India, Asia emerging as global tech powerhouse

The global Information Technology (IT) sector is experiencing an unprecedented wave of inventions and discoveries, with advancements in Artificial Intelligence (AI), the Internet of Things (IoT), quantum computing, 5G technology, and blockchain poised to redefine industries and societies. India and other Asian countries are not just passive recipients of these innovations but are emerging as key players in their implementation and adaptation, driving digital transformation across the continent.

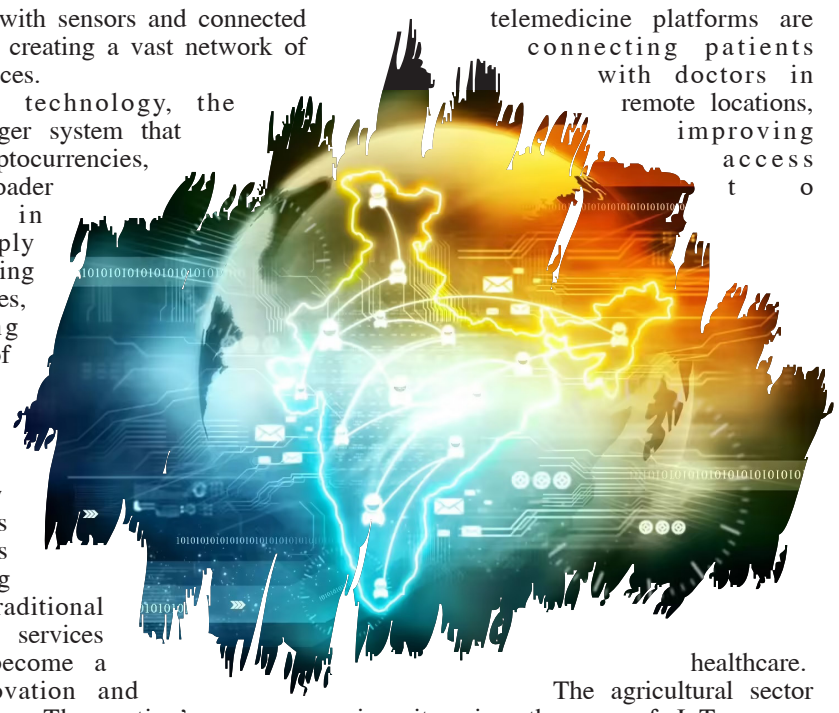
Recent breakthroughs are pushing the boundaries of what's possible in the digital realm. Generative AI has captured the global imagination with its ability to create novel content, from text and images to complex code.

This technology is being rapidly integrated into a wide array of applications, revolutionising content creation, software development, and customer service.

Quantum computing, with its potential for exponential processing power, is moving from theoretical research to practical applications. While still in its nascent stages, its impact on fields like drug discovery, materials science, and complex financial modelling is expected to be transformative. The rollout of 5G networks is another critical development, offering ultra-high-speed connectivity and low latency.

This is a foundational technology that enables a host of other innovations, including the proliferation of the Internet of Things (IoT), where everyday objects are embedded with sensors and connected to the internet, creating a vast network of intelligent devices.

Blockchain technology, the distributed ledger system that underpins cryptocurrencies, is finding broader applications in securing supply chains, verifying digital identities, and ensuring the integrity of data.



India is aggressively adopting these new technologies across various sectors, moving beyond its traditional role as an IT services provider to become a hub for innovation and implementation. The nation's Global Capability Centres (GCCs) are increasingly at the heart of this transformation, with multinational corporations leveraging Indian talent for cutting-edge research and development.

In the healthcare sector, AI-powered diagnostic tools are helping in the early detection of diseases in rural areas. The Aarogya Setu app, a COVID-19 tracking tool, demonstrated the potential of mobile technology in public health. Furthermore, telemedicine platforms are connecting patients with doctors in remote locations, improving access to healthcare.

