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## Department of Computer Applications(MCA)

# Technical **TechEdge** Newsletter

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## Alumni Section

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### No-Code Application Development

In the fast-paced world of software development, innovation knows no bounds. Over the years, we have seen tremendous advances in technology, resulting in increasingly sophisticated applications that meet our ever-changing needs. One such revolutionary approach that has gained significant traction is "codeless application development."

No-code application development, also known as no-code or low-code development, is a paradigm shift in software creation that allows people without extensive coding knowledge to easily build and deploy applications. This approach allows users to focus on the creative aspects of development rather than getting bogged down with complex lines of code. It enables a more complete and efficient way to develop software solutions, democratizes application development and bridges the gap between technical and non-technical users.

#### Basic principles of codeless development

1. Drag-and-drop interface: At the heart of no-code app development is a user-friendly drag-and-drop interface. Visual development environments allow users to design applications by placing pre-built components, widgets and modules on the canvas, eliminating the need to manually code each feature.
2. Pre-built templates and components: No-code platforms often offer a wide range of ready-made templates and components that include various functions from database management to user authentication. These reusable elements make the development process easier, saving time and effort.
3. Seamless integration: No-code development tools often offer integration options with popular services, APIs, and third-party software, allowing users to easily add external functionality to their applications.
4. Real-time collaboration: Many no-code development platforms support real-time collaboration, which facilitates teamwork and makes it easier for multiple stakeholders to collaborate on the same project at the same time.

#### Advantages of codeless app development

1. Faster speed to market: Codeless development significantly reduces time to build applications. By eliminating manual coding, developers can focus on application logic and user experience, speeding up the overall development cycle.
2. Lower development costs: Traditional coding often requires specialized developers, resulting in higher development costs. With codeless development, companies can leverage existing talent from different departments, resulting in cost savings and better resource allocation.
3. Empower Citizen Developers: No-code app development allows people from different backgrounds, such as business analysts, project managers, and designers, to actively participate in the app development process. This democratization of development encourages innovation and a more agile and responsive organizational culture.
4. Flexibility and Iterative Improvement: The visual nature of no-code development facilitates iterative improvement. Developers can quickly make changes based on user feedback, test new features and customize the app, ensuring a more user-friendly end product.

5. Smooth adaptation to market changes. In today's rapidly changing business environment, adaptability is essential. Code-free development allows companies to quickly respond to market demands and changes, enabling them to stay ahead of their competitors.

### **Challenges and limitations**

Although codeless application development offers many advantages, it is not without its challenges.

1. Complexity Limitations: Highly complex and specialized applications may require custom coding as codeless platforms may not provide the required level of customization.
2. Integration Limitations: Some no-code platforms may have limitations on integration with certain niche or proprietary systems.
3. Learning curve: Although no-code platforms are easy to use, they still require some learning and training for users to fully understand the features and capabilities they offer.
4. Performance Issues: In some cases, no-code applications may experience performance issues compared to fully custom solutions. This trade-off between speed and fine-tuning must be considered based on the application requirements.

### **Conclusion**

Code-free application development represents a significant shift in how we approach software creation. Code-free platforms promote collaboration, creativity and innovation, allowing people with different abilities to actively participate in the development process. While it may not be the best solution for every type of application, codeless development will undoubtedly play a key role in the future of software, increasing efficiency, flexibility and accessibility across industries. As technology evolves, we can expect codeless development to further expand its capabilities, making app creation easier and more dynamic than ever before.



## India launches historic Chandrayaan-3 mission to land spacecraft on the moon



**I**NDIA is bidding to become only the fourth country to execute a controlled landing on the moon with the successful launch 14<sup>th</sup> July (Friday) of its Chandrayaan-3 mission.

Chandrayaan, which means “moon vehicle” in Sanskrit, blasted off from the Satish Dhawan Space Center at Sriharikota in southern Andhra Pradesh state at just after 2:30 p.m. local time.

Crowds gathered at the space center to watch the history-making launch and more than 1 million people tuned in to watch on YouTube.

The Indian Space Research Organization confirmed on Twitter later Friday that Chandrayaan-3 is in “precise orbit” and has “begun its journey to the moon.”

It added that the health of the spacecraft is “normal.”

In response, Indian Prime Minister Narendra Modi tweeted: “Chandrayaan-3 scripts a new chapter in India's space odyssey. It soars high, elevating the dreams and ambitions of a every Indian. This momentous achievement is a testament to our

Indian. This momentous achievement is a testament to our scientists' relentless dedication. I salute their spirit and ingenuity!” The craft is expected to land on the moon on August 23.

Chandrayaan-3, India's third lunar exploration mission, took off from the Satish Dhawan Space Centre in Sriharikota in Andhra Pradesh on Friday afternoon, in hopes to land the country among the elite group of nations to have achieved a soft landing on the Moon's surface.

The mission follows the Indian Space Research Organization (ISRO) Chandrayaan-2, which failed a desired soft landing on the lunar surface nearly four years ago in September 2019, after the lander's communication failure with the ground stations at an altitude of just 2.1 km from the surface of the Moon.

Chandrayaan-3 will journey for over a month before landing on the lunar surface later in August. If successful, the mission will make India the only fourth nation, after the United States, the former Soviet

### Highlights

- India launched its Chandrayaan-3 mission, aiming to become the fourth country to execute a controlled landing on the moon
- The spacecraft took off from the Satish Dhawan Space Centre in Sriharikota and is expected to land on the moon's surface on August 23.
- Chandrayaan-3 follows Chandrayaan-2, which failed a soft landing on the moon in September 2019 due to a communication failure.
- The mission's objectives include a safe and soft landing on the moon, demonstrating rover roving, and studying the lunar environment
- The success of Chandrayaan-3 would make India the fourth nation, after the United States, the former Soviet Union, and China, to achieve a lunar soft landing.

Union and China, to have accomplished the task.

