New, Emerging & Strategic Technologies Division
Ministry of External Affairs
Government of India

TECH PULSE

NEST NEWSLETTER JANUARY 2026

Key Highlights

- *New Imaging Technology Detects Early Signs of Heart Disease Through the Skin*
- *Engineers just created a "phonon laser" that could shrink your next smartphone*
- *NASA's Perseverance Rover Completes First AI-Planned Drive on Mars*
- *International Data Privacy Day - Strengthening confidence in India's evolving digital ecosystem*

➔ *India's Premier Research Institutions – Government, Academic and Private Institutions!*

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ARTIFICIAL INTELLIGENCE

International

1. ***The breakthrough that makes robot faces feel less creepy***

Columbia engineers have taught a robot to learn lip movements by observation, much like a human learning in front of a mirror.

Engineers at Columbia University School of Engineering and Applied Science have developed a humanoid robot that learns realistic lip movements by observing itself and studying human videos, a step that could help robots cross the uncanny valley. Humans focus heavily on lips during conversation, and even small errors in facial motion can make robots seem unsettling. While robotics has advanced in walking and grasping, facial expression has remained a weak point.

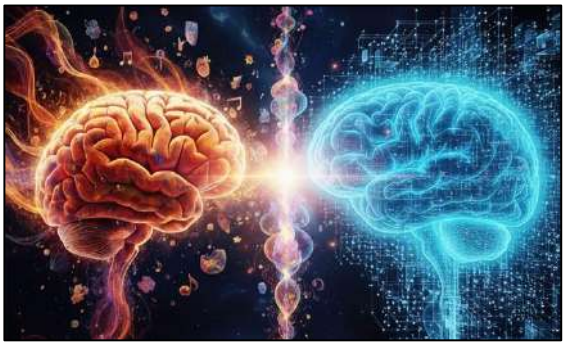
Led by Hod Lipson at Columbia Engineering's Creative Machines Lab, the team created a flexible robotic face powered by 26 small motors. Instead of programming fixed mouth shapes, they allowed the robot to experiment in front of a mirror, generating thousands of random expressions and learning how motor actions shaped its face. This vision to action learning approach helped the machine build an internal model of its own facial mechanics.

After mastering self control, the robot analyzed hours of online videos to connect sounds with corresponding lip shapes. It learned to synchronize speech and singing across multiple languages, even performing songs from its debut album hello world_. Although it still struggles with certain sounds such as B and W, performance improves with continued exposure.

Researchers believe combining this capability with conversational AI systems could deepen human robot interaction. Realistic facial gestures may prove essential as humanoid robots enter education, healthcare, entertainment, and elder care, where emotional connection and trust are critical. Read More

2. ***Researchers tested AI against 100,000 humans on creativity***

AI can beat average human creativity, but the most imaginative minds are still unmistakably human.



A large scale study at the Université de Montréal compared the creative performance of leading generative AI systems with more than 100000 human participants. Published in Scientific Reports, the research represents the most extensive direct comparison of human and AI creativity to date. The findings show that several advanced language models, including GPT 4, can outperform the average human on specific measures of divergent linguistic creativity.

The researchers used the Divergent Association Task to assess creative thinking in both humans and machines. This test asks participants to produce ten words that are as unrelated as possible, measuring the ability to generate diverse and original ideas. Results indicate that some AI systems now exceed average human scores on this task. However, when focusing on the most creative individuals, especially the top 10 percent, humans consistently achieved higher results than any AI model tested.

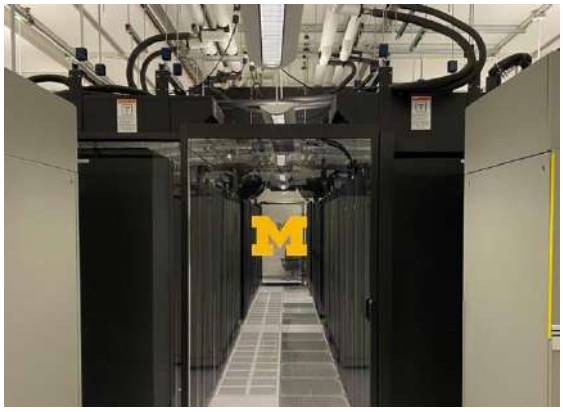
The study also examined more complex creative activities such as writing haiku, generating movie plots, and composing short stories. While AI sometimes matched or surpassed average human output, highly creative individuals continued to demonstrate superior originality and depth.

Researchers found that AI creativity can be adjusted through technical settings such as temperature, which influences how predictable or exploratory responses are. Prompt design also plays a significant role in shaping output. Overall, the findings suggest that AI has reached average human creativity on certain tasks but remains dependent on human guidance and does not surpass the most imaginative minds. Read More

3. *Up to 30% of the power used to train AI is wasted: Here's how to fix it*

Smarter use of processor speeds saves energy without compromising training speed and performance

A study from the University of Michigan reports that up to 30 percent of the energy used to train large language models can be wasted without improving training speed or model performance. The researchers developed a method that reduces energy consumption while maintaining the same training time, offering potential environmental and economic benefits. Based on projections of AI power demand, the approach could save enough electricity to power 1.1 million U.S. homes in 2026 and help reduce the growing carbon and water footprint of data centers.



The inefficiency stems from how AI training is distributed across thousands of GPUs. Because modern AI models are too large to fit on a single processor, they must be divided across many machines. However, it is nearly impossible to divide the workload evenly. Some processors receive heavier computational tasks, while others receive lighter ones. Since current systems run all processors at maximum speed, those with lighter workloads finish early and wait idle for others to complete their tasks. This does not shorten overall training time but consumes unnecessary energy. Additional delays from hardware faults or network issues can worsen the imbalance.

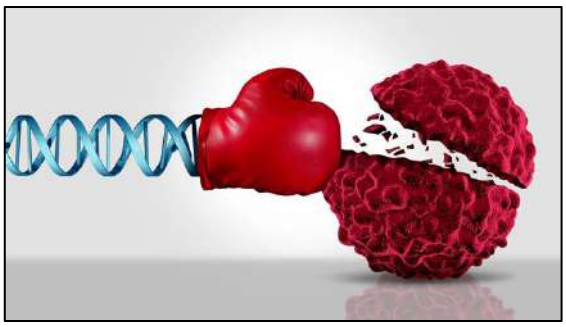
To address this problem, the researchers created Perseus, a software tool that identifies the critical path, or the sequence of tasks that takes the longest to complete. Processors not on this path are slowed so that all finish at roughly the same time, eliminating excess energy use. Tests on GPT 3, other language models, and a computer vision model showed energy savings of up to 30 percent without sacrificing performance. Read More

BIOTECHNOLOGY & HEALTH

International

4. *AI Model Identifies How Every Country Can Improve Its Cancer Outcomes*

Researchers have turned artificial intelligence into a powerful new lens for understanding why cancer survival rates differ so dramatically around the world.



Researchers have used machine learning to identify the health system factors most closely linked to cancer survival across 185 countries. Published in the Annals of Oncology by the European Society for Medical Oncology, the study analyzes global cancer incidence and mortality data alongside national health and economic indicators. The goal was to move beyond broad comparisons and provide country specific guidance on which policy changes could most improve outcomes.

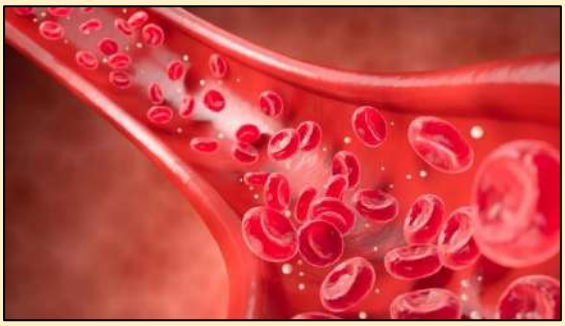
The team combined data from GLOBOCAN 2022 with information from the World Health Organization, World Bank, United Nations agencies, and the Directory of Radiotherapy Centres. Variables included GDP per capita, health spending, workforce density, access to radiotherapy, pathology services, universal health coverage, gender inequality, and out of pocket costs. The model calculated mortality to incidence ratios as a measure of cancer care effectiveness and used SHAP analysis to determine how strongly each factor contributed to national outcomes.

Across countries, access to radiotherapy, universal health coverage, and economic strength were frequently associated with better survival. However, the most influential factors varied by nation. In Brazil, universal health coverage showed the strongest association with improved outcomes. In Poland, radiotherapy availability, GDP per capita, and health coverage were most important. Japan, the United States, and the United Kingdom showed broader links across multiple indicators, while China's results highlighted the ongoing impact of out of pocket costs despite health system expansion.

Although limited by national level data and inability to prove causation, the study offers a data driven framework to help policymakers prioritize investments and reduce global disparities in cancer survival. Read More

5. *New Imaging Technology Detects Early Signs of Heart Disease Through the Skin*

A new imaging technology called fast-RSOM lets researchers see the smallest blood vessels in the body without invasive procedures.