The agricultural sector is witnessing the use of IoT sensors and drones for crop monitoring, soil analysis, and precision irrigation, leading to increased yields and resource optimisation.

AI-based platforms are also providing farmers with real-time advice on crop management and market prices.

Fintech continues to be a major success story, with the Unified Payments Interface (UPI) revolutionising digital payments. Indian fintech startups are leveraging AI and blockchain to offer innovative solutions in lending, insurance, and wealth management.

The Indian Government's Digital India initiative is a key driver of this technological adoption, with a focus on creating a robust digital infrastructure and promoting e-governance services. Across Asia, nations are harnessing the power of new IT inventions to address unique challenges and create new opportunities.

Singapore, with its "Smart Nation" initiative, is a living laboratory for the implementation of advanced technologies. The city-state has deployed unmanned retail stores that use AI and IoT for a seamless shopping experience.13 In healthcare, "smart wards" in hospitals utilise sensors and AI to monitor patients and assist medical staff.

Japan, a traditional powerhouse in robotics and automation, continues to lead in the application of these technologies in its manufacturing sector, particularly in the automotive industry. The country is also at the forefront of using robotics to address the challenges of an aging population, with applications in elder care and assisted living. In agriculture, Japan is deploying AI-powered robots for tasks like harvesting and planting to combat labour shortages.

China is making significant strides in the application of blockchain technology for supply chain management, enhancing transparency and traceability of goods. The country is also a global leader in the rollout and adoption of 5G, which is a critical component of its smart city projects, enabling applications like intelligent traffic management and autonomous vehicles.

South Korea is another leader in 5G implementation, leveraging the technology to build hyper-connected smart cities. This includes real-time public transportation updates, smart energy grids and advanced public safety systems.

In Southeast Asia, Indonesia, Malaysia and Vietnam are experiencing a fintech boom, with a rapid increase in the adoption of digital payments and lending platforms. These nations are also focussing on e-governance to improve the delivery of public services and enhance transparency. Vietnam, for instance, has seen significant success in its national public service portal, streamlining

administrative processes for citizens and businesses.

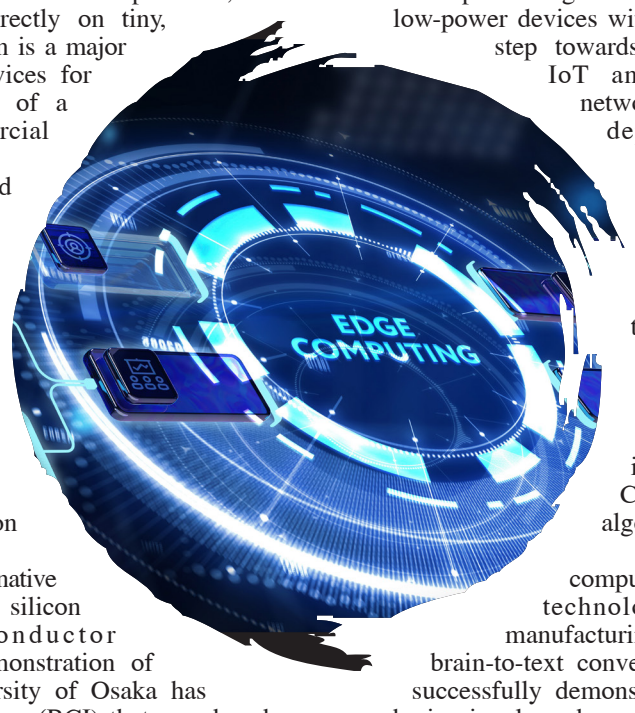
The rapid pace of IT innovation, coupled with the enthusiastic adoption and adaptation by India and other Asian nations, is setting the stage for a new era of economic growth and societal development across the continent. As these technologies mature and converge, their impact is expected to be even more profound, further solidifying Asia's position as a global technology powerhouse.