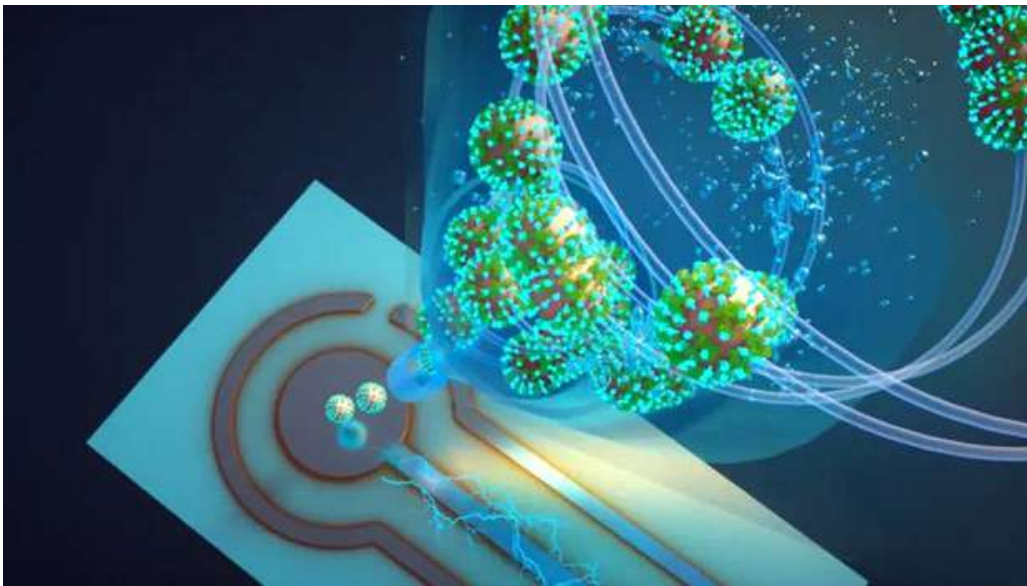
The ISRO explained the three main objectives of this ₹615 crore mission – safe and soft landing on the Moon, to demonstrate the Rover roving on its surface and study its environment. The spacecraft consists of a six-wheeled lander and rover module, which is configured with payloads to provide data related to the moon's surface. “Chandrayaan-3 consists of an indigenous Lander module (LM), Propulsion module (PM) and a Rover with an objective of developing and demonstrating new technologies required for interplanetary missions,” the ISRO explained on its website about the project.

The ISRO and the former scientists associated with the space agency, including ex-chairman Madhavan Nair and scientist Nambi Narayan, expressed high confidence about the success of the mission. Both Nair and Narayan reiterated that the ISRO has revised the data collected from Chandrayaan-2 mission, factored in all elements, and studied past mistakes. “Chandrayaan-3 will definitely be a game changer for India, and I hope it will be successful,” Narayan had told news agency ANI ahead of the launch.

Visuals surfaced from across India showing people cheering for Chandrayaan-3, congratulating, and wishing ISRO in anticipation of the mission's success ahead of its launch. Meanwhile, Prime Minister Narendra Modi, also tweeted, expressing optimism about the mission and said it will carry the “hopes and dreams of India.”

The mission brings back the memories of Chandrayaan-2 launch, which successfully deployed an orbiter, but its lander and rover were destroyed in a crash. The image of an emotional and dejected K Sivan, the then ISRO chief, being consoled by PM Modi during the moment remains etched in the memories of many.





## New air monitor can detect COVID-19, flu, RSV, and other viruses in real-time

A team of researchers at the McKelvey School of Engineering and the School of Medicine has developed a proof-of-concept air quality monitor that can detect live SARS-CoV-2 virus (severe acute respiratory syndrome coronavirus 2) in indoor environments. The monitor uses a biosensor made with nanobodies that is integrated into an air sampler that operates based on the wet cyclone technology. Credit: Joseph Puthussery

### **Proof-of-concept device could also monitor for flu, RSV, and other respiratory viruses.**

Now that the emergency phase of the COVID-19 pandemic has ended, scientists are looking at ways to surveil indoor environments in real-time for viruses. By combining recent advances in aerosol sampling technology and an ultrasensitive biosensing technique, researchers at Washington University in St. Louis have created a real-time monitor that can detect any of the SARS-CoV-2 virus variants in a room in about 5 minutes.

The inexpensive, proof-of-concept device could be used in hospitals and health care facilities, schools, and public places to help detect CoV-2 and potentially monitor for other respiratory virus aerosols, such as influenza and respiratory syncytial virus (RSV). Results of their work on the monitor, which they say is the most sensitive detector available, are published on July 10 in the journal *Nature Communications*.

The interdisciplinary team of researchers from the McKelvey School of Engineering and the School of Medicine consists of Rajan Chakrabarty, the Harold D. Jolley Career Development Associate Professor of energy, environmental & chemical engineering in McKelvey Engineering; Joseph Puthussery, a postdoctoral research associate in Chakrabarty's lab; John Cirrito, a professor of neurology at the School of Medicine; and Carla Yuede, an associate professor of psychiatry at the School of Medicine.

### *Highlights*

- Researchers at Washington University in St. Louis developed an air quality monitor that can detect live SARS-CoV-2 virus in indoor environments in real-time, providing results in about 5 minutes.
- The monitor uses an ultrasensitive biosensor made with nanobodies from llamas, which recognize the spike protein of the SARS-CoV-2 virus.
- Integrated with a wet cyclone air sampler, the monitor has an ultrahigh flow rate of 1,000 liters per minute, making it one of the most sensitive and fast detectors available.
- The proof-of-concept device holds potential for monitoring other respiratory viruses like influenza and respiratory syncytial virus (RSV) in hospitals, schools, and public places, contributing to improved infection control and public health.

“There is nothing at the moment that tells us how safe a room is,” Cirrito said. “If you are in a room with 100 people, you don’t want to find out five days later whether you could be sick or not. The idea with this device is that you can know essentially in real time, or every 5 minutes, if there is a live virus.”

Cirrito and Yuede had previously developed a micro-immunoelectrode (MIE) biosensor that detects amyloid beta as a biomarker for Alzheimer’s disease and wondered if it could be converted into a detector for SARS-CoV-2. They reached out to Chakrabarty, who assembled a team that included Puthussery, who had expertise in building real-time instruments to measure the toxicity of air.