Researchers at Helmholtz Munich and the Technical University of Munich have developed a new non invasive imaging technology called fast RSOM that can detect early signs of cardiovascular disease by visualizing the body's smallest blood

vessels through the skin. The tool identifies subtle impairments in microvascular endothelial function, a condition known as microvascular endothelial dysfunction, which can appear years before symptoms of heart disease develop.

Fast RSOM enables high resolution imaging at the level of single capillaries and individual skin layers. These detailed images reveal dynamic biomarkers linked to early vascular dysfunction. Such changes are often associated with risk factors including smoking, high blood pressure, and obesity. Unlike traditional assessments that estimate cardiovascular risk based on these factors, fast RSOM directly measures the physical effects already present in the microvascular system.

The technology builds on Raster Scan Optoacoustic Mesoscopy, which uses brief pulses of light to generate ultrasound signals and produce three dimensional images beneath the skin. This approach allows detection of small changes in blood vessels, oxygen levels, and tissue composition that conventional imaging methods cannot capture.

Because the system is portable, fast, and non invasive, researchers believe it could eventually be integrated into routine outpatient checkups. The team plans to validate the technology in larger and more diverse patient populations and work toward incorporating its biomarkers into clinical practice. By enabling earlier diagnosis and more precise monitoring, fast RSOM could support earlier interventions and improve long term cardiovascular prevention and management. Read More

6. *Stanford's AI spots hidden disease warnings that show up while you sleep*

Scientists created the first artificial intelligence model that can predict more than 100 health conditions from one night's sleep.

Stanford Medicine researchers have developed an artificial intelligence system called SleepFM that can estimate a person's future risk of more than 100 diseases using data from a single night of sleep. The study, suggests that detailed physiological signals recorded during sleep contain early warning signs of illnesses that may appear years later.

SleepFM was trained on nearly 600000 hours of polysomnography data from 65000 individuals. Polysomnography, considered the gold standard sleep test, records brain activity, heart rhythms, breathing patterns, eye movements, muscle activity, and other signals overnight. Traditionally, only a fraction of this information has been analyzed. The researchers built a foundation model that learns patterns across multiple physiological signals, dividing sleep recordings into five second segments and applying a training method that reconstructs missing data streams to understand how signals interact.

After training, the model was tested on standard sleep assessments and matched or exceeded existing tools. The team then linked sleep data with decades of electronic health records from the Stanford Sleep Medicine Center, enabling long term outcome analysis. SleepFM identified 130 conditions that could be predicted with reasonable accuracy using sleep data alone. Strong predictive performance was observed for Parkinson's disease, dementia, hypertensive heart disease, heart attack, prostate cancer, breast cancer, and mortality.

The findings indicate that mismatches among brain, heart, and breathing signals during sleep may reveal hidden disease risk. Researchers are working to refine the model and improve understanding of how it generates predictions. Read More

7. ***Scientists found a way to regrow cartilage and stop arthritis***

A Stanford Medicine-led study found that blocking a 'gerozyme' reverses cartilage loss in mice and human tissue.

Researchers at Stanford Medicine have identified a treatment that restores aging knee cartilage and prevents osteoarthritis in mice by blocking a protein linked to aging. The study focuses on inhibiting 15-PGDH, an enzyme whose levels increase with age and contribute to tissue decline. In older mice, injections of a small molecule inhibitor reversed cartilage thinning and regenerated healthy hyaline cartilage across joint surfaces. The same treatment also prevented osteoarthritis after knee injuries resembling ACL tears.

Osteoarthritis affects about one in five adults in the United States and currently has no approved drugs that reverse cartilage damage. Existing therapies mainly manage pain or rely on joint replacement surgery. By targeting 15-PGDH, the new approach addresses underlying cartilage loss rather than symptoms. The enzyme breaks down prostaglandin E2, a molecule involved in tissue repair. Blocking 15-PGDH increases prostaglandin E2 levels, promoting regeneration.

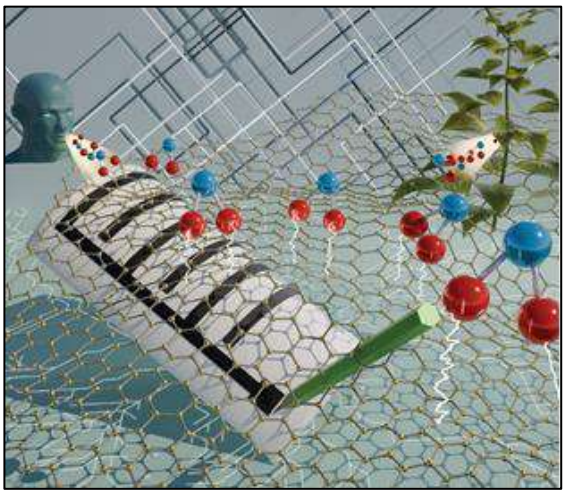
Unlike many regenerative therapies, this method does not rely on stem cells. Instead, it reprograms existing cartilage producing chondrocytes. In treated mice, cells associated with inflammation and cartilage breakdown declined, while those linked to healthy cartilage formation increased significantly. The regenerated tissue showed characteristics of functional articular cartilage rather than scar like fibrocartilage.

Human cartilage samples from knee replacement surgeries also responded to the inhibitor, showing reduced degeneration markers and early signs of regeneration after one week of treatment. An oral version of the drug is already undergoing early clinical testing for age related muscle weakness. Researchers hope similar trials will evaluate its potential to restore cartilage and reduce the need for joint replacement surgery. Read More

National

8. ***Pencil, paper & graphene brought together for sensors useful for hospital and farms***

Flexible and Cost-Effective Graphene-Based Sensor on Paper Substrate Using Pencil IDEs for Multifunctional Applications in Plant and Human Health Monitoring



Researchers at Gauhati University have developed a low cost, flexible sensor made from pencil drawn graphite and graphene oxide on ordinary paper, offering a sustainable alternative to conventional rigid and metal based sensors. The work, led by Dr. Hemen Kumar Kalita and his PhD students Rajnandan Lahkar and Biswajit Dehingia in the Department of Physics, was published in ACS Applied Electronic Materials.

Traditional sensors often rely on expensive metals such as gold or platinum and require complex cleanroom manufacturing processes, limiting their scalability and use in large area applications like agriculture and wearable health monitoring. To address this, the team created a capacitive sensor using interdigitated electrodes drawn directly onto paper with a standard pencil. Graphene oxide acts as the active sensing layer. This simple fabrication method removes the need for costly materials and chemical intensive steps, producing a lightweight, mechanically flexible, and environmentally friendly device suitable for disposable use.

The sensor demonstrated high sensitivity to humidity and moisture, with a response exceeding 1500 percent at high relative humidity. It also showed versatility across multiple applications. Tests confirmed its effectiveness in measuring soil moisture, monitoring plant drought stress through transpiration, tracking human breathing patterns, assessing skin moisture, enabling non-contact proximity sensing, and detecting diaper wetness.

By combining paper substrates, pencil drawn electrodes, and graphene oxide, the study shows that high performance multipurpose sensors can be built using accessible and affordable materials, supporting broader adoption in healthcare and agriculture. Read More

CLEAN ENERGY

International

9. *A breakthrough that turns exhaust CO2 into useful materials*

It converts the captured CO2 into formic acid, which is used in energy and manufacturing. The system even functions at CO2 levels found in normal air..

Scientists have developed a device that captures carbon dioxide and converts it into a useful chemical in one step. The system works with realistic exhaust gases and even at the low carbon dioxide levels found in normal air. This approach could make carbon capture and reuse more practical.

Researchers reported a new electrode that combines carbon capture and conversion into a single process. Instead of separating and purifying carbon dioxide before transforming it, the device captures the gas directly from exhaust streams and converts it into formic acid. Formic acid is widely used in fuel cells and industrial manufacturing, making it a valuable product from waste emissions.

Converting carbon dioxide has been challenging because industrial exhaust contains a mixture of gases such as nitrogen and oxygen. Most existing technologies require concentrated carbon dioxide to function efficiently, limiting their use in

real world conditions. The new system was designed to operate under realistic gas mixtures, including simulated flue gas containing 15 percent carbon dioxide along with oxygen and nitrogen.

The electrode consists of three layers: a carbon dioxide capturing material, a gas permeable carbon paper layer, and a catalytic layer made of tin oxide. This structure allows carbon dioxide to pass through, be captured, and converted into formic acid within the same device.

In laboratory tests with pure carbon dioxide, the electrode achieved about 40 percent higher efficiency than comparable technologies. It also continued producing significant amounts of formic acid under simulated exhaust conditions and at atmospheric carbon dioxide levels. The researchers suggest that this integrated approach could improve industrial carbon reuse and may eventually be adapted to other greenhouse gases. Read More

10. ***China's 'artificial sun' just broke a fusion limit scientists thought was unbreakable***

Researchers using China's 'artificial sun' fusion reactor have broken through a long-standing density barrier in fusion plasma.