Quiet neural network for complex AI tasks

Given below are four recent significant developments in the IT sector from the US, China, and Japan:

US: Breakthrough in quiet AI for edge computing at MIT

Researchers at MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL) have developed a new type of "quiet" neural network that can run complex AI tasks on microcontrollers with extremely limited memory (under 256 kilobytes). The breakthrough, detailed in a paper released last month, involves a novel training and pruning technique that significantly reduces the "noise" or unnecessary computational overhead during AI inference. This allows for powerful, real-time AI processing - such as advanced audio analysis and sensor fusion - directly on tiny, low-power devices without needing to send data to the cloud. This innovation is a major step towards creating truly autonomous and intelligent edge devices for IoT and industrial applications, operating independently of a network connection.



China: First commercial deployment of a photonic chiplet

A Shanghai-based startup, in collaboration with the Institute of Computing Technology of the Chinese Academy of Sciences, has announced the first commercial deployment of a photonic chiplet designed for AI acceleration. Unlike traditional electronic chips that use electrons, this chiplet uses photons (light) to perform computations, drastically reducing latency and power consumption for specific AI workloads like deep learning inference. The chiplet is being integrated into the data centers of a major Chinese e-commerce giant to accelerate recommendation algorithms. This move marks a significant step in computing architectures to bypass China's pursuit of alternative technology and reduce reliance bottlenecks in traditional silicon manufacturing. on foreign semiconductor

Japan: Successful demonstration of brain-to-text conversion

A team at the University of Osaka has successfully demonstrated a new brain-computer interface (BCI) that can decode brain signals and convert them into text with over 90% accuracy for patients with severe paralysis. The system, which uses a combination of electrocorticography (ECoG) and a proprietary AI model, does not require the patient to imagine handwriting or speaking. Instead, the AI interprets the high-level neural signals associated with intended communication. The successful trial, published recently, is being hailed as a major advancement in assistive technology, potentially offering a new way for individuals who have lost the ability to speak or move to communicate naturally and efficiently.

US: DARPA's New foundations programme

The US Defence Advanced Research Projects Agency (DARPA) has quietly launched a new programme called Foundations for Next-Generation Computing. The programme's goal is to fundamentally reinvent the concept of abstraction in computer science - the layers of software and hardware that allow complex systems to be built without developers needing to know the intricate details of the underlying components. The current abstraction model is over 50 years old and is seen by DARPA as a major bottleneck for developing secure and efficient next-generation systems, especially for AI and cybersecurity. The multi-million dollar programme is funding several university-led research teams to develop entirely new models for how software interacts with hardware, aiming for a future where systems are provably secure and can self-optimise for performance.

Glass fibres could replace silicon brains

Imagine a computer that does not rely only on electronics but uses light to perform tasks faster and more efficiently. Collaboration between two research teams from Tampere University in Finland and Université Marie et Louis Pasteur in France, have now demonstrated a novel way for processing information using light and optical fibers, opening up the possibility to build ultra-fast computers.

The study performed by postdoctoral researchers Mathilde Hary from Tampere University and Andrei Ermolaev from the Université Marie et Louis Pasteur, Besançon, demonstrated how laser light inside thin glass fibers can mimic the way artificial intelligence (AI) processes information. Their work has investigated a particular class of computing architecture known as an Extreme Learning Machine, an approach inspired by neural networks.

"Instead of using conventional electronics and algorithms, computation is achieved by taking advantage of the nonlinear interaction between intense light pulses and the glass," Hary and Ermolaev explain.

Traditional electronics approaches their limits in terms of bandwidth, data throughput and power consumption. AI models are growing larger, they are more energy-hungry, and electronics can process data only up to a certain speed. Optical fibers on the other hand can transform input signals at speeds thousands of times faster and amplify tiny differences via extreme nonlinear interactions to make them discernable.