To convert the biosensor from detecting amyloid beta to coronavirus, the researchers exchanged the antibody that recognizes amyloid beta for a nanobody from llamas that recognizes the spike protein from the SARS-CoV-2 virus. David Brody, MD, PhD, a former faculty member in the Department of Neurology at the School of Medicine and an author on the paper, developed the nanobody in his lab at the National Institutes of Health (NIH). The nanobody is small, easy to reproduce and modify and inexpensive to make, the researchers said.

“The nanobody-based electrochemical approach is faster at detecting the virus because it doesn’t need a reagent or a lot of processing steps,” Yuede said. “SARS-CoV-2 binds to the nanobodies on the surface, and we can induce oxidation of tyrosine’s on the surface of the virus using a technique called square wave voltammetry to get a measurement of the amount of virus in the sample.”

Chakrabarty and Puthussery integrated the biosensor into an air sampler that operates based on the wet cyclone technology. Air enters the sampler at very high velocities and gets mixed centrifugally with the fluid that lines the walls of the sampler to create a surface vortex, thereby trapping the virus aerosols. The wet cyclone sampler has an automated pump that collects the fluid and sends it to the biosensor for seamless detection of the virus using electrochemistry.

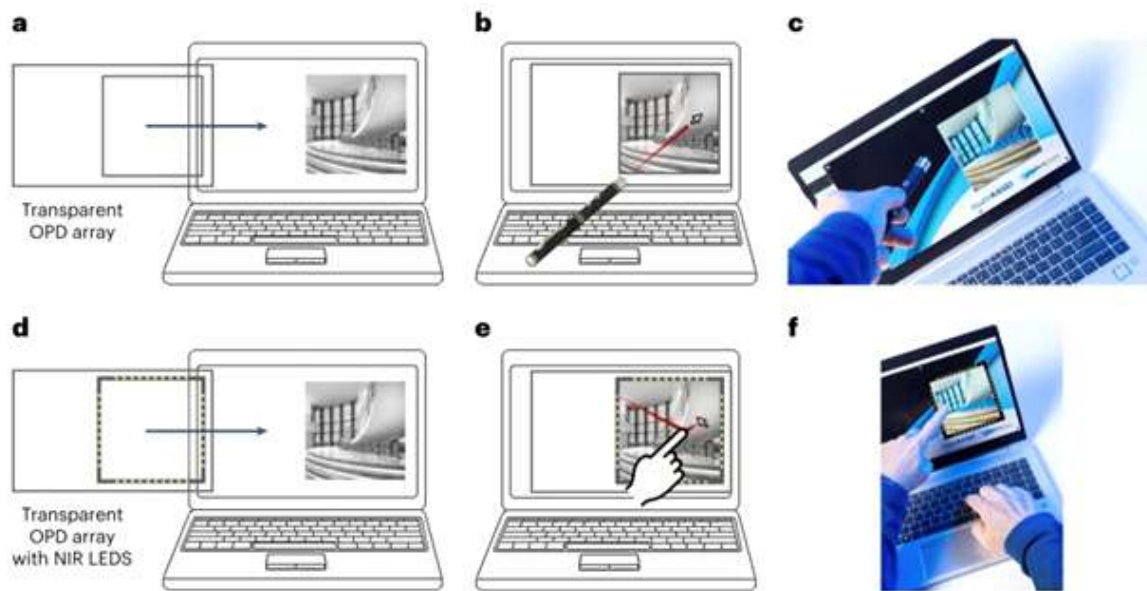
“The challenge with airborne aerosol detectors is that the level of virus in the indoor air is so diluted that it even pushes toward the limit of detection of polymerase chain reaction (PCR) and is like finding a needle in a haystack,” Chakrabarty said. “The high virus recovery by the wet cyclone can be attributed to its extremely high flow rate, which allows it to sample a larger volume of air over a 5-minute sample collection compared with commercially available samplers.”

Most commercial bioaerosol samplers operate at relatively low flow rates, Puthussery said, while the team’s monitor has a flow rate of about 1,000 liters per minute, making it one of the highest flow-rate devices available. It is also compact at about 1 foot wide and 10 inches tall and lights up when a virus is detected, alerting administrators to increase airflow or circulation in the room.

The team tested the monitor in the apartments of two COVID-positive patients. The real-time PCR results of air samples from the bedrooms were compared with air samples collected from a virus-free control room. The devices detected RNA of the virus in the air samples from the bedrooms but did not detect any in the control air samples.

In laboratory experiments that aerosolized SARS-CoV-2 into a room-sized chamber, the wet cyclone and biosensor were able to detect varying levels of airborne virus concentrations after only a few minutes of sampling.

“We are starting with SARS-CoV-2, but there are plans to also measure influenza, RSV, rhinovirus and other top pathogens that routinely infect people,” Cirrito said. “In a hospital setting, the monitor could be used to measure for staph or strep, which cause all kinds of complications for patients. This could really have a major impact on people’s health.” The team is working to commercialize the air quality monitor.



## Researchers introduce transparent optical imager with near-infrared sensitivity and touchless interface

Most existing devices are operated via the sense of touch, either via touchscreens or mouse, remote controls, keyboards, and other equipment. Some engineers, however, have been trying to introduce alternative interfaces that do not require users to touch anything, as these could be more hygienic.

Past studies showed that smartphones, for instance, are often dirtier and more loaded with bacteria than the average toilet, as they are touched often but rarely cleaned. Touchless interfaces would allow users to operate their devices without touching them, thus most likely limiting the bacteria accumulating on them.

Researchers at the Dutch Organization for Applied Scientific Research, Asahi Kasei Corporation, Eindhoven University of Technology and IMEC (International Maritime Employers' Council) recently introduced a new optical imager with near-infrared sensitivity that could support touchless operation. This imager, introduced in a paper in *Nature Electronics*, could be applied on top of various device displays, ultimately allowing users to operate them using gestures or a penlight (i.e., a pen that acts as a flashlight).