Researchers using China's Experimental Advanced Superconducting Tokamak have surpassed a long standing plasma density limit in fusion experiments. The achievement confirms that plasma can remain stable at extremely high densities when interactions with reactor walls are carefully controlled. This advance removes a key barrier that has slowed progress toward fusion ignition.

Scientists working on the Experimental Advanced Superconducting Tokamak reached what theory describes as a density free regime, in which plasma remains stable even when its density exceeds traditional empirical limits. The results, published in Science Advances, challenge decades of assumptions about how tokamak plasmas behave under high density conditions. The research was co led by Ping Zhu of Huazhong University of Science and Technology and Ning Yan of the Hefei Institutes of Physical Science at the Chinese Academy of Sciences.

Fusion energy relies on heating deuterium tritium fuel to about 150 million kelvin. At such temperatures, fusion power increases with the square of plasma density. However, attempts to raise density have typically triggered instabilities that disrupt confinement and halt experiments. These limits have restricted improvements in fusion performance.

A theoretical model known as plasma wall self-organization proposes that density limits arise from interactions between plasma and reactor walls. If this interaction is carefully balanced, a stable high density regime can form. In the EAST experiments, researchers optimized startup conditions by adjusting fuel gas pressure and applying electron cyclotron resonance heating. This reduced impurity buildup and energy losses, allowing density to increase steadily without instability.

The findings suggest a practical pathway to extend density limits in future fusion reactors and bring fusion ignition closer to reality. Read More

11. ***Researchers Build World's Fastest, Low-Cost, Ultraefficient Silicon Carbide Power Module***

The new silicon-carbide-based power module, called ULIS, packs dramatically more power into a smaller, lighter, and cheaper design while wasting far less energy in the process.

Researchers at the National Renewable Energy Laboratory have introduced a compact power module designed to make electricity use far more efficient. Called ULIS, the silicon carbide based device delivers higher power density while reducing energy losses and manufacturing costs. The innovation could help meet rising global electricity demand from data centers, manufacturing, transportation, and future energy systems.

Global electricity demand is increasing rapidly, driven in part by artificial intelligence data centers and expanding industrial activity. Instead of relying solely on new power generation, researchers are focusing on improving how efficiently existing electricity is converted and delivered. ULIS, short for Ultra Low Inductance Smart power module, is designed to address this need.

The 1200 volt, 400 amp module achieves five times the energy density of earlier designs while occupying less space. A key advantage is its extremely low parasitic inductance, which it reduces by seven to nine times compared with advanced silicon carbide modules. Lower inductance allows faster switching and more efficient power conversion, enabling more usable power from the same energy supply.

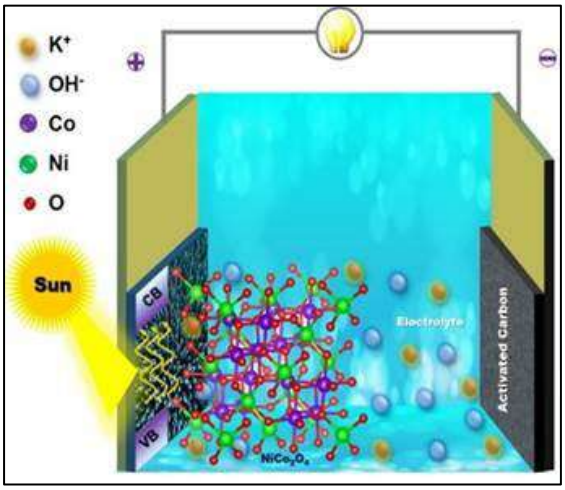
ULIS also features a flat, octagonal layout rather than a traditional stacked design. This structure reduces size and weight while minimizing magnetic interference. It uses a flexible polymer bonded to copper instead of rigid ceramic bases, lowering production costs to the hundreds of dollars. The module can monitor its own condition, anticipate failures, and operate wirelessly.

Designed for demanding environments such as aviation, military systems, data centers, and future fusion applications, ULIS is adaptable to emerging semiconductor materials. The technology is now available for licensing. Read More

National

12. *Indian scientists developed a self-charging energy storage device powered by sunlight*

Scientists have developed a sunlight powered supercapacitor that can both capture and store solar energy in a single device.



The innovation simplifies traditional solar systems and reduces energy loss, cost, and device size. It could support clean, self sustaining power solutions for portable and off grid technologies.

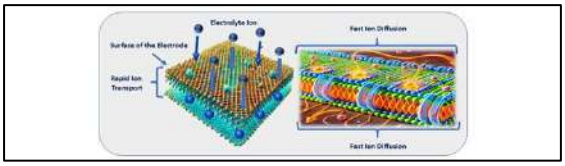
Researchers at the Centre for Nano and Soft Matter Sciences in Bengaluru created a photo rechargeable supercapacitor that integrates solar energy harvesting and storage into one architecture. Conventional solar systems use separate panels and storage units, requiring additional power management components that increase complexity and reduce efficiency. The new device eliminates this separation by directly converting sunlight into electrical energy and storing it for later use.

Under the guidance of Dr Kavita Pandey, the team developed binder free nickel cobalt oxide nanowires grown on nickel foam through an in situ hydrothermal process. The nanowires form a porous and conductive three dimensional network that absorbs sunlight and stores charge simultaneously. When illuminated, the electrode showed a 54 percent increase in capacitance, rising from 570 to 880 millifarads per square centimeter at a current density of 15 milliamperes per square centimeter. It retained 85 percent of its original capacity after 10000 charge discharge cycles.

An asymmetric device using activated carbon as the negative electrode delivered 1.2 volts and maintained 88 percent capacitance after 1000 photo charging cycles under varying light conditions. Theoretical analysis showed that nickel substitution narrows the band gap and creates spin dependent conductivity, improving charge transport. The study demonstrates a new approach to integrated, light responsive energy storage systems. Read More

13. ***Novel supercapacitors with dual-functional porous graphene can provide EV with faster acceleration***

Researchers in India have developed a high voltage supercapacitor using a dual functional porous graphene carbon nanocomposite electrode.



Scientists at the International Advanced Research Centre for Powder Metallurgy and New Materials created the supercapacitor to overcome voltage and safety limitations of traditional electrolytes, which tend to decompose or pose flammability risks above 3.0 volts. By engineering a porous graphene carbon nanocomposite electrode, they achieved stable operation at 3.4 volts while significantly enhancing energy storage performance. It offers higher energy density, improved stability, and potential benefits for electric vehicles and renewable energy applications.

The improved results stem from the material's dual functional surface, which is both water repellent and highly compatible with organic electrolytes. This design limits water induced degradation and enables faster electrolyte penetration into the porous structure, improving ion transport and electrochemical efficiency. The device delivers 33 percent higher energy storage, a power density of up to 17000 watts per kilogram, and retains 96 percent of its performance after 15000 charge discharge cycles.

The electrodes are produced through an eco friendly hydrothermal carbonization process using 1,2 propanediol at 300 degrees Celsius for 25 hours. The method avoids harsh chemicals and external gases, achieves yields above 20 percent, and can be scaled for industrial production.

The higher operating voltage reduces the need to stack multiple low voltage cells, enabling more compact modules. The technology may enhance electric vehicle range and acceleration while supporting grid storage and portable electronics. Read More

QUANTUM & PHOTONICS

International

14. *A breakthrough that could make ships nearly unsinkable*

More than a century after the Titanic, the dream of unsinkable ships is still alive, and scientists may be closer than ever.

Researchers at the University of Rochester have developed aluminum tubes that remain buoyant even when submerged for long periods or heavily damaged. By engineering the metal surface to repel water, the tubes trap air inside and resist sinking. The approach could eventually support unsinkable ships, floating platforms, and wave powered energy systems.

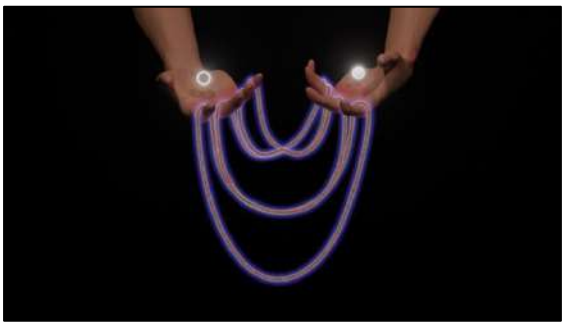
The research team modified the interior surfaces of ordinary aluminum tubes by etching microscopic and nanoscale textures. This process makes the surface superhydrophobic, meaning it strongly repels water. When placed underwater, the treated tubes trap a stable pocket of air inside. The trapped air prevents water from filling the tube, maintaining buoyancy even if the tube is punctured with multiple holes.

