars. Its design echoes the charisma of characters like R2-D2 and BB-8 — but it's not all show.

Underneath its charming design lies a highly advanced cognitive engine. Blue runs on a variation of DeepMind's latest RLHF (Reinforcement Learning with Human Feedback) model, enabling it to engage in social learning, collaborate with humans in shared spaces, and even emulate empathy.

"Blue is our attempt to merge storytelling with robotics," explains Dr. Jae Kim of Disney Research. "It's not just about function, but about fostering meaningful interactions. Blue can tell stories, understand emotions, and adapt its tone to connect with different audiences from children in hospitals to engineers in labs."

Blue's physical capabilities are no less impressive. Its humanoid frame features adaptive soft robotics, allowing it to safely interact with humans and respond to nuanced gestures and facial expressions. And with a personality database co-designed with Disney animators, Blue doesn't just react — it performs.

The Future is Collaborative

One of the most exciting developments is the possibility of collaborative cognition between GR00T N1 and Blue. While GR00T handles precise physical tasks and general problem-solving, Blue can serve as the intuitive communicator and emotional bridge in human-robot teams.

Early demonstrations showcased the duo assisting in a simulated hospital scenario: GR00T managed logistics and physical care tasks, while Blue communicated with patients, responded to their moods, and even entertained children in the recovery ward.

“This is more than just tech synergy,” says AI ethicist Dr. Liam Navarro. “It’s a vision of robotic harmony — blending logic, empathy, and physical capability.”

Challenges Ahead

Of course, the road to widespread adoption is still filled with hurdles. Questions around data privacy, ethical training, and affordability continue to shape the conversation. Critics argue that without strict guidelines, emotional robots like Blue could blur the lines of human-machine relationships.

NVIDIA and Disney, however, remain optimistic. Both companies have pledged transparent governance and open-source collaborations to guide ethical deployment.

Conclusion:A Brave New Age

Isaac GR00T N1 and Blue aren’t just tools. They’re milestones — living proof of what happens when storytelling, science, and engineering converge. As they roll out into research centers, public spaces, and (eventually) homes, these two robots could redefine how we think about artificial intelligence — not just as a service, but as a presence.

The age of robots is no longer coming. It’s here — and it has heart, hands, and maybe even a sense of humor.

.....

SCREENLESS DISPLAY



Nihal Prasad
CSE, 1st Year
Batch : 2024 - 2028

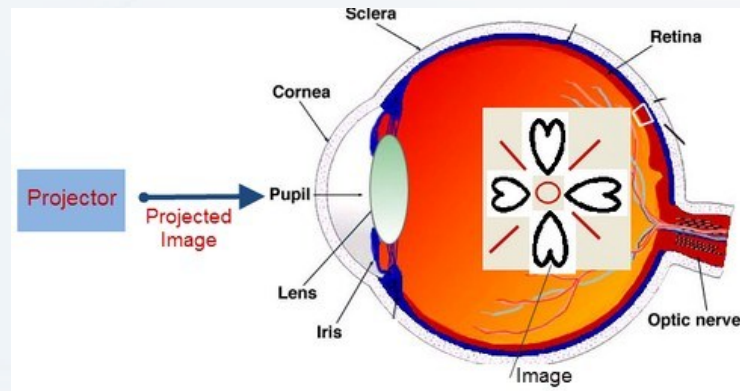
Screenless display is the advanced display technology, which replaces the touch screen technology to resolve the problems and to make lives more comfortable. Therefore, this article is intended to give an idea of the screenless display, which transmits or displays the information without using a projector or the screen. By using this screenless display technology, we can display the images directly on the open space, human retina and also to the human brain.

The categorisation of screenless display is as follows:

The first category, visual image is defined as the things that can be seen by the human eye such as holograms. The working principle of this display states that the light gets reflected by the intermediate object before reaching the retina or the eye. The intermediate object can be a hologram, Liquid Crystal Displays (LCD)s or even windows.