Many of the touchless user interfaces proposed in recent years allow users to control devices using hand gestures. These interfaces typically rely on the use of near-infrared cameras, cameras that can precisely sense environments in low lighting conditions.

While some of these systems can effectively pick up gestures, they often have a limited field of view and demanding calibration requirements. The researchers at the Dutch Organization for Applied Scientific Researchers and their colleagues set out to develop an optical imager that could overcome these limitations, and that could be easily integrated

### Highlights

- Engineers are exploring touchless user interfaces as a more hygienic alternative to conventional touch-based interfaces on devices like smartphones, remote controls, and keyboards.
- Researchers from the Dutch Organization for Applied Scientific Research, Asahi Kasei Corporation, Eindhoven University of Technology, and IMEC introduced a new optical imager with near-infrared sensitivity that enables touchless operation on various device displays.
- The optical imager can be easily integrated with commercially available displays, significantly improving its field of view and positional accuracy compared to existing touchless interfaces.
- The imager's photo detectivity is approximately  $10^{12}$  Jones at 850 nm, and it boasts a high visible-light transmittance of 70%.



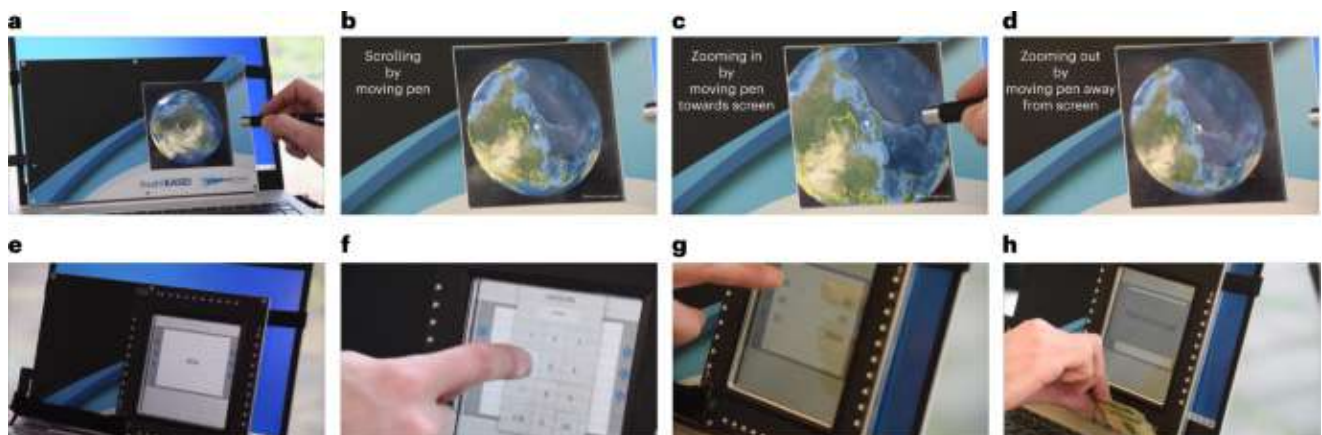
"We report a touchless user interface that is based on a visually transparent near-infrared-sensitive organic photodetector array and can be used on top of a display," Takeshi Kamijo, Albert J.J.M. van Breemen and their colleagues wrote in their paper. "Optical transparency is achieved by using a printed copper grid as a bottom transparent conductive electrode and an array of patterned organic photodetector subpixels."

The optical imager introduced by Kamijo, Breemen and their colleagues appears transparent to the human eye. It can also be easily placed in front of conventional and widely available displays, which greatly improves its field of view and positional accuracy.

In initial tests, the imager performed remarkably well, as it could detect movements and changes in the environment with good precision. The researchers also integrated it on a common laptop display and showed that it could enable both gesture-based and penlight-based interactions with the laptop.

"Electro-optical modeling is used to optimize the design of the image sensor, leading to a photo detectivity of approximately  $10^{12}$  Jones at 850 nm and a high visible-light transmittance of 70%," Kamijo, Breemen and their colleagues wrote in their paper. "We show that the imager can be used as a penlight-controlled and gesture-controlled touchless user interface when combined with a commercial display."

In the future, the new optical imager created by this team of researchers could be further developed and fabricated on a large-scale to enable touchless interactions with various devices. In addition, it could inspire the creation of other promising devices supporting gesture-based and penlight-based interfaces.





Japanese researchers find a simple and affordable way to store hydrogen

### Highlights

- Japanese researchers at the RIKEN Center for Emergent Matter Science (CEMS) have discovered a simple and affordable method to store ammonia, an important chemical used across various industries. The breakthrough could also contribute to establishing a hydrogen-based economy.
- The researchers found that the perovskite ethyl ammonium lead iodide (EAPbI<sub>3</sub>) can react with ammonia at room temperature and pressure, converting it into lead iodide hydroxide (Pb(OH)I) and effectively storing the ammonia. The process is reversible, allowing for easy retrieval of ammonia when needed.
- This discovery is significant because ammonia serves as a carrier for hydrogen, which can be stored safely within the perovskite material. Since hydrogen on its own is highly combustible, using ammonia as an intermediary offers a safe and practical solution for storing and transporting hydrogen, contributing to the transition to a hydrogen-based economy and promoting renewable energy sources.

Researchers at the RIKEN Center for Emergent Matter Science (CEMS) in Japan have found a simple and affordable way to store ammonia, an important chemical in a range of industries. The discovery could also help in establishing a hydrogen-based economy.

Ammonia, chemically written as NH<sub>3</sub>, is widely used across industries ranging from textiles to pharmaceuticals and is an important component in the manufacture of fertilizers. For its current use, ammonia is stored in pressure-resistant containers after liquefying it at temperatures of -27 Fahrenheit (-33 degrees Celsius).

Alternate methods of storing ammonia in porous compounds have been explored. The storage and retrieval process can be achieved at room temperature, but the storage capacity of these compounds is limited.