To improve stability, the team added a divider inside each tube. This ensures that air remains trapped even if the tube is pushed vertically into water. Unlike earlier disk based designs demonstrated in 2019, which could lose buoyancy at extreme angles, the new tube structure offers greater durability and stability in rough conditions. Tests conducted over several weeks showed no loss of floating ability, even after significant physical damage.

The researchers also connected multiple tubes to form rafts capable of supporting heavier loads. Laboratory experiments included tubes nearly half a meter long, and the design is considered scalable to larger sizes. In addition to marine transport and floating infrastructure, the team demonstrated that tube based rafts can harness energy from moving water, suggesting possible applications in wave driven renewable energy systems. Read More

15. *Researchers unlocked a new shortcut to quantum materials*

By tapping into a material's own quantum energy, scientists have found a safer way to transform matter.



Researchers led by the Okinawa Institute of Science and Technology Graduate University and Stanford University demonstrated a new approach to Floquet engineering, a technique that uses repeating influences such as light to temporarily alter how electrons behave inside a material. Traditionally, achieving these effects required extremely intense light, which often damaged materials while producing limited results.

The new method relies on excitons, short lived electron hole pairs that naturally form inside semiconductors. Because excitons originate from the material's own electrons, they interact more strongly with the crystal structure than external photons. This stronger coupling allows researchers to induce significant changes in electronic band structures using much lower light intensities.

Using time and angle resolved photoemission spectroscopy, the team compared conventional light driven Floquet effects with exciton driven effects in an atomically thin semiconductor. While observing light induced changes required many hours of data collection, excitonic Floquet effects appeared more quickly and with greater strength, even when the light intensity was reduced by more than an order of magnitude.

The findings show that periodic quantum effects can be driven by internal quasiparticles rather than powerful lasers. This approach broadens the tools available for engineering quantum materials and may support the development of more practical and durable quantum technologies. Read More

16. *Unbreakable? Researchers warn quantum computers have serious security flaws*

The study reveals that weaknesses can exist not only in software, but deep within the physical hardware itself, where valuable algorithms and sensitive data may be exposed.

Quantum computers promise major advances in science and industry, but new research warns they also face serious security weaknesses. A study from Penn State highlights vulnerabilities not only in software but also deep within quantum hardware. Researchers argue that protecting these systems will require safeguards at every level of their design.

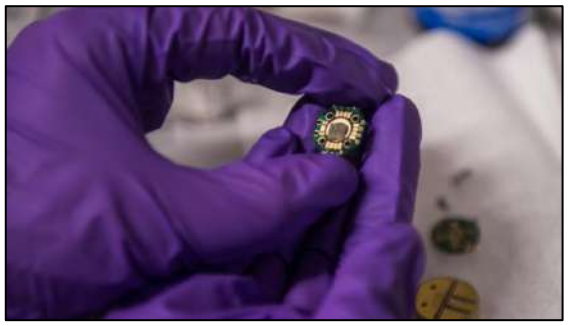
Quantum computers differ from traditional machines because they use qubits instead of bits. While classical bits represent either zero or one, qubits can exist in superposition and can be entangled with one another. These properties allow quantum systems to process vast amounts of information simultaneously, enabling applications such as drug discovery and advanced analytics. However, the same features that give quantum computers their power also introduce new security risks.

According to the study, there is currently no efficient method to verify the integrity of quantum programs and compilers, many of which are developed by third parties. Sensitive corporate algorithms and client data are often embedded directly into quantum circuits. If attackers gain access to these circuits, they could extract intellectual property or confidential information. In addition, unintended interactions between qubits, known as crosstalk, may leak information or disrupt computations, especially when multiple users share the same processor.

The researchers emphasize that classical security techniques cannot simply be applied to quantum systems. They recommend device level protections to reduce noise and crosstalk, circuit level methods such as scrambling and encoding, and system level compartmentalization of data. New software tools are also needed to detect and defend against emerging quantum specific threats. Read More

17. When will quantum technologies become part of everyday life?

Functional quantum systems now exist, but scaling them into truly powerful machines will require major advances in engineering and manufacturing. By comparing different quantum platforms, the study reveals both impressive progress and steep challenges ahead.



In a paper published in Science, an international team led by the University of Chicago evaluated the current state of quantum information hardware. Over the past decade, quantum systems have evolved from laboratory demonstrations to early applications in computing, communication, and sensing. This progress has been driven by collaboration among universities, government agencies, and industry.

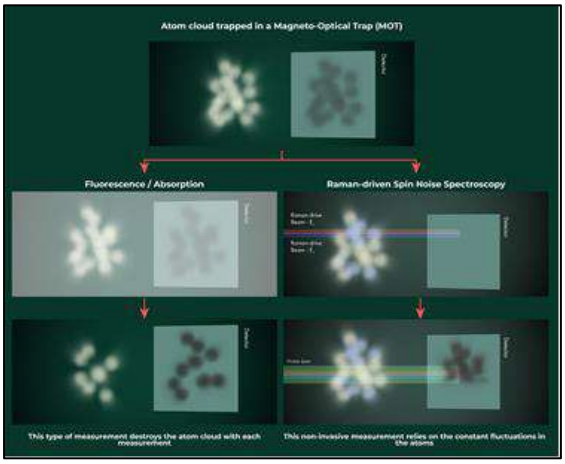
The study compared six leading hardware platforms: superconducting qubits, trapped ions, spin defects, semiconductor quantum dots, neutral atoms, and optical photonic qubits. Using technology readiness levels as a benchmark, the researchers assessed how mature each platform is across computing, simulation, networking, and sensing. Superconducting qubits ranked highest for computing, neutral atoms for simulation, photonic qubits for networking, and spin defects for sensing. However, even the most advanced systems remain limited in performance.

Many future applications, such as large scale quantum chemistry simulations, may require millions of physical qubits with far lower error rates than current devices can achieve. Scaling challenges include improving materials and fabrication, managing wiring and signal delivery, and addressing power, temperature, and calibration issues. The authors emphasize that, like classical electronics, quantum technology may take years or decades to reach its full potential, requiring sustained engineering and realistic expectations. Read More

National

18. Non-invasive way to feel density of atoms can provide a new window into the Quantum World

Real-time local density probe for cold atoms utilizing Raman driven spin noise spectroscopy



Scientists have developed a non invasive method to measure the local density of cold atoms in real time without significantly disturbing them. The technique offers high spatial and temporal resolution and could support advances in quantum computing and quantum sensing. It enables precise measurements that were difficult with conventional imaging methods.

In traditional cold atom experiments, atoms are cooled close to absolute zero to reveal their quantum properties. Detecting their quantum state typically relies on absorption

or fluorescence imaging. However, absorption imaging struggles with dense atomic clouds, while fluorescence imaging requires longer exposure times and can disturb or alter the atomic state.

Researchers at the Raman Research Institute introduced Raman Driven Spin Noise Spectroscopy, which combines spin noise spectroscopy with two additional laser beams that coherently drive atoms between adjacent spin states. The method detects natural spin fluctuations by measuring polarization changes in a laser beam passing through the sample. The added Raman beams amplify the signal by nearly a million times.

The probe focuses on a tiny volume of about 0.01 cubic millimeters, targeting roughly 10000 atoms and providing a direct measure of local density rather than total atom number. In experiments with potassium atoms in a magneto optical trap, the team found that central density saturation occurred faster than changes in total atom count measured by fluorescence.

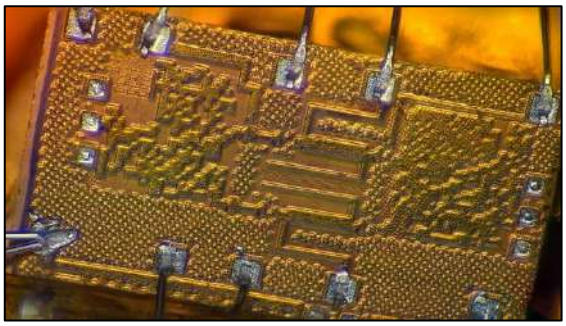
The technique operates with low power and far detuned light, enabling accurate microsecond scale measurements with minimal disturbance. It can function even in asymmetric or dynamically evolving clouds. The approach may benefit quantum sensing devices and studies of many body dynamics, transport phenomena, and non equilibrium systems. Read More

SEMICONDUCTORS

International

19. *AI slashes cost and time for chip design, but that is not all*

Humans cannot really understand the designs, but they improve performance and efficiency



Researchers have used artificial intelligence to dramatically reduce the time and cost required to design advanced wireless microchips. The system can generate complex electromagnetic structures and circuits in hours rather than weeks. It also produces unconventional designs that often outperform traditional human engineered chips.

In a study published in Nature Communications, scientists from Princeton Engineering and the Indian Institute of Technology described an AI driven method that automatically creates intricate electromagnetic structures based on specified design goals. Wireless chips combine electronic circuits with elements such as antennas, resonators, and signal splitters. Designing these systems is highly complex and typically involves careful manual integration of components, a process that becomes increasingly difficult as performance demands grow.