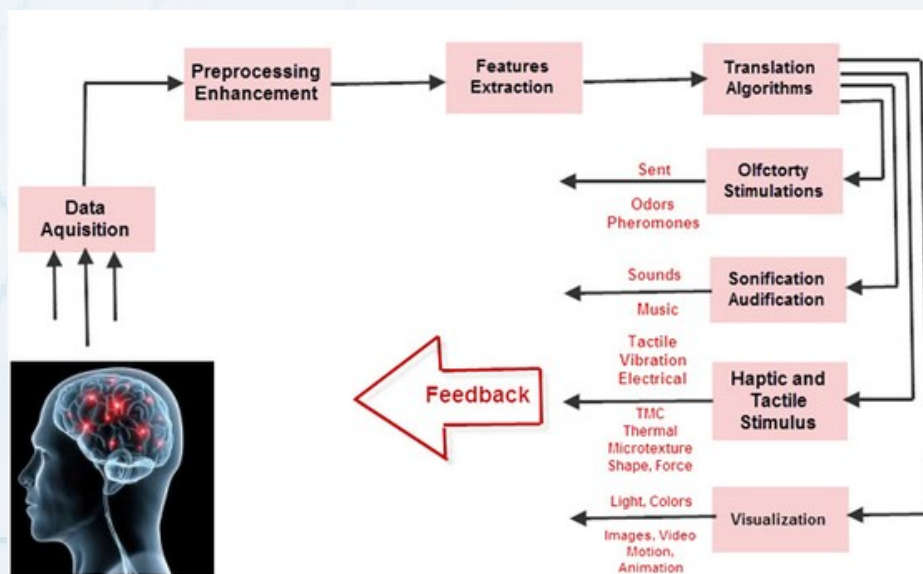


The second category, retinal display – the name itself- indicates the display of image directly onto the retina. The second category of advancement in display system, retinal display as the name itself indicates the display of image directly onto the retina. Instead of using some intermediate object for light reflection to project the images, this display directly projects the image onto the retina. The user will sense that the display is moving freely in the space. Retinal display is commonly known as retinal scan display and retinal projector. This display allows short light emission, coherent light and narrow band color appears to be floating in the air whenever the laser and object beams overlaps with each other. This display can supply accurate depth cues and high-quality images and videos that can be viewed by the human eyes without any need of special observation devices. Based on the colors of the laser projector, images are formed in three distinct planes. Holographic displays are commonly used as an alternative to screens.



The third category, synaptic reference which means sending information directly to the human brain. Many of the users do not need to look away from their field of view because the device displays the information on a windshield. An ordinary heads up display comprises of following components: a projector unit, combiner and a computer. The projector unit projects the image, and the combiner redirects the displayed image by that projected image, and the field of view are seen simultaneously. The screenless computer acts as an interface between the projector and the combiner (data to be displayed).

The brain computer interface allows direct interaction between the human brain and external devices such as computer. This category can also be known by different names such as human machine interface, synthetic telepathy interface, mind machine interface and direct neural interface.



.....

NVIDIA Cosmos: AI Training Redefined



Nilavra Pan
CSE, 1st Year
Batch : 2024 - 2028

NVIDIA has unveiled **NVIDIA Cosmos**, an advanced AI training platform that leverages photorealistic simulations to enhance robotics, autonomous vehicles, and AI-driven applications. Announced at **CES 2025**, Cosmos aims to revolutionize AI training by bridging the gap between virtual environments and real-world deployment.



What is NVIDIA Cosmos?

NVIDIA Cosmos is a **world foundation model (WFM) platform** built on **NVIDIA Omniverse**, providing AI with realistic training environments. By generating **synthetic data**, Cosmos eliminates costly real-world data collection, accelerating AI development.

Next-Gen Breakthroughs in NVIDIA Cosmos

1. World Foundation Models (WFM)

Cosmos introduces **text-to-world** and **video-to-world** capabilities, allowing AI to learn in dynamic, realistic simulations.

2. Advanced Video Processing

Cosmos includes **video processing and curation pipelines**, streamlining AI training with optimized, high-quality video datasets.

3. High-Performance Tokenizers

Cosmos integrates **visual tokenizers** with **8x better compression** and **12x faster processing**, optimizing video analysis for AI.

4. Autoregressive and Diffusion Models

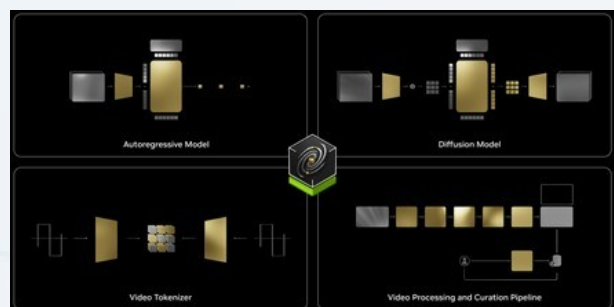
Autoregressive models enhance AI's predictive capabilities, while **diffusion models** generate high-quality synthetic training data, improving AI adaptability.

5. NeMo Curator for Data Processing

The **NeMo Curator** tool refines large datasets, ensuring high-quality, efficient AI training with minimal manual effort.