A research team led by Masuki Kawamoto at RIKEN CEMS has now found that perovskites, crystalline structures associated with improving energy conversion efficiencies of solar panels, can also serve as an excellent medium for the storage and retrieval of ammonia.

#### **Perovskite as an ammonia carrier**

Kawamoto's team found that the perovskite ethyl ammonium lead iodide (EAPbI<sub>3</sub>) reacts with ammonia at room temperature and pressure to make lead iodide hydroxide, or Pb(OH)I. Ethyl ammonium lead iodide has a one-dimensional columnar structure but, after reacting with ammonia, forms a two-dimensional layered structure.

Ammonia is a highly corrosive gas, but the chemical reaction with the perovskite allows for its safe storage that does not need any special equipment to store it either. The retrieval process is also very straightforward. Under vacuum, ethyl ammonium lead iodide can be heated to 122 Fahrenheit (50 degrees Celsius) to release ammonia gas.

Reversible reaction that allows storage and retrieval of ammonia with ease.

## Moving to a hydrogen economy

The discovery of the role of perovskite is very important since it also offers a way to store hydrogen. Each molecule of ammonia packs three atoms of hydrogen and packing 20 percent of the weight of the molecule.

On its own, hydrogen is highly combustible, but ammonia does not combust easily, making it a good medium to store it until needed.

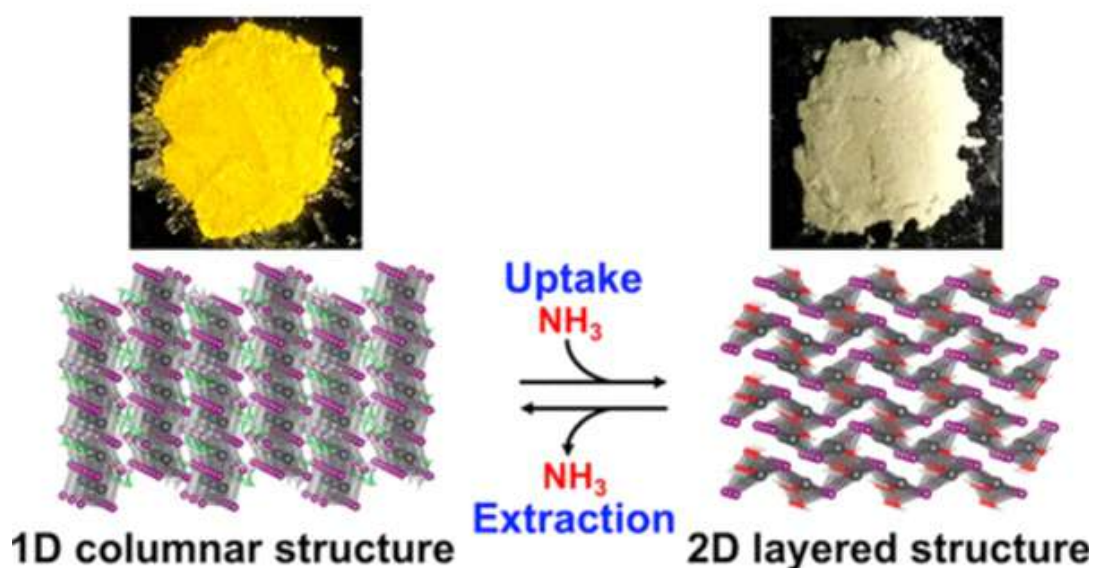
The perovskite-ammonia reaction is fully reversible, and the perovskite can be reused to store ammonia again after retrieval is completed. Interestingly, the perovskite also changes color to white when it stores ammonia and returns to its original yellow after ammonia is retrieved. Scientists can exploit this feature to make color-based sensors to determine the amount of ammonia stored in the perovskite.

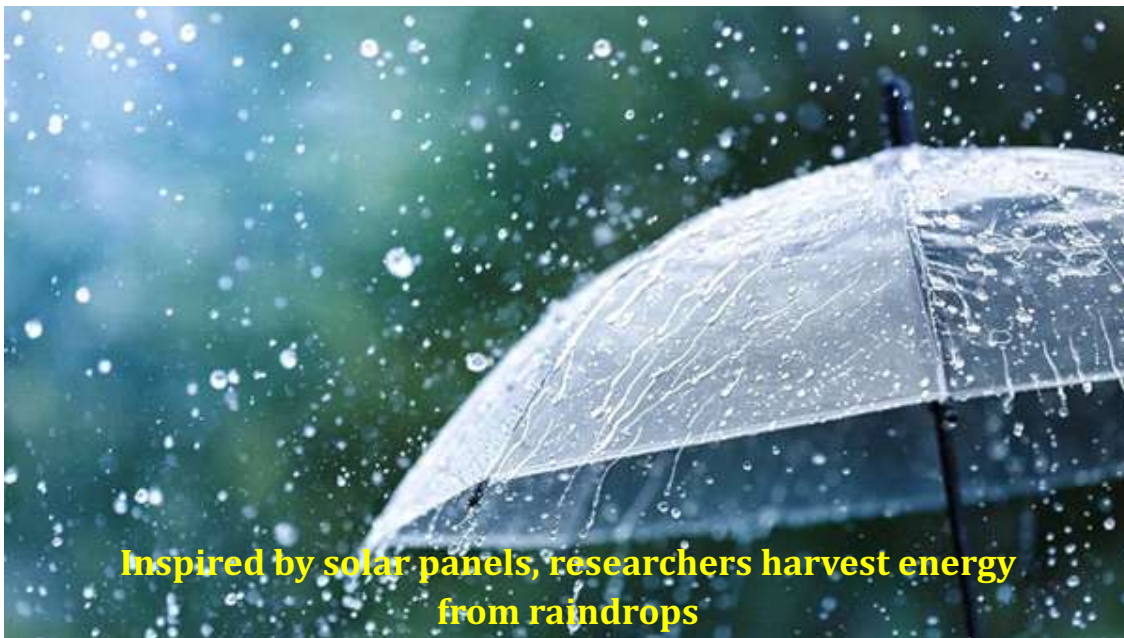
Our attempts to move away from fossil fuels are likely to prove futile if we cannot find alternatives to carry out tasks like long haul and heavy transport. Hydrogen's power density is almost thrice that of gasoline or diesel, but its combustible nature brings high risk.