The AI approaches chip design as a unified artifact rather than assembling it piece by piece. This enables exploration of an enormous design space that exceeds what human designers can practically consider. The resulting layouts often appear irregular or unintuitive, yet they frequently achieve

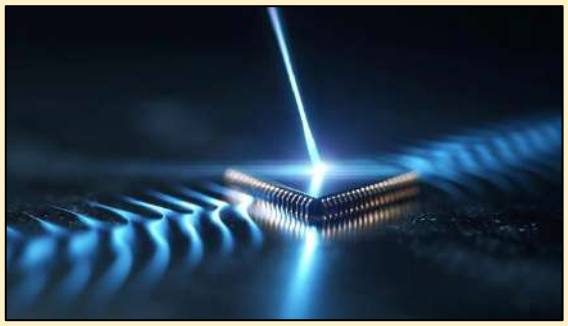
superior energy efficiency, broader frequency operation, and performance levels previously unattainable with conventional techniques. In some cases, the AI can generate structures that traditional algorithms cannot synthesize.

Although the system accelerates electromagnetic simulations and expands design possibilities, human oversight remains essential. The AI can produce flawed configurations, requiring expert correction and validation. Researchers emphasize that the goal is not to replace engineers but to enhance productivity by automating time consuming tasks.

The team has already demonstrated broadband amplifier designs and plans to extend the method to full wireless chip systems. Read More

20. Engineers just created a 'phonon laser' that could shrink your next smartphone

Engineers have created a device that generates incredibly tiny, earthquake-like vibrations on a microchip and it could transform future electronics



Engineers have developed a phonon laser that generates tiny surface vibrations on a microchip, potentially transforming wireless electronics. The single chip device can produce high frequency surface acoustic waves using less power than conventional systems. It may enable smaller, faster, and more energy efficient smartphones and wireless technologies.

The research, led by the University of Colorado Boulder, focuses on surface acoustic waves, or SAWs, which travel along the surface of materials. These waves already play a critical role in smartphones, GPS receivers, radar systems, and other wireless devices by filtering and processing radio signals. Current SAW systems typically require multiple chips and external power sources.

The new phonon laser integrates wave generation into a single chip. Unlike optical lasers that emit light, this device produces controlled mechanical vibrations. It consists of layered materials including silicon, lithium niobate, and indium gallium arsenide. Lithium niobate converts vibrations into electric fields and vice versa, while indium gallium arsenide supports fast moving electrons that amplify the surface waves.

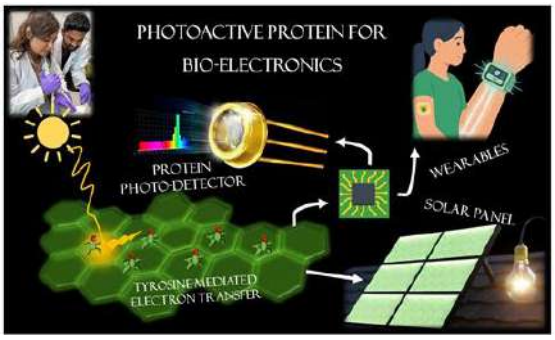
When electric current flows through the device, vibrations form and reflect within the structure, similar to light bouncing between mirrors in a conventional laser. Each pass strengthens the forward moving wave until a portion exits the chip.

The system has already achieved vibrations at about 1 gigahertz, with potential to reach tens or hundreds of gigahertz. This exceeds the typical limits of traditional SAW devices and could allow entire radio systems to be integrated onto a single compact chip. Read More

National

21. Photoactive natural protein could reshape the future of electronic materials

Scientists have discovered that a naturally occurring bacterial shell protein can function as a light responsive semiconductor.



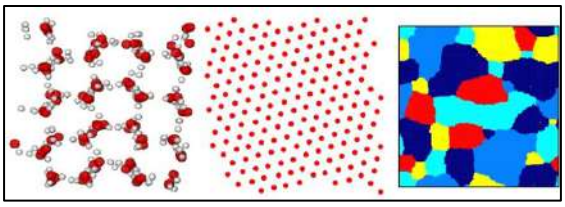
Researchers at the Institute of Nano Science and Technology in Mohali investigated self assembling bacterial shell proteins that naturally form stable two dimensional sheets. Led by Dr Sharmistha Sinha, the team found that these ordered protein films exhibit intrinsic photoactivity. When exposed to ultraviolet light, the sheets generate electrical signals, behaving like light driven semiconductors.

The effect arises from the protein's internal structure. The sheets contain tyrosine residues, amino acids that release electrons when excited by light. As electrons and protons move across the organized protein surface, an electrical current is produced. This process does not require dyes, synthetic additives, high temperature processing, or external power sources. Experiments confirmed that the semiconducting behavior depends on the precise arrangement of the protein sheets. Disordered or unfolded proteins containing tyrosine did not show the same effect.

Because the material is flexible and biocompatible, it could be used in wearable health monitors, ultraviolet detection patches, implantable medical sensors, and disposable environmental devices. The approach offers a low energy, genetically tunable pathway for creating light sensitive electronic materials. The study, published in Chemical Science, represents progress toward bio inspired electronics designed for sustainability and reduced electronic waste.
Read More

22. *Supercomputer simulation of ice formation gives evidence of paradoxical phenomenon of water*

Understanding why hot water can freeze faster than cold water, a phenomenon known as the Mpemba effect is important for gaining deeper insights into systems far from equilibrium.



Scientists have used supercomputer simulations to demonstrate the Mpemba effect in water, the counterintuitive phenomenon in which hot water can freeze faster than colder water. The study provides the first detailed computational evidence of this effect in ice formation. It offers new insight into out of equilibrium physics and may inform improved cooling strategies in advanced technologies.

The Mpemba effect, first noted by Aristotle and later rediscovered by Erasto Mpemba, has long puzzled researchers. Although experimental observations have suggested that hotter water can sometimes freeze more quickly than colder water, the mechanism behind the phenomenon has remained unclear. Water simulations are computationally demanding, and until now no detailed simulation had resolved the debate.

Researchers at the Jawaharlal Nehru Centre for Advanced Scientific Research used supercomputers to model ice formation and capture the effect. Their simulations showed that as water cools, it can become trapped in intermediate molecular arrangements before ice nucleation begins. These transient states delay freezing.

The study found that water starting at different initial temperatures can spend different amounts of time in these intermediate states. In some cases, hotter water avoids longer delays and reaches the nucleation stage more quickly than colder water. The researchers also demonstrated that similar behavior can occur in other fluid to solid transitions.

The findings provide new understanding of relaxation processes following sudden temperature changes and contribute to the broader study of nonequilibrium phenomena. Read More

SPACE & DEFENCE

International

23. NASA's Perseverance Rover Completes First AI-Planned Drive on Mars

AI analyzed the images and terrain data normally used by rover planners, identified hazards like rocks and sand ripples, and charted a safe path across the Martian surface.

NASA's Perseverance rover has completed the first drives on Mars planned entirely by artificial intelligence. A vision enabled AI system analyzed terrain images, selected safe waypoints, and generated routes without human planners. After extensive testing, the rover successfully followed the AI generated paths, traveling hundreds of feet autonomously.

The milestone demonstration was led by NASA's Jet Propulsion Laboratory in Southern California. Traditionally, rover routes are carefully designed by human operators on Earth because communication delays make real time control impossible. Engineers typically analyze orbital images and terrain data, then create waypoint based paths that the rover executes independently.

For this test, a generative AI system based on vision language models examined the same high resolution orbital images and digital elevation data used by human planners. The AI identified hazards such as rocks, boulders, and sand ripples, then mapped a continuous safe driving path. The generated commands were first validated using a digital twin of the rover that evaluated more than 500000 telemetry variables to ensure safety.

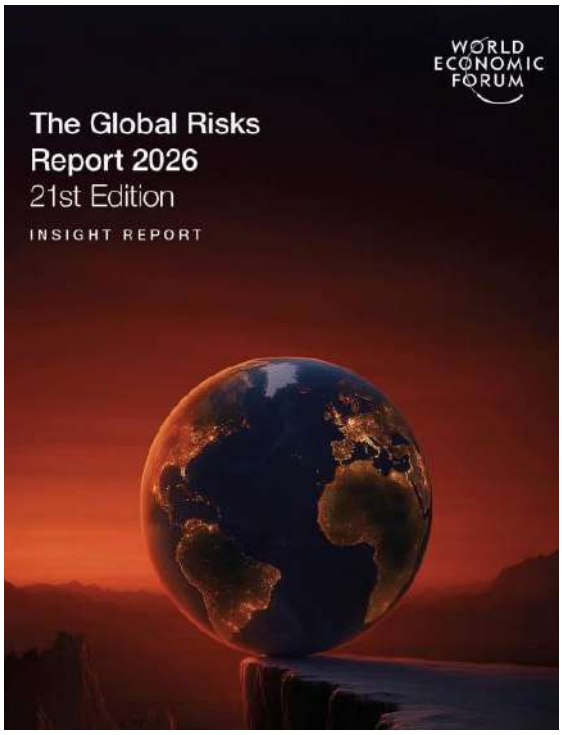
On two separate Martian days in December, Perseverance drove 689 feet and 807 feet using AI planned routes. The success suggests that future missions could rely more heavily on onboard intelligent systems to reduce operator workload and handle longer, more complex traverses.