In their recent work, the researchers used femtosecond laser pulses (a billion times shorter than a camera flash) and an optical fiber confining light in an area smaller than a fraction of human hair to demonstrate the working principle of an optical ELM system. The pulses are short enough to contain a large number of different wavelengths or colours. By sending those into the fiber with a relative delay encoded according to an image, they show that the resulting spectrum of wavelengths at the output of the fiber transformed by the nonlinear interaction of light and glass contains sufficient information to classify handwritten digits (like those used in the popular MNIST AI benchmark). According to the researchers the best systems reached an accuracy of over 91%, close to the state of art digital methods, in under one picosecond. What is remarkable is that the best results did not occur at maximum level of nonlinear interaction or complexity; but rather from a delicate balance between fiber length, dispersion (the propagation speed difference between different wavelengths) and power levels.

"Performance is not simply matter of pushing more power through the fiber. It depends on how precisely the light is initially structured, in other words how information is encoded, and how it interacts with the fiber properties," says Hary.

By harnessing the potential of light, this research could pave the way towards new ways of computing while exploring routes towards more efficient architectures.

"Our models show how dispersion, nonlinearity and even quantum noise influence performance, providing critical knowledge for designing the next generation of hybrid optical-electronic AI systems," continues Ermolaev.

Both research teams are internationally recognized for their expertise in nonlinear light-matter interactions. Their collaboration brings together theoretical understanding and state-of-the-art experimental capabilities to harness optical nonlinearity for various applications.

"This work demonstrates how fundamental research in nonlinear fiber optics can drive new approaches to computation. By merging physics and machine learning, we are opening new paths toward ultrafast and energy-efficient AI hardware**"** say professors Goëry Genty from Tampere University and John Dudley and Daniel Brunner from the Université Marie et Louis Pasteur, who led the teams.

Light-powered chip makes AI 100 times more efficient

Artificial intelligence (AI) systems are increasingly central to technology, powering everything from facial recognition to language translation. But as AI models grow more complex, they consume vast amounts of electricity -- posing challenges for energy efficiency and sustainability. A new chip developed by researchers at the University of Florida could help address this issue by using light, rather than just electricity, to perform one of AI's most power-hungry tasks.

The chip is designed to carry out convolution operations, a core function in machine learning that enables AI systems to detect patterns in images, video, and text. These operations typically require significant computing power. By integrating optical components directly onto a silicon chip, the researchers have created a system that performs convolutions using laser light and microscopic lenses -- dramatically reducing energy consumption and speeding up processing.

"Performing a key machine learning computation at near zero energy is a leap forward for future AI systems," said study leader Volker J. Sorger, the Rhines Endowed Professor in Semiconductor Photonics at the University of Florida. "This is critical to keep scaling up AI capabilities in years to come."

In tests, the prototype chip classified handwritten digits with about 98 percent accuracy, comparable to traditional electronic chips. The system uses two sets of miniature Fresnel lenses -- flat, ultrathin versions of the lenses found in lighthouses -- fabricated using standard semiconductor manufacturing techniques. These lenses are narrower than a human hair and are etched directly onto the chip.

To perform a convolution, machine learning data is first converted into laser light on the chip. The light passes through the Fresnel lenses, which carry out the mathematical transformation. The result is then converted back into a digital signal to complete the AI task.

"This is the first time anyone has put this type of optical computation on a chip and applied it to an AI neural network," said Hangbo Yang, a research associate professor in Sorger's group at UF and co-author of the study.

The team also demonstrated that the chip could process multiple data streams simultaneously by using lasers of different colors -- a technique known as wavelength multiplexing. "We can have multiple wavelengths, or colors, of light passing through the lens at the same time," Yang said. "That's a key advantage of photonics."

The research was conducted in collaboration with the Florida Semiconductor Institute, UCLA, and George Washington University. Sorger noted that chip manufacturers such as NVIDIA already use optical elements in some parts of their AI systems, which could make it easier to integrate this new technology.

"In the near future, chip-based optics will become a key part of every AI chip we use daily," Sorger said. "And optical AI computing is next."