A simple and affordable method where hydrogen can be extracted at the site of its need, only in amounts that it is required, will pave a quicker way toward a hydrogen-based economy in the near future.

The research findings were published July 10 in the journal of the American Chemical Society.

Toward renewable energy for global leveling, compounds that can store ammonia (NH<sub>3</sub>), a carbon-free energy carrier of hydrogen, will be of great value. Here, we report an organic-inorganic halide perovskite compound that can chemically store NH<sub>3</sub> through dynamic structural transformation. Upon NH<sub>3</sub> uptake, a chemical structure change occurs from a one-dimensional columnar structure to a two-dimensional layered structure by addition reaction. NH<sub>3</sub> uptake is estimated to be 10.2 mmol g<sup>-1</sup> at 1 bar and 25 °C. In addition, NH<sub>3</sub> extraction can be performed by a condensation reaction at 50 °C under vacuum. X-ray diffraction analysis reveals that reversible NH<sub>3</sub> uptake/extraction originates from a cation/anion exchange reaction. This structural transformation shows the potential to integrate efficient uptake and extraction in a hybrid perovskite compound through chemical reaction. These findings will pave the way for further exploration of dynamic, reversible, and functionally useful compounds for chemical storage of NH<sub>3</sub>.





## Inspired by solar panels, researchers harvest energy from raindrops

### Highlights

- Researchers at Tsinghua University in China have developed a novel method to harvest electricity from raindrops using a "solar panel-like" bridge array generator (BAG). This approach overcomes scaling issues and can effectively convert the kinetic energy of falling raindrops into electricity.
- Previous attempts at harvesting raindrop energy involved droplet-based triboelectric nanogenerators (D-TENGs), but connecting multiple D-TENGs led to unintended power loss due to coupling capacitance between the electrodes. The new BAG design reduces this power loss and allows for more efficient large-scale raindrop energy harvesting.
- The BAGs demonstrated a peak power output of 200 watts per square meter, nearly five times higher than conventional large-area raindrop energy harvesting methods. This breakthrough opens up promising possibilities for harnessing renewable energy in regions with frequent and abundant rainfall, offering a new option in the mix of renewable energy sources and contributing to the global transition away from fossil fuels.

Researchers at Tsinghua University in Shenzhen, China, have returned to the panel arrangement used in solar cells to harness electricity from raindrops falling from the sky. This has helped them overcome long-standing issues in scaling up the approach to generating electricity.

With the world looking to move away from fossil fuels, newer methods that can tap into renewable energy sources to meet our power requirements are always welcome. Raindrops falling from the sky contain kinetic energy that can be theoretically captured and converted into electricity.

This isn't the first time somebody has considered tapping into this resource. Researchers have previously tapped into liquid-solid contact electrification to harvest electricity from devices. Triboelectric nanogenerators (TENG) can also gather electricity from other sources, such as waves but have issues in scaling up.

### Harvesting electricity from raindrops

Previous work in this area has led to the development of droplet-based TENG, commonly called D-TENGs. While these devices have very high instantaneous output, one would need multiple D-TENGs to generate the megawatt-level electricity that power plants usually generate.

Connecting multiple D-TENGs would be the most obvious solution to the problem, but it has an undesirable effect. When multiple D-TENGs are connected, there is an unintended coupling capacitance between the upper and lower electrodes, reducing the devices' output.

A team of researchers led by Zong Li, a professor at the Tsinghua Shenzhen International Graduate School in China, took inspiration from solar panels to set up bridge array generators and reduce the influence of capacitance.

### How do bridge array generators help

When raindrops fall on a surface of a panel of the D-TENG, called the FEP (fluorinated ethylene propylene) surface, the droplet becomes positively charged while the surface becomes negatively charged.

“The amount of charge generated by each droplet is small, and the surface charge on the FEP will gradually dissipate. After a long time on the surface, the charges on the FEP surface will gradually accumulate to saturation,” said Li in a press release. “At this point, the dissipation rate of the FEP’s surface charge is balanced with the amount of charge generated by each impact of the droplet.”

Researchers used bridge array generators with different sizes of sub-electrodes and panels of various thicknesses to see if there was an impact on the power loss. D-TENG panels built with bridge array generators were found to be independent of each other, and that meant that the unintended power loss could be reduced.

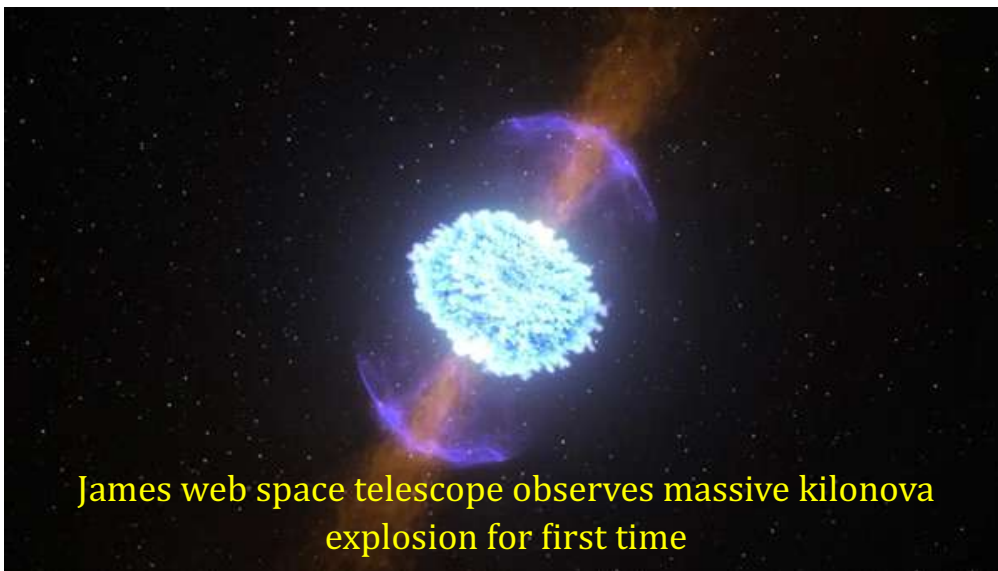
“The peak power output of the bridge array generators is nearly five times higher than that of the conventional large-area raindrop energy with the same size, reaching 200 watts per square meter, which fully shows its advantages in large-area raindrop energy harvesting,” Li said in the press release.