The achievement marks progress toward more autonomous robotic exploration, particularly for missions operating far from Earth where communication delays limit human involvement. Read More

REPORTS/POLICY DOCUMENTS

International

24. WEF - Global Risks Report 2026



The Global Risks Report 2026 marks the 21st edition of the annual assessment of major global threats and signals the midpoint of a turbulent decade. The report evaluates risks across three time horizons to help decision makers balance urgent crises with longer term strategic priorities. Drawing on insights from more than 1300 experts worldwide through the Global Risks Perception Survey, it compares how the risk landscape evolves from the immediate term to the next decade.

Chapter 1 presents survey findings for three periods: the current or immediate term in 2026, the short to medium term through 2028, and the long term through 2036. The results highlight shifting priorities as acute pressures intersect with structural challenges. Immediate risks reflect ongoing geopolitical, economic, environmental, and technological tensions. Over the short to medium term, concerns broaden to include systemic vulnerabilities and the compounding effects of unresolved crises. In the long term, respondents anticipate deeper structural transformations and escalating global pressures that could reshape economies and societies.

Chapter 2 examines the implications and interconnections of these risks through six thematic analyses. It emphasizes that global threats rarely occur in isolation and instead interact across domains, amplifying impacts. By comparing perceptions across time horizons, the report underscores the need for coordinated action that addresses both near term instability and long term resilience.

Overall, the report provides a structured framework for understanding evolving global risks and supports more informed, forward looking decision making. Download Report

National

25. Office of Principal Scientific Adviser Releases White Paper on Strengthening AI Governance Through Techno-Legal Framework

The Office of the Principal Scientific Adviser to the Government of India has released a White Paper titled Strengthening AI Governance Through Techno Legal Framework. The document outlines India's strategy for building a trusted, accountable, and innovation aligned artificial intelligence ecosystem. It proposes a governance model that balances risk mitigation with flexibility and technological progress.

The White Paper introduces a techno legal approach to AI governance, which embeds legal, technical, and institutional safeguards directly into the design and operation of AI

systems. Rather than relying solely on regulation after deployment, the framework integrates baseline legal protections, sector specific rules, technical controls, and institutional oversight throughout the AI lifecycle.

According to Principal Scientific Adviser Prof Ajay Kumar Sood, this approach is essential for sustaining technological advancement while ensuring accountability and safety.

Key focus areas include defining the contours of techno legal governance, enabling safe and trusted AI systems, identifying technological pathways for implementation, and developing compliance tools suited to India's context. The framework emphasizes governance by design, ensuring safeguards are built into systems by default.

This publication is the second in a White Paper Series on Emerging Policy Priorities for India's AI Ecosystem. The first paper, released in December 2025, addressed democratising access to AI infrastructure as a shared national resource. Together, the documents aim to inform policy discussions and strengthen India's role in shaping global AI governance. Download Report

TECHNOLOGY ENGAGEMENTS/NEWS BYTES

International

26. Apple Acquires Israeli AI Startup Q.ai to Strengthen Audio and Hardware AI Capabilities

Apple has acquired Israeli AI startup Q.ai in a deal reportedly valued between 1.6 and 2 billion dollars. The acquisition strengthens Apple's hardware focused AI strategy, particularly in audio intelligence, sensor driven interaction, and on device processing for products such as AirPods and Vision Pro. The move highlights Apple's emphasis on tightly integrated, privacy preserving AI embedded directly into consumer devices.

Q.ai specialized in imaging and machine learning systems that interpret whispered speech, isolate voices, and enhance clarity in noisy environments. These capabilities align with recent AirPods features such as live translation and adaptive noise control. The company also developed technology to analyze facial skin micromovements to infer mouthed or softly spoken words and detect physiological signals including heart

rate and respiration, expanding its relevance to multimodal sensing.

The acquisition, announced on January 29, 2026, is one of Apple's largest to date and stands out given the company's preference for smaller targeted deals. Q.ai employs about 100 people, and its entire team, including CEO Aviad Maizels, will join Apple. Maizels previously founded PrimeSense, whose depth sensing technology became foundational to Face ID.

The deal comes as Apple faces pressure to advance its AI capabilities while maintaining its hardware centric approach. In parallel with partnerships for external models, Apple is investing heavily in embedded AI that enhances human computer interaction. The acquisition signals continued focus on integrating advanced sensing and intelligence directly into next generation consumer devices. Read More

27. *IMF Chief Warns of AI Shock to Entry Level Jobs: What the Data Actually Shows*

IMF Managing Director Kristalina Georgieva has warned that artificial intelligence is reshaping labor markets at unprecedented speed, with entry level jobs particularly exposed. Speaking at the World Economic Forum in Davos, she described AI as a tsunami hitting the labor market. IMF analysis suggests that about 60 percent of jobs in advanced economies and 40 percent globally could be affected through transformation, enhancement, or elimination. While AI may boost global growth by an estimated 0.8 percent, the benefits and disruptions are uneven.

Research cited by the IMF indicates that routine and principle based tasks, common in junior roles, face the highest exposure to automation. In regions with strong demand for AI skills, employment in highly exposed occupations has declined, with some studies showing a 3.6 percent drop over five years. At the same time, roughly one in ten jobs in advanced economies now requires AI related skills, reflecting growing demand for technical and analytical capabilities.

Additional evidence highlights hiring slowdowns for young workers. In the United Kingdom, entry level vacancies fell by nearly 32 percent between late 2022 and mid 2025. A U.S. study found a 13 percent relative decline in employment among early career workers in highly AI exposed occupations. Corporate restructuring announcements have also cited AI adoption as a contributing factor.

The data suggest that AI is accelerating skill polarization, increasing demand for higher order skills while reducing opportunities in routine entry level roles. Read More

28. *NVIDIA Launches Earth-2, an Open AI Stack for Weather Forecasting*

NVIDIA has launched Earth-2, described as the first fully open, GPU accelerated AI stack for weather and climate forecasting.

The platform provides an end to end suite of pretrained models, tools, and developer frameworks that support forecasts from minute scale local nowcasting to 15 day global predictions. By shifting workloads from traditional CPU based supercomputers to GPUs, Earth-2 reduces compute time and costs, expanding access to advanced forecasting.

Earth-2 Medium Range delivers forecasts up to 15 days ahead across more than 70 atmospheric variables, including temperature, wind, humidity, and pressure. Built on NVIDIA's Atlas architecture, it is designed to outperform leading open models on standard forecasting benchmarks. Earth-2 Nowcasting, based on the StormScope generative AI architecture, produces zero to six hour forecasts at kilometer resolution, directly predicting satellite and radar imagery for storm and precipitation events. Another component, Global Data Assimilation using the HealDA architecture, generates global atmospheric initial conditions in seconds on GPUs.

The stack integrates earlier NVIDIA models such as CorrDiff for rapid downscaling and FourCastNet3 for high speed forecasting, along with open models from other research institutions. National weather agencies and private sector organizations in energy, insurance, and finance are testing or deploying the system.

Earth-2 models are licensed for commercial and non commercial use and are available through platforms such as Earth2Studio, GitHub, and Hugging Face. The initiative signals a shift toward open, AI driven, and scalable weather forecasting systems. Read More

29. *OpenAI signs $10 billion computing deal with Nvidia challenger Cerebras*

OpenAI has signed a multi year compute agreement valued at more than 10 billion dollars with Cerebras Systems, securing up to 750 megawatts of capacity through 2028. The deal addresses OpenAI's growing infrastructure constraints and reflects a strategic move to diversify beyond Nvidia GPUs, particularly for real time inference workloads.

The agreement will bring computing capacity online in phases starting in 2026, directly supporting ChatGPT and other latency sensitive services. With over 900 million weekly users and rising demand for longer outputs, code generation, image creation, and agent based workflows, OpenAI has described a severe compute shortage. The Cerebras systems are intended to reduce response times and improve performance for interactive applications.

Cerebras builds wafer scale processors that use an entire silicon wafer as a single chip. Its latest Wafer Scale Engine integrates 900000 AI cores and 4 trillion transistors, combining compute and memory to reduce data movement and avoid inter chip communication bottlenecks. The company positions its systems as optimized for low latency, high throughput inference rather than general GPU clusters.