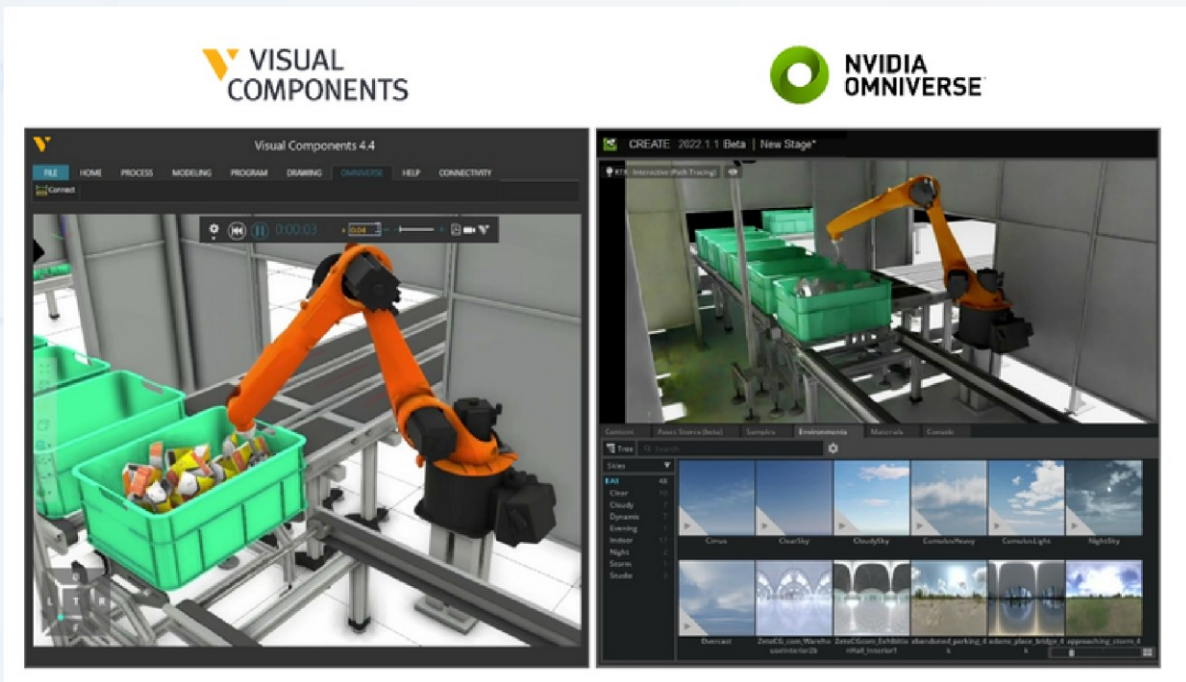
6. Simulation Theory Model

At **CES 2025**, NVIDIA introduced the **Simulation Theory Model**, enhancing AI's decision-making by providing **hyper-realistic, physics-driven training environments**. By incorporating **probabilistic modelling and generative AI**, Cosmos improves AI adaptability and efficiency.



7. Omniverse-Powered Simulations

Built on **NVIDIA Omniverse**, Cosmos features **real-time physics, multi-GPU rendering, and cloud AI training** ensuring realistic and adaptive simulations.



8. Open-Source and Industry Adoption

NVIDIA Cosmos is available under an **open model license**, ensuring accessibility for various industries. Leading tech firms like **Uber, Agility Robotics, and Waabi** are already leveraging Cosmos for autonomous AI training.

The Future of AI with Cosmos

NVIDIA CEO **Jensen Huang** envisions Cosmos as a **“ChatGPT moment”** for robotics and automation. With its open accessibility through NVIDIA’s API catalog, NGC catalog, and Hugging Face, Cosmos is set to drive the next wave of AI innovation.

Conclusion

NVIDIA Cosmos is a game-changer in AI training, offering cutting-edge **simulation capabilities, efficiency, and accessibility**. As industries increasingly adopt AI, Cosmos provides essential tools to shape the future of robotics, self-driving technology, and beyond.

.....

Zero Trust Security Model in cybersecurity



Maitri Midya
CSE, 1st Year
Batch : 2024 - 2028

In the constantly evolving digital landscape, cybersecurity has become more critical than ever before. With the rise of remote work, cloud computing, and interconnected smart devices, the traditional concept of network security is proving increasingly insufficient. In response, the Zero Trust Security Model has emerged as a powerful and necessary evolution in how we protect our systems and data. Unlike conventional models that operate on the assumption that everything within the internal network can be trusted,



Zero Trust's philosophy is built around the idea of “never trust, always verify.” In practice, this means that every access request—whether from an internal user, a third-party contractor, or an external service—is subjected to strict verification processes. This marks a fundamental shift from perimeter-based security approaches, which often allowed lateral movement within the system once initial access was granted. In a Zero Trust model, access is continuously verified and reevaluated, helping to minimize the risk of unauthorized actions and significantly reducing the attack surface within the organization.