Increasing the FEP thickness also led to decreased coupling capacitance without affecting the surface charge density, which could be used to further improve the performance of bridge array generators.

The discovery could open up new ways of harnessing renewable energies, especially in areas that see incessant rain for a large number of days in the year.



Illustration to demonstrate what D-TENG panels could look like



### Highlights

- *The James Webb Space Telescope (JWST) has observed a massive kilonova explosion for the first time, caused by the collision of two neutron stars. The explosion produced an exceptionally bright gamma-ray burst (GRB), making it the second brightest GRB ever recorded.*
- *The kilonova event was investigated by a team of astronomers led by Andrew Levan from Radboud University in the Netherlands. The GRB, named GRB 230307A, was detected on March 7, 2023, and the JWST conducted follow-up observations 29 and 61 days after the discovery, revealing a transition from a blue hue to a red hue characteristic of a kilonova explosion.*
- *Kilonova explosions resulting from neutron star mergers not only produce gamma-ray bursts but also create heavy elements through a process known as neutron capture or the r-process. These heavier elements, including thorium, gold, and uranium, play a crucial role in the evolution and formation of stars in the universe, and the JWST observations confirm the creation of r-process elements across a broad atomic mass range in GRBs*

**W**hen two neutron stars crash together, they produce a big and bright explosion known as a kilonova. A neutron star is the condensed remnant of incredibly massive stars that have undergone gravitational collapse.

The orbiting neutron stars collide at tremendous speeds, and in this process emit gamma-ray bursts (GRBs), which are brief bursts of extremely energetic gamma rays. GRBs frequently release an equivalent amount of energy within a brief timespan that surpasses the total energy output our Sun will emit over its entire lifespan of 10 billion years.

Thanks to the incredibly bright gamma-ray burst, astronomers have been able to study the kilonova event for the first time using the James Webb Space Telescope (JWST).

In perhaps the biggest plot twist: the GRB - the second brightness of all time - lasted half a minute, i.e., a second "long" burst accompanied by r-process production. Likely a neutron star merger, but one which challenges our ideas about how long the central engine should "jet".

### **Second brightest GRB recorded to date**

A team of astronomers led by Andrew Levan from Radboud University in the Netherlands investigated GRB 230307A, which is sourced to the merging of neutron stars.

This is the second brightest GRB recorded to date, and it was discovered on March 7, 2023, by NASA's Fermi Gamma-ray Space Telescope.

The GRB lasted only for 34 seconds and was detected by many telescopes at the same time, allowing researchers to pinpoint its origin.

The follow-up observation of the kilonova was conducted twice using Webb, while its mid-infrared imaging and spectroscopy instrument was used to gather data.

The first Webb observation occurred 29 days after the GRB discovery, and then again at 61 days. During these observations, the JWST detected a transition from a blue hue to a red hue, which serves as a distinctive indication of a kilonova explosion.

Using a powerful vision of the Webb, the team spotted several galaxies around the kilonova. The galaxy identified as the brightest, and thus the most probable location of this explosion, is situated approximately 8.3 million light-years away from Earth.

### **Kilonova explosions also produce metals**

These colossal explosions have also been found to produce the most massive elements in the universe, confirming a long-standing speculation that was finally substantiated in 2017.

According to space.com, these heavy metals are thought to develop via a mechanism known as neutron capture or the r-process. As the name implies, the process allows atomic nuclei to capture neutrons, resulting in the formation of new and heavier elements such as iron, thorium, gold, platinum, uranium, and many more and r-processes occur only in extreme and violent settings, such as those seen surrounding neutron star mergers.

"These observations demonstrate that nucleosynthesis in GRBs can create r-process elements across a broad atomic mass range and play a central role in heavy element nucleosynthesis across the universe," the team wrote in a paper uploaded on the pre-print server.

These heavier elements are important to understand the evolution and formation of stars found in the universe.

There are other potential methods for studying neutron star collisions as well, most notably gravitational waves.

But, at the time when the signal from the Laser Interferometer Gravitational-Wave Observatory (LIGO), responsible for detecting GRBs, reached Earth, the observatory was not operational. The facility was temporarily closed for three years for upgrades before reopening in May 2023.

These new findings are currently in the review process, while the pre-print version has been uploaded on arXiv.

### **Study Abstract**

The mergers of binary compact objects such as neutron stars and black holes are of central interest to several areas of astrophysics, including as the progenitors of gamma-ray bursts (GRBs), sources of high-frequency gravitational waves and likely production sites for heavy element nucleosynthesis via rapid neutron capture (the r-process). These heavy elements include some of great geophysical, biological, and cultural importance, such as thorium, iodine and gold. Here we present observations of the exceptionally bright gamma-ray burst GRB 230307A. We show that GRB 230307A belongs to the class of long-duration gamma-ray bursts associated with compact object mergers, and contains a kilonova like AT2017gfo, associated with the gravitational-wave merger GW170817. We obtained James Webb Space Telescope mid-infrared (mid-IR) imaging and spectroscopy 29 and 61 days after the burst. The spectroscopy shows an emission line at 2.15 microns which we interpret as tellurium (atomic mass  $A=130$ ), and a very red source, emitting most of its light in the mid-IR due to the production of lanthanides. These observations demonstrate that nucleosynthesis in GRBs can create r-process elements across a broad atomic mass range and play a central role in heavy element nucleosynthesis across the Universe.