The partnership aligns with OpenAI's broader strategy of diversifying compute suppliers. The company is also collaborating with Broadcom on custom silicon, has agreements for AMD accelerators, and has discussed large scale chip supply arrangements with Nvidia. The deal highlights growing competition in the

inference hardware market and signals a shift toward more specialized, workload specific AI infrastructure. Read More

National

30. Technology Highlights: Economic Survey 2025-26

India's Economic Survey 2025-26 highlights technology and innovation as central drivers of the country's transition toward a high growth, resilient economy. Advances in digital infrastructure, manufacturing technology, financial technology, and innovation ecosystems are strengthening productivity, exports, and financial inclusion.

Manufacturing growth has been supported by technology intensive sectors under the Production Linked Incentive schemes across 14 industries. These initiatives have attracted over ₹2 lakh crore in investment and accelerated output in electronics, automotive, and advanced manufacturing segments. Industrial data show strong expansion in computer, electronic and optical products, motor vehicles, and other transport equipment, reflecting a shift toward higher value, technology enabled production. India's improvement in the Global Innovation Index ranking from 66th in 2019 to 38th in 2025 further signals a strengthening research and innovation ecosystem.

The services sector, now contributing over half of GDP, is increasingly driven by digitally delivered and knowledge intensive services. India's position as the world's seventh largest exporter of services reflects expanding IT, financial, and professional technology enabled exports. Services exports reached record levels, reinforcing India's role as a global technology and business services hub.

Digital public infrastructure continues to underpin financial deepening and tax compliance. Rising income tax filings and GST collections reflect wider use of technology in tax administration. The e Shrama portal has registered over 31 crore unorganised workers, while the National Career Service platform connects millions of job seekers and employers through digital matching. E way bill volumes and high frequency transaction indicators point to expanding digital commerce activity.

In financial markets, household participation in equity and mutual funds has increased significantly, supported by digital trading platforms and fintech expansion. The RBI's Financial Inclusion Index improved, reflecting broader access, usage, and quality of financial services enabled by digital channels.

Overall, technology adoption across manufacturing, services, governance, and finance is strengthening productivity, export competitiveness, and inclusion, reinforcing India's medium term growth capacity.

31. India Energy Week 2026 concludes with strong affirmation of India's energy leadership amid geopolitical flux and recognition of innovation excellence

The India Energy Week 2026 concluded with a strong focus on technological innovation, digital transformation, and advanced energy solutions, reinforcing India's position as a forward looking energy leader. The event highlighted how digital tools, artificial intelligence, and

clean technology are reshaping the country's energy ecosystem amid global uncertainty.

Union Minister Hardeep Singh Puri emphasized that India's energy strategy integrates diversification with rapid transition toward cleaner fuels. Alongside supply security, the government is prioritising technology driven resilience. Secretary Neeraj Mittal highlighted the growing role of digitalisation, artificial intelligence, and logistics optimisation in strengthening operational efficiency across the energy value chain. These technologies are being used to improve exploration, production planning, asset monitoring, and supply chain coordination.

Innovation recognition formed a key part of the closing ceremony. Under the AVINYA Energy Startup Challenge, Minimines Cleantech Solutions was awarded for its proprietary low carbon process to recover high value materials from end of life lithium ion batteries, solar panels, catalytic converters, and permanent magnets. The VASUDHA Overseas Upstream Startup Challenge winner, SENERGETICS from the Netherlands, was recognised for AI driven corrosion monitoring systems that enhance safety and reliability in upstream energy operations.

The Hackathon Challenge was won by IIT Bombay for Aura, an AI powered unified reservoir analysis platform that integrates machine learning to improve exploration and production decision making. These innovations demonstrate increasing integration of advanced analytics and AI into core energy operations.

Industry awards also reflected technological leadership. Indian Oil Corporation's R&D Division and Mangalore Refinery and Petrochemicals Limited's Innovation Center were recognised for research and innovation excellence. The emphasis across awards underscored digital transformation, materials recovery, AI enabled optimisation, and sustainable process engineering as central pillars of India's evolving energy strategy.

Overall, IEW 2026 highlighted how technological capability, innovation ecosystems, and AI integration are strengthening India's energy competitiveness and long term resilience.

32. India and Germany sign a Joint Declaration of Intent (JDI) on Telecommunications Cooperation

India and Germany have signed a Joint Declaration of Intent on telecommunications cooperation, marking a significant step in advancing collaboration in digital technologies and ICT. The agreement establishes a structured framework for joint work in emerging telecom technologies, policy alignment, and innovation driven growth.

The Declaration was signed during the official visit of the German Federal Chancellor to India and represents a key outcome of high level bilateral engagements. Concluded between India's Department of Telecommunications and Germany's Federal Ministry for Digital Transformation and Government Modernisation, the pact reflects both countries' commitment to strengthening cooperation in telecommunications and information and communication technologies.

The JDI provides for regular consultations, high level annual meetings, and the formation of dedicated working groups. These will involve government agencies, industry representatives, academia, and research institutions to ensure coordinated and outcome oriented engagement. The framework aims to promote structured collaboration in areas such as emerging and future digital technologies, regulatory cooperation, manufacturing partnerships, and improving ease of doing business in telecom and ICT sectors.

A key focus of the agreement is the exchange of information and best practices to support innovation and technology development. The two sides will jointly develop a detailed work plan outlining specific goals and priority areas aligned with national digital strategies. Collaboration will also extend to international forums, where both countries intend to coordinate positions and promote shared perspectives on telecommunications governance and digital transformation.

Overall, the Declaration strengthens India Germany technology ties and supports inclusive, sustainable digital transformation through innovation, regulatory cooperation, and industrial collaboration in advanced telecommunications and ICT ecosystems. Read More

33. International Data Privacy Day - Strengthening confidence in India's evolving digital ecosystem

As the world's third largest digitalised economy, India operates digital public infrastructure at population scale, making privacy engineering, cybersecurity architecture, and secure data governance central to national digital strategy.

India's Digital Public Infrastructure integrates identity, payments, governance, and health platforms at massive scale. Systems such as Aadhaar for digital identity, UPI for real time payments, MyGov for participatory governance, and eSanjeevani for telemedicine operate across billions of transactions and users. With over 101 crore broadband subscribers and highly affordable mobile data, digital platforms now underpin identity verification, financial transactions, healthcare access, education, and grievance redressal. This scale increases the technological imperative for privacy by design, secure authentication, encryption, and resilient infrastructure.

The Digital Personal Data Protection Act, 2023 and the Digital Personal Data Protection Rules, 2025 establish a technology aligned regulatory framework. The regime embeds consent architecture, data minimisation, breach notification systems, and enforceable digital rights within data processing ecosystems. The creation of the Data Protection Board of India introduces a dedicated enforcement mechanism to oversee compliance, investigate breaches, and ensure corrective action. The framework balances innovation with accountability, supporting lawful data processing while safeguarding citizen rights.

Cybersecurity capability has been strengthened through institutional and technological measures. CERT-In functions as the national cyber incident response agency, supported by platforms such as the National Cyber Crime

Reporting Portal and the Citizen Financial Cyber Fraud Reporting and Management System. Real time coordination is enabled through the Cyber Fraud Mitigation Centre, while analytics driven enforcement is supported by the Samanvaya platform. Indigenous cybersecurity tools developed by C-DAC promote technological self reliance. Capacity building initiatives such as the Cyber Commando Programme and Certified Security Professional in Artificial Intelligence programme address emerging AI related cyber risks.

A budget allocation of ₹782 crore for cybersecurity in 2025-26 reinforces infrastructure protection. Together, privacy legislation, secure digital architecture, AI focused cybersecurity readiness, and institutional oversight strengthen confidence in India's evolving, large scale digital ecosystem. Read More

34. Visit of His Highness Sheikh Mohamed bin Zayed Al Nahyan, President of UAE to India - Technology Outcomes

The January 19, 2026 visit of the UAE President to India resulted in several technology driven outcomes across space, artificial intelligence, advanced computing, defence innovation, digital infrastructure, and clean energy systems.

A key development was the Letter of Intent between IN-SPACe and the UAE Space Agency to build joint infrastructure for space industry development and commercialisation. The collaboration includes launch complexes, manufacturing and technology zones, incubation centres and accelerators for space startups, and training institutes, creating an integrated cross border space innovation ecosystem.

A major digital infrastructure announcement was the planned establishment of a supercomputing cluster in India through collaboration between C-DAC and UAE based G-42. As part of the AI India Mission, the facility will expand high performance computing capacity for artificial intelligence research, advanced modelling, application development, and commercial deployment across sectors.

Technology enabled infrastructure development is central to the Dholera Special Investment Region partnership, which envisions smart urban systems, advanced aviation infrastructure, maintenance and repair facilities, greenfield port development, railway connectivity, and integrated energy infrastructure. In defence, both sides agreed to deepen cooperation in defence industrial collaboration, advanced technologies, cyber capabilities, interoperability systems, and defence innovation.

Civil nuclear cooperation will focus on advanced reactor technologies, including large nuclear reactors and Small Modular Reactors, along with collaboration in nuclear safety and plant operations.