Several core principles define the Zero Trust Security Model and make it particularly well-suited to the modern cybersecurity environment. These include explicit verification, where access is granted only after identity is confirmed using strong methods such as multi-factor authentication; the least-privilege principle, which ensures that users have access only to the data and systems necessary for their tasks; and micro-segmentation, which breaks down networks into smaller zones to prevent a breach in one area from spreading across the entire system. The model also relies heavily on continuous monitoring and behavior analysis to detect unusual or risky activity as it happens, ensuring real-time threat detection and response.

the growing number of sophisticated cyberattacks is one of the primary reasons for the global shift toward Zero Trust. High-profile incidents, such as the SolarWinds breach, have shown how even trusted internal systems can be exploited by attackers. These events exposed the weaknesses of traditional trust-based frameworks and made it clear that a more proactive, skeptical approach to cybersecurity is needed.

Organizations are now understanding that trust should not be granted automatically—it must be earned and continually assessed. The Zero Trust model addresses this need by implementing identity-based security, dynamic controls, and granular policies that follow users across devices and networks.

Adopting Zero Trust offers several compelling advantages for organizations. It improves threat isolation, preventing attackers from moving freely through a system if they manage to gain access. It also offers scalability, allowing companies to secure hybrid environments that include a mix of on-premise infrastructure, cloud platforms, and edge computing solutions. Importantly, Zero Trust also helps businesses meet growing regulatory and compliance demands by enforcing strict access and data protection standards. These capabilities make the model especially attractive to enterprises handling sensitive information across complex IT environments.

In conclusion, the Zero Trust Security Model is no longer just a trend or a buzzword—it's a critical necessity in today's digital age. As cyber threats become more advanced and persistent, the need for smarter, more adaptive security models becomes undeniable. By refusing to take trust for granted and ensuring that every access request is thoroughly verified, Zero Trust provides a framework that is both resilient and forward-thinking. For businesses committed to safeguarding their data, users, and systems, embracing Zero Trust is not just a strategic decision—it is an essential step toward future-proofing their cybersecurity posture.



AI-Powered Search Engines

SEO



Vikram Kumar

CSE, 2nd year

Batch : 2023-2027

Search engines have long served as the gateway to the internet, helping users navigate the vast sea of online information. Traditionally, these engines ranked websites based on keywords, backlinks, metadata, and other technical factors. Search Engine Optimization (SEO) was the essential toolkit for digital marketers, businesses, and content creators aiming to improve their visibility. With the integration of machine learning and advanced natural language processing, search is no longer just about matching keywords—it's about understanding intent, context, and delivering human-like responses.



The history of search engines reflects a clear trajectory—from simple keyword-based systems to intelligent, predictive tools. In the early stages, search engines depended solely on exact keyword matches. As algorithms evolved, especially with the rise of Google, new layers such as backlinks and PageRank transformed how web pages were ranked. This marked the era of technical SEO dominance. But the 2010s brought a different wave—machine learning and AI began entering the scene. These technologies allowed search engines to interpret language more naturally, analyze user behavior, and deliver more accurate, context-aware results. Today, search engines don't just find data; they understand it, summarize it, and in many cases, respond to queries directly—bypassing the need to even visit a website.

The fundamental difference between traditional SEO and AI-driven search lies in the way search engines interpret and deliver information. While traditional SEO revolved around strategic placement of keywords, metadata optimization, and backlink building, AI-based systems emphasize user experience and intent. They are trained to read between the lines of a query, understanding not just the words used, but what the user is truly looking for. This shift is especially visible in tools like Google's Search Generative Experience (SGE), where AI-generated answers appear directly on the search results page. Rather than linking to multiple websites, these engines offer summarized, conversational responses—creating a more direct and intuitive experience for users.

The power of AI extends beyond just search result summaries. AI chatbots such as ChatGPT and Google Bard are transforming how people look for information altogether. Instead of typing multiple queries into a search bar, users are engaging in conversations with AI that adapt in real-time. Voice search has also gained traction due to AI's enhanced understanding of natural language



These developments mean that businesses can no longer rely solely on keyword density or link profiles. Instead, success in the AI era demands content that is clear, conversational, relevant, and deeply aligned with user needs. Structured data and intent-driven narratives now play a far greater role than ever before.

This dramatic shift in search dynamics has already begun to impact real-world businesses and marketing strategies. Recent studies show that many small businesses, once heavily reliant on traditional SEO techniques, are now seeing drops in organic traffic.



They are focusing on structured data, featured snippets, and content that directly addresses search intent. The goal is no longer just to rank—but to be understood and preferred by the AI behind the search engine.

Experts across the fields of SEO and AI echo this sentiment. SEO strategist John Smith notes that the future of SEO lies not in chasing backlinks, but in understanding and fulfilling user intent. AI researcher Jane Doe adds that future search engines will act more like intelligent assistants than traditional information retrievers, capable of holding context-rich conversations and performing multi-step reasoning. These perspectives confirm a critical truth: content creators must evolve their strategies to remain relevant. The rules of the game have changed, and adaptability is now the most valuable asset.