## Nokia and TSSC launch 5G skill development center in Gujarat

### Highlights

- Nokia and the Telecom sector skill council (TSSC) have jointly announced plans to set up a 5G skill development center in Gujrat.
- Nokia's investment in infrastructure, equipment, and training for the five labs in the CoE reflects its strong commitment to the development of skilled manpower.
- Arvind Bali, CEO of Telecom Sector Skill Council, shared his excitement about the state-of-the-art CoE.

In partnership with the Telecom Sector Skill Council (TSSC) and Kaushalya-The Skill University, Nokia has announced the establishment of a 5G skill development center in Gujarat. The Center of Excellence (CoE) at ITI Kubernagar will establish a skill Lab dedicated to training individuals in 5G technology skills.

The primary objective is to offer job placements to at least 70 percent of learners within 4-6 weeks after completing the course. In the first year of the project, approximately 300 candidates will benefit from this program. Balvantsinh Rajput, the cabinet minister for Labor and Employment in the state, presided over the inauguration ceremony of the 5G skill development center.

Nokia's Efforts in developing a skilled 5G workforce for a Connected India

Nokia is leading the way in pioneering advancements in telecom technology and is committed to cultivating a highly skilled workforce to contribute to the development of the 5G ecosystem. As part of its India corporate social responsibility (CSR) program, Nokia is making substantial investments in infrastructure, equipment, and training for the five labs within the Center of Excellence (CoE). Additionally, Nokia aims to foster connectivity and digitization, leveraging these efforts to generate positive socioeconomic, educational, and health benefits in India.







## HCL tech joins XR startup programme with MeitY Meta

### Highlights

- *HCL tech collaborates with Meta and Meity startup hub to accelerate the growth of the extended reality tech ecosystem in India.*
- *The XR Startup Program is playing a crucial role in supporting startups to embrace extended reality technologies. We are delighted to collaborate with HCLTech for this program," said Shivnath Thukral, Director and Head Public Policy, India, Meta.*
- *HCL Tech, a multinational IT company, has joined the XR Startup Program, a collaborative effort between Meta and the MeitY Startup Hub, to bolster and accelerate extended reality (XR) technology startups in India.*

**A**s part of this collaboration, HCL Tech will play a key role in establishing a flourishing ecosystem for Indian startups, enabling them to lead and innovate in vital sectors like education, healthcare, and Agri-tech.

HCL Tech's team of experts will provide tailored mentorship to the startups, conducting thought leadership sessions and sharing invaluable business and industry insights. As the program advances, the startups can utilize HCLTech's global infrastructure, next-generation engineering technology, and innovation labs to develop, test, and validate their use cases.

MeitY Startup Hub (MSH) is an initiative of Ministry of Electronics and Information Technology (MeitY), committed to strengthening and enriching the startup ecosystem across India. The hub focuses on promoting technology innovation, startups, and the creation of Intellectual Properties (Ips).

It serves as a national coordination, facilitation, and monitoring center, bringing together all incubation centers, startups, and innovation-related activities under MeitY.

Through its emphasis on innovation and entrepreneurship, MeitY Startup Hub has played a key role in propelling India to become the third-largest startup ecosystem worldwide.

Extended Reality (XR) encompasses Augmented Reality (AR), Virtual Reality (VR), Mixed Reality (MR), and related technologies. The initiative seeks to expedite India's role in shaping the metaverse and fostering the growth of XR technologies in the country.

The metaverse is a network of interconnected digital spaces, offering 3D experiences. Users can effortlessly move between these spaces, engaging in activities that go beyond the boundaries of the physical world.

"The XR Startup Program is playing a crucial role in supporting start-ups to embrace extended reality technologies. We are delighted to collaborate with HCLTech for this programme. Their leadership and guidance as a trusted partner will greatly benefit the program participants and further Meta's vision of nurturing immersive technologies and innovation in India to make the country a hub for these emerging technologies," said Shivnath Thukral, director and head of public policy, India, Meta.

MeitY's larger Startup Hub project hosts more than 4,000 companies, 26 centres of entrepreneurship (CoEs), and more than 400 mentors.



## There's a giant 'gravity hole' in Indian Ocean and scientists have finally explained the reason

### Highlights

- For years scientists have tried to understand the underlying cause behind such phenomenon and finally found out why there is a massive hole in the Indian Ocean.
- The gravitational force varies depending on the mass distribution of crust, mantle and core as the shape and gravity are not uniform across the Earth's surface instead it is slightly flattened at the poles and wider at the equator.
- Its origins can be traced to an ancient ocean bed that got submerged due to tectonic plate movements.

Researchers from Bengaluru's Indian Institute of Science have made a breakthrough discovery of the 'gravity hole' in the Indian Ocean which is a region where the gravitational pull is significantly lower than the surrounding, creating a dip in the Earth's Gravity Field.

One of the most striking examples of the variation in the gravitational force is the Indian Ocean Geoid Low (IOGL).

The IOGL was first detected by a Dutch geophysicist Felix Andries Vening Meinesz in 1948 during a ship-based survey.

Indian Ocean Geoid Low (IOGL) is a huge depression in the sea level that is about 106 metres lower than the global average.

The cause of IOGL anomaly remained a mystery for decades and now a new study revealed the reason behind this. Gravity hole is an area where the gravitational pull is lighter in comparison to the other surroundings.

Gravity holes happen due to the variation in density and mass distribution as the Earth's Gravitational Force is not uniform.

### Methodology

- Researchers from the Indian Institute of Science of Bengaluru- Debanjan Pal and Attreyee Ghosh explained their hypothesis about the origin of the gravitational anomaly.
- Researchers used computer-simulated models to reconstruct the geological history of the past 140 years. Through this they discovered the traced of the ancient ocean which was about 965km deep inside the earth's crust below Africa.
- The computer-simulations showed that there were molten rocks plump under Africa, which could have been formed by the subduction of tectonic plates into the mantle.
- According to them, these plumps could be responsible for IOGL.
- Later they admitted new scientist as they have not any clear evidence to confirm the existence of plumes under the Indian Ocean.
- Scientists thought there are some other unknown factors that need to be investigated further.