The two sides also agreed to explore Digital or Data Embassies under mutually recognised sovereignty frameworks, reflecting growing emphasis on digital sovereignty and secure cross border data infrastructure. Collectively, the outcomes strengthen bilateral collaboration in AI, space technology, advanced energy systems, cybersecurity, and digital infrastructure. Read More

WHAT'S UPCOMING?

35. Startup Mahakumbh 5.0, 9-10 March, 2026, New Delhi

Startup Mahakumbh 2026, India's largest startup congregation, is scheduled for March 9-10, 2026, at Yashobhoomi (Dwarka), New Delhi, organized by DPIIT, FICCI, ASSOCHAM, NASSCOM, TiE, IVCA, and Bootstrap Foundation to celebrate innovation, foster collaborations, and propel the Bharat startup story globally. Building on the 2025 edition's success (1300+ exhibitors, 50,000+ visitors, 15,000+ B2B meetings, 751 speakers across 10 tracks), it will feature sector pavilions in AI/DeepTech/Cybersecurity, D2C, FinTech, Defense/Space Tech, AgriTech, Climate Tech, B2B/Precision Manufacturing, Gaming/Sports, BioTech/HealthTech, Mobility, and Incubators/Accelerators, with Startup MahaRathi challenges, mentoring, investor meets, and global participation from 60+ countries.

The event offers startups booth space, pitch opportunities, MoU signings, national awards, and high-value networking for founders, VCs, MSMEs, and policymakers, emphasizing scalable solutions in high-impact sectors to drive investment, market linkages, and entrepreneurial growth toward India's $1 trillion digital economy vision. Know More

36. Bharat Space Conclave 2026, March 12, New Delhi

FICCI will be hosting the Bharat Space Conclave 2026 on 12 March 2026 at Federation House, New Delhi. Anchored around the theme 'Towards a $40B Space & Geospatial Ecosystem: Technology, Policy & Industry Collaboration,' the Conclave will bring together senior policymakers, industry leaders, startups, investors, academia, and user ministries to deliberate on key priorities shaping India's space and geospatial ecosystem, including policy and regulatory developments, investment opportunities, technology integration across sectors, manufacturing and downstream services, commercialization, and high-impact applications.

In addition to the conference sessions, the Conclave will feature a dedicated exhibition and startup showcase, providing participating organizations an opportunity to present their technologies, products, and solutions to a distinguished audience of decision-makers and stakeholders.

The platform is designed to facilitate industry engagement, partnerships, and knowledge exchange within the evolving New Space and geospatial ecosystem. Know More

37. NASSCOM Global Confluence 2026, March 17, New Delhi

Nasscom Global Confluence is a the only global platform that brings together international governments, the Government of India, global industry leaders, policy makers and technology pioneers under a unified platform to shape the future of global technology collaboration.

The inaugural edition of Nasscom Global Confluence 2025, successfully convened 320+ participants from 12+ countries, featuring 50+ eminent speakers across 15+ curated sessions. The platform emerged as a high-impact forum for geopolitical and digital diplomacy, offering deep business intelligence and enabling access to business and investment opportunities across both established and non-traditional markets. The 2026 edition assumes strategic importance amid rapid geopolitical realignments that are reshaping the global order. As nations recalibrate partnerships and prioritise resilience across supply chains, technology, and talent, Nasscom's 2nd Global Confluence presents a compelling opportunity to position India as a Globally Trusted, Reliable, and Innovative Technology partner. Know More

THE TECH SHOWCASE! (ANNEXURE)

Compilation of Technology Innovations by premier research institutions of India. The details are shared in the Annexure.

IIT Roorkee

1. Porphyrin-based covalent organic frameworks and synthesis method thereof
2. Robotic one-DOF needling system with real-time force and position feedback
3. GaN MMIC architecture for enhanced power and efficiency using intrinsic harmonic injection
4. A method for the inclusion of boron, sulphur, phosphorus, and iodine into nitrogen-enriched nanoporous polytriazine frameworks
5. A process for the production of biochar immobilized urea
6. A recycled copper-based conductive ink for rotogravure, screen and flexographic printing applications
7. Antibacterial peptide conjugate
8. A process for direct thermal liquefaction of lignocellulosic biomass
9. A synergistic design and synthesis of azo-based Fe(II) complex-PANI hybrid composites as self-adhesive electrocatalysts
10. Nano-hydrogel and method of preparing it
11. Process for recovering indium tin oxide

INDIA'S PREMIER RESEARCH INSTITUTIONS

Government Research Institutions

1. DRDO (Defence Research & Development Organisation)

- **Focus:** Advanced materials, directed energy systems, aerospace, defense electronics, cybersecurity, quantum technologies
- **Website:** https://drdo.gov.in/drdo/en
- **Key Labs:** DRDL, ADA, CAIR, DTTE, DEAL

2. CSIR (Council of Scientific & Industrial Research)

- **Focus:** Chemistry, materials science, pharmaceuticals, renewable energy, geothermal, water treatment, biotechnology
- **Website:** www.csir.res.in
- **Key Labs:** IICT, IMMT, CECRI, NEIST, NIIST (37 research institutes total)

3. ISRO (Indian Space Research Organisation)

- **Focus:** Satellite technology, space debris tracking, laser communications, advanced materials for space, remote sensing
- **Website:** www.isro.gov.in
- **Key Centers:** VSSC, SHAR, SAC, LPSC, IIST

4. BARC (Bhabha Atomic Research Centre)

- **Focus:** Nuclear science, advanced materials, fusion energy, medical isotopes, radiation technology
- **Website:** www.barc.gov.in

5. ICAR (Indian Council of Agricultural Research)

- **Focus:** Precision agriculture, alternative proteins, climate-resilient crop genetics, food technology, soil health
- **Website:** www.icar.gov.in
- **Key Institutes:** IARI, IIMR, IINRG

6. ICMR (Indian Council of Medical Research)

- **Focus:** Medical devices, diagnostics, neurotechnology, biomedical research, vaccine development, healthcare AI
- **Website:** www.icmr.gov.in

Academic Research Institutions

7. IIT Delhi (Indian Institute of Technology)

- **Focus:** Materials science, advanced manufacturing, energy storage, AI hardware, directed energy systems, photonics
- **Website:** www.iitd.ac.in
- **Key Labs:** Advanced Materials Lab, Photonics Lab, Energy Lab

8. IIT Bombay

- **Focus:** Biotechnology, pharmaceutical engineering, water treatment, renewable energy, advanced ceramics
- **Website:** www.iitb.ac.in
- **Key Centers:** CTARA, Biotech Center

9. IIT Madras

- **Focus:** Advanced materials, aerospace composites, microelectronics, quantum computing, geothermal energy research
- **Website:** www.iitm.ac.in

10. IISc Bangalore (Indian Institute of Science)

- **Focus:** Quantum technologies, photonics, materials science, sustainable energy, food technology, neuromorphic computing
- **Website:** www.iisc.ac.in
- **Key Centers:** Center for Quantum Information & Quantum Technologies, Advanced Materials Lab

11. Tata Institute of Fundamental Research (TIFR)

- **Focus:** Physics, math, biology, computer science
- **Website:** https://www.tifr.res.in/

12. Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR)

- **Focus:** Nanoscience, materials, biology
- **Website:** https://www.jncasr.ac.in/

Private Research Institutions

13. TCS Research (Tata Consultancy Services - IT & Quantum)

- **Focus:** Quantum computing, AI/ML, semiconductor design, cybersecurity, edge computing, healthcare AI
- **Website:** www.tcs.com/research
- **Key Labs:** TCS Research, TCS Innovation Labs (global network)

14. Infosys Labs

- **Focus:** AI, machine learning, blockchain, advanced data analytics, edge AI, autonomous systems
- **Website:** https://www.infosys.com/iki/research.html

15. Biocon Research Centre

- **Focus:** Biologics, biosimilars, drug discovery
- **Website:** https://www.biocon.com/

16. Reliance Research & Development

- **Focus:** Petrochemicals, advanced polymers, renewable energy, hydrogen production, materials science
- **Website:** www.ril.com (R&D divisions)

*More to be added in future editions.

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For suggestions/feedback or sharing your innovations with us, please reach out to us on:
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The New, Emerging, and Strategic Technologies (NEST) Division, established in 2020 under the Ministry of External Affairs (MEA), focuses on technology diplomacy and the international aspects of critical, strategic and emerging technologies. It enhances India's participation in global forums, shaping technology governance and safeguarding national interests. As technology has become central to economic and geopolitical agendas, the Division coordinates with domestic and international stakeholders on advancements like Artificial Intelligence, Quantum Technology, 5G/6G, Biotechnology, Green energy, Semiconductors, and others. NEST also builds internal capacity within MEA, facilitates policy engagement, and assesses foreign policy implications. It plays a key role in shaping India's stance on global tech governance and cooperation.

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