As we look ahead, the question isn't whether SEO will disappear—it's how SEO will transform. Traditional tactics may continue to fade, but new forms of optimization will emerge, focused on aligning with AI's understanding of human needs. Businesses must create content that answers questions meaningfully, interacts fluidly with AI systems, and provides genuine value to the end user. The age of AI-powered search is not the death of SEO—it's its rebirth. Those who recognize and adapt to this shift will thrive, while those clinging to outdated methods may find themselves left behind in an internet that listens, learns, and responds more intelligently than ever before.

The Rise of Open-Source AI Models



Disha Bhattacharya

(Meta AI, OpenAI, Mistral)

CSE, 3rd Year

The Rise of Open-Source AI Models

Artificial Intelligence (AI) is no longer confined to tech giants with vast resources—it is now in the hands of developers and researchers worldwide. The explosion of open-source AI models is revolutionizing industries, from healthcare to finance, by making state-of-the-art machine learning tools freely accessible. This shift is breaking down barriers, fostering innovation, and intensifying competition in AI development. Tech leaders like Meta AI, OpenAI, and Mistral are spearheading this movement, offering open-source models that challenge traditional proprietary solutions.

Meta AI: Democratizing AI Development

Meta AI has taken significant strides in the open-source AI movement. Its LLaMA (Large Language Model Meta AI) series has provided developers with powerful tools for natural language processing (NLP). Unlike closed-source models that require expensive access fees, LLaMA's open approach fosters collaboration, allowing researchers to fine-tune models for diverse applications such as chatbots, code generation, and content creation. By prioritizing transparency, Meta AI is empowering the AI community to drive innovation.

OpenAI: Balancing Open-Source and Commercial Interests

OpenAI, initially founded with an open-source ethos, has since balanced its offerings between open and proprietary models. While models like GPT-4 remain closed-source due to safety and commercialization concerns, OpenAI continues to support the open-source ecosystem. Projects like Whisper, an advanced speech recognition system, and CLIP, a vision-language model, highlight OpenAI's commitment to enabling public AI research. The company's strategic approach ensures responsible AI deployment while still contributing valuable tools to developers.

Mistral AI: A Rising Contender in Open-Source AI

Mistral, a relatively new player in the AI field, has quickly gained attention with its commitment to fully open-source AI models. Unlike its competitors, Mistral releases models with minimal restrictions, allowing unrestricted modifications and deployments. This openness has positioned Mistral as a favorite among developers looking for transparency and control over their AI solutions. The company's lightweight, efficient models provide a viable alternative to larger, resource-intensive AI systems.

The Future of Open-Source AI

Open-source AI models are rapidly shaping the future of artificial intelligence, driven by the contributions of organizations like Meta AI, OpenAI, and Mistral. Meta has been at the forefront with its LLaMA series, offering more accessible, efficient language models that encourage collaboration and innovation. Their focus on open-source tools has the potential to make AI development more democratized, allowing researchers, startups, and industries to easily build and fine-tune models. On the other hand, OpenAI, despite being more conservative about open-sourcing its latest models like GPT-4, continues to contribute to the AI ecosystem through APIs and enterprise solutions. OpenAI's early open-source efforts, particularly with GPT-2, laid the groundwork for future AI research. The future of open-source AI models will likely be marked by increased collaboration, widespread adoption, and the development of AI tools that are not only more powerful but also more adaptable to a range of industries, including healthcare, finance, and entertainment. As these open-source models evolve, they will play a key role in democratizing AI access and fostering innovation across multiple domains.



.....

Beyond 5G-How Next Generation Wireless Networks Will Strengthen Cloud Security

CSE, 3rd year



Titiksha Dalal

Batch : 2022-2026

In an increasingly digital world, cloud computing has become the backbone of modern infrastructure for both individuals and organizations. The accelerated adoption of cloud services, fueled by the proliferation of mobile devices, AI applications, and IoT systems, has led to an explosion of data being generated, stored, and transmitted. While 5G has significantly improved connectivity and data transfer speeds, the complexity and frequency of cyber threats have also grown.



The need for enhanced cloud security has never been more urgent. With businesses relying heavily on cloud-based platforms to manage everything from customer data to operational processes, the risk of cyberattacks, data breaches, and unauthorized access has increased dramatically. Traditional perimeter-based security models, which once worked effectively, now fall short in the face of sophisticated, decentralized threats. The interconnectedness of devices and systems has expanded the attack surface, making security more complex and dynamic. Future wireless networks will address these vulnerabilities by embedding security into the very fabric of their architecture, using a multi-layered approach that combines real-time monitoring, intelligent response systems, and secure data handling practices.

One of the key pillars of next-generation network security will be the integration of artificial intelligence and machine learning into threat detection systems. These intelligent technologies will analyze vast amounts of network traffic, recognize anomalies, and respond to threats instantly—often before they can cause harm. By automating many aspects of threat management, AI-driven security solutions will enhance response speed and accuracy, reducing human error and strengthening the overall resilience of cloud environments. These systems will continuously learn from emerging attack patterns, allowing them to adapt and evolve alongside potential threats.

Another breakthrough in future network security lies in the implementation of quantum encryption. As quantum computing becomes more advanced, traditional cryptographic methods could become vulnerable to new types of attacks



In response, next-gen wireless systems will utilize Quantum Key Distribution (QKD), a revolutionary encryption technique that enables secure communication by ensuring that encryption keys cannot be intercepted or altered without detection

This quantum-resistant security layer will be crucial in protecting sensitive data in sectors such as finance, defense, and healthcare, where breaches can have far-reaching consequences.



Despite the promise of stronger cloud security, the path forward is not without challenges. The deployment of next-generation wireless infrastructure involves high implementation costs and regulatory hurdles. Moreover, as technology evolves, so do the threats. Cybercriminals will continue to develop new methods to bypass security systems, necessitating constant vigilance and innovation. Organizations must invest in both technology and training to stay ahead, adopting proactive security strategies that evolve with the threat landscape.

In conclusion, the future of cloud security lies beyond 5G, in a realm where artificial intelligence, quantum encryption, edge computing, and Zero Trust principles converge to create a more intelligent and resilient defense framework. These technologies will empower businesses to secure their data more effectively, prevent breaches, and build digital ecosystems that are as secure as they are efficient. While obstacles remain, the next generation of wireless networks promises not only faster and smarter connectivity—but also a safer, more trusted cloud environment for the digital era.

The Open-Source Revolution in AI: Democratizing the Future of Technology



Rohit Kumar

CSE, 1st Year
Batch : 2024 - 2028

Artificial Intelligence (AI) has emerged as a transformative force across industries, from healthcare to finance, reshaping the way the world operates. Traditionally, AI development has been dominated by proprietary models controlled by a handful of tech giants. These closed systems limited public access, keeping the architecture, training methods, and data concealed. However, a significant shift is underway as open-source AI models gain prominence. Companies like Meta AI, OpenAI, and Mistral are championing this movement, driving innovation and democratizing access to cutting-edge technology. This transformation signals a new era of collaboration, transparency, and accessibility in the AI landscape.

Open-source AI is built on the principles of transparency and collaboration. Unlike proprietary systems that restrict access, open-source models invite developers, researchers, and innovators to explore, critique, and improve their functionalities. This approach fosters a culture of shared progress, ensuring that AI evolves not only as a powerful tool but also as an ethical and inclusive technology. By making models, frameworks, and datasets publicly available, open-source initiatives remove barriers to entry, empowering even small businesses and individual developers to harness AI's potential.



Meta AI has emerged as a leading advocate for open-source AI. Its groundbreaking contributions, such as the Large Language Model Meta AI (Llama), provide researchers and developers with access to high-performance tools while promoting ethical practices. Beyond language models, Meta's efforts extend to frameworks and datasets that enable a wide range of AI applications. By embracing openness, Meta underscores the value of collective innovation, proving that democratized access can accelerate advancements in the field.

OpenAI, a pioneer in the AI domain, has struck a balance between open-source and commercial interests. Initially known for freely accessible models like GPT-2 and GPT-3, OpenAI has since adopted a more commercial approach with its advanced iterations, such as GPT-4. Despite this shift,

OpenAI continues to contribute to the community through research papers, datasets, and AI safety guidelines.

These efforts have inspired numerous open-source projects, highlighting the profound impact of collaborative research on the AI ecosystem. OpenAI's hybrid strategy demonstrates that innovation and accessibility can coexist in meaningful ways.



Mistral, a rising star in the open-source AI arena, has taken a bold approach by fully committing to transparency and accessibility. By focusing on lightweight, efficient AI architectures, Mistral has made advanced AI solutions more attainable for startups and smaller enterprises. This democratization of AI technology challenges the dominance of proprietary giants, proving that cutting-edge innovation can thrive in an open ecosystem. Mistral's emphasis on inclusivity and decentralized collaboration sets a benchmark for the future of AI development.

The growing adoption of open-source AI reflects a broader trend toward inclusivity and community-driven progress. Transparent models reduce biases and enhance trust, ensuring that AI applications are both fair and reliable. The accessibility of these systems removes financial and technical barriers, allowing innovators from diverse backgrounds to participate in shaping the AI landscape. As open-source AI gains momentum, it paves the way for smarter, more equitable technological advancements.

The future of AI will be defined by collaboration, transparency, and accessibility. Open-source initiatives, championed by companies like Meta AI, OpenAI, and Mistral, are democratizing the field, ensuring that the benefits of AI reach everyone—not just a privileged few. As this movement gains traction, it will unlock unprecedented possibilities, driving global progress and making artificial intelligence a shared asset for humanity.

.....

AI in Cyber Threat Detection And Prevention



Anish Debnath
CSE, 2nd Year
Batch : 2023 - 2027

The digital world faces relentless cyber threats, with attackers constantly evolving their tactics. Traditional security systems often struggle to cope with the speed and complexity of these threats. Artificial Intelligence (AI) has emerged as a transformative force in cybersecurity, offering enhanced capabilities to detect and prevent malicious activities. By harnessing the power of AI, organizations can bolster their defences and stay ahead of attackers.

AI's ability to process vast amounts of data and identify patterns is a game-changer in detecting cyber threats. Machine Learning (ML) and Deep Learning (DL) algorithms excel at analyzing network activity, user behavior, and system operations to spot irregularities. Unlike traditional rule-based systems, AI learns from past data to uncover subtle signs of malicious behavior, even when it doesn't follow established attack patterns. For instance, AI can monitor network traffic, flag unusual login attempts, or detect suspicious file modifications, making it a robust tool for anomaly detection.

Behavioral analysis further strengthens AI's role in cybersecurity by profiling users and entities. This allows AI to identify compromised accounts or insider threats by analyzing deviations from normal patterns, such as accessing sensitive data from unusual locations or at odd hours. Similarly, in malware detection, AI leverages its ability to learn from vast malware databases, identifying even zero-day threats through patterns in code behavior and file characteristics.



AI is not limited to identifying threats; it also plays a proactive role in preventing cyberattacks. Predictive security leverages AI to analyze threat intelligence feeds and historical attack data, allowing organizations to anticipate vulnerabilities and preemptively strengthen defences. Automated responses driven by AI further enhance security by isolating compromised systems, blocking malicious traffic, and alerting security teams in real time. These capabilities significantly reduce response times, limiting the potential damage caused by breaches.

AI also aids in vulnerability management by analyzing code, configurations, and systems to identify weak points. It can prioritize these vulnerabilities based on risk, ensuring critical flaws are addressed promptly. This proactive approach minimizes the attack surface and reduces the likelihood of successful intrusions.

Despite its advantages, AI is not a standalone solution. Effective cybersecurity requires a layered approach, combining AI tools with human expertise and traditional methods. However, AI empowers security teams by automating repetitive tasks, providing actionable insights, and enabling faster decision-making. As attackers adopt increasingly sophisticated techniques, AI's role in safeguarding digital infrastructure becomes indispensable.



In conclusion, AI is revolutionizing cyber threat detection and prevention, making it possible to tackle evolving threats with greater precision and efficiency. By enabling proactive measures, real-time responses, and enhanced vulnerability management, AI is shaping a more secure digital future. As technology continues to advance, the integration of AI in cybersecurity will be pivotal in staying one step ahead of cybercriminals and safeguarding critical digital assets.

.....

THE EVOLUTION OF DEEPFAKE-DRIVEN CYBERCRIME

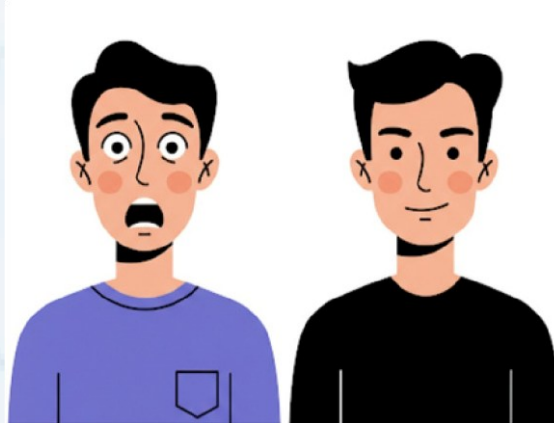


Sayon Biswas
CSE , 1st Year
Batch : 2024-2028

In an era where seeing is no longer believing, deepfake technology has emerged as one of the most sophisticated—and dangerous—tools in the cybercriminal arsenal. Leveraging artificial intelligence (AI) and machine learning, deepfakes generate hyper-realistic audio, video, and images that can impersonate public figures, manipulate events, and fabricate evidence. While the technology holds promise for creative industries, its misuse has escalated cybercrime to unprecedented levels, threatening individual privacy, corporate security, and democratic institutions. This article examines the mechanics of deepfake technology, its exploitation in cybercrime, and the urgent need for countermeasures.

What Are Deepfakes?

Deepfakes are synthetic media created using generative adversarial networks (GANs), a class of AI algorithms. GANs pit two neural networks against each other: a generator that produces fake content and a discriminator that attempts to detect its authenticity. Through iterative training, the generator learns to create outputs nearly indistinguishable from reality. Originally popularized for entertainment (e.g., swapping actors' faces in films), deepfakes now enable malicious actors to clone voices, forge videos, and fabricate identities with alarming precision.



Cybercriminals have weaponized deepfakes to bypass traditional security measures and exploit human psychology. Key applications include:

Phishing and Social Engineering

Deepfakes enable spear phishing attacks where criminals impersonate CEOs, government officials, or trusted contacts via synthetic video calls or voice messages. In 2019, a UK energy firm lost \$243,000 after attackers used AI-generated audio to mimic a CEO's voice and authorize fraudulent transactions.

Identity Theft and Fraud

Fraudsters use deepfakes to bypass biometric authentication systems (e.g., facial recognition) or create fake IDs for financial scams. For instance, synthetic profiles on social media can lure victims into investment schemes or romance scams.

In 2023, a multinational corporation faced a reputational crisis when a deepfake video of its CEO admitting to unethical practices went viral. Despite swift debunking, the company's stock plummeted by 15%, highlighting how synthetic media can erode stakeholder trust and market stability.

The Psychological Edge: Why Deepfakes WorkPAGE 2

Deepfakes exploit cognitive biases, particularly the human tendency to trust audiovisual evidence. Studies show that even tech-savvy individuals struggle to identify high-quality deepfakes, with detection rates below 50%. This “reality apathy” creates fertile ground for manipulation.

Combating the Deepfake Epidemic

Addressing deepfake-driven cybercrime requires a multi-pronged approach:

Technological Solutions

Detection Tools: AI-powered platforms like Deepware Scanner and Microsoft Video Authenticator analyze metadata, facial movements, and audio anomalies to flag deepfakes.

Blockchain Verification: Embedding digital watermarks or blockchain timestamps in media can authenticate origin and edits.

Public Awareness

Educational campaigns teaching individuals to scrutinize sources, check for inconsistencies (e.g., unnatural blinking), and verify claims through trusted channels are critical.

Deepfake technology epitomizes the paradox of modern innovation: a tool capable of both awe-inspiring creativity and devastating harm. As cybercriminals refine their tactics, the responsibility falls on policymakers, technologists, and individuals to fortify defenses and preserve digital trust. Proactive investment in detection, legislation, and education will determine whether society can harness AI's potential without succumbing to its darker applications. The battle against deepfake-driven cybercrime is not just technical—it is a fight for truth itself.

The Psychological Edge: Why Deepfakes WorkPAGE 2

Deepfakes exploit cognitive biases, particularly the human tendency to trust audiovisual evidence. Studies show that even tech-savvy individuals struggle to identify high-quality deepfakes, with detection rates below 50%. This “reality apathy” creates fertile ground for manipulation.

Combating the Deepfake Epidemic
Addressing deepfake-driven cybercrime requires a multi-pronged approach:

Technological Solutions

Detection Tools: AI-powered platforms like Deepware Scanner and Microsoft Video Authenticator analyze metadata, facial movements, and audio anomalies to flag deepfakes.

Blockchain Verification: Embedding digital watermarks or blockchain timestamps in media can authenticate origin and edits.

Public Awareness

Educational campaigns teaching individuals to scrutinize sources, check for inconsistencies (e.g., unnatural blinking), and verify claims through trusted channels are critical.

Deepfake technology epitomizes the paradox of modern innovation: a tool capable of both awe-inspiring creativity and devastating harm. As cybercriminals refine their tactics, the responsibility falls on policymakers, technologists, and individuals to fortify defenses and preserve digital trust. Proactive investment in detection, legislation, and education will determine whether society can harness AI's potential without succumbing to its darker applications. The battle against deepfake-driven cybercrime is not just technical—it is a fight for truth itself.

DEEPPFAKE
Oyeno pon of rnel comap: Postlesges of listcootfood
IN CYER CANERAEME

Ideorivily thaploipret
Desent locturion cond the
desent locturion cond the
desent locturion cond the

Identy theplot
Charactarist camen choices
des choices of choice to choice
desent

Disexpurhes Lakovere
Wise a wile desent locturion
desent locturion cond the

Highhedsard
Desent locturion cond the
desent locturion cond the
desent locturion cond the

**Stardislarbure on
Tocerte**
Desent locturion cond the
desent locturion cond the
desent locturion cond the

Oolmuinnabe
Desent locturion cond the
desent locturion cond the
desent locturion cond the

**Orie-er ion i prifed
opuratic amipate**
Desent locturion cond the
desent locturion cond the
desent locturion cond the

Lozem ipsam obr oit atistumt
Desent locturion cond the
desent locturion cond the
desent locturion cond the





Dr. B. C. Roy Engineering College, Durgapur

DEPARTMENT OF COMPUTER SCIENCE AND
ENGINEERING

College Campus/Corporate Officer

Jemua Road, Fuljhore, Durgapur- 713206

Phone No. - 0343-250-1353/2449/3985/3360/4224/4106