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1. Google DeepMind's Genie, an AI model that creates virtual worlds from image prompts

Why in news?
The biggest draw of video games is the escapism or the fantasy of a world far removed from our immediate reality. Now, imagine if you get the ability to create your own world. Well, researchers at Google DeepMind have come up with something that will enable you to create your own fictional world, similar to the outlandish landscapes seen in high-octane games.

Google DeepMind has just introduced Genie, a new model that can generate interactive video games from just a text or image prompt. That too without any prior training on game mechanics (which are essentially rules, elements, and processes that make up a game).

What is Genie?
According to the official Google DeepMind blog post, Genie is a foundation world model that is trained on videos sourced from the Internet. The model can "generate an endless variety of playable (action-controllable) worlds from synthetic images, photographs, and even sketches."

The research paper 'Genie: Generative Interactive Environments' states that Genie is the first generative interactive environment that has been trained in an unsupervised manner from unlabelled internet videos.

What does Genie do?
We have seen numerous generative AI models that produce creative content with language, images and even videos. Genie is a breakthrough as it makes playable environments from a single image prompt.

Why is it important?
The standout aspect of Genie is its ability to learn and reproduce controls for in-game characters exclusively from internet videos. This is noteworthy because internet videos do not have labels about the action that is performed in the video, or even which part of the image should be controlled.

According to Google DeepMind, the most distinct aspect of this model is that it allows you to create an entire new interactive environment from a single image. This opens up many possibilities, especially new ways to create and step into virtual worlds. To demonstrate this, the researchers created an in image using text-to-image model Imagen 2 and then used it as a prompt to create virtual worlds. The same can be done with sketches.

Relevance: GS Prelims & Mains Paper III; Science & Technology
Source: The Indian Express

2. PM Modi announces 4 astronauts for Gaganyaan

Prime Minister Narendra Modi hands over wings to astronauts-designate Shubanshu Shukla, Prashanth Balakrishnan Nair, Angad Prathap and Ajit Krishnan who have been selected to be the astronauts on India's first crewed mission to space 'Gaganyaan Mission', at the Vikram Sarabhai Space Centre (VSSC), in Thiruvananthapuram

Why in news?
Group Captain Prasanth Balakrishnan Nair, Group Captain Ajit Krishnan, Group Captain Angad Pratap, and Wing Commander Shubhanshu Shukla are India's astronauts-designate for Gaganyaan, India's first crewed space mission, announced by PM Modi.

All four Indian Air Force officers have had extensive experience as test pilots and are currently in training for the mission. Modi, who bestowed them with the prestigious astronaut wings, described them as "four forces" who represent the aspirations and optimism of 1.4 billion Indians.

Where was announcement made?

The announcement was made at the Vikram Sarabhai Space Centre in Thumba, Kerala, days after the Indian Space Research Organisation (ISRO) said it had successfully tested the human readiness of the cryogenic engine that will be used on the Gaganyaan mission vehicles.

First Test flight

The first mission flight, Gaganyaan-1, an unmanned test flight to check technology readiness, is expected by the end of 2024. The manned mission, which will take a three-member crew into a low earth orbit of 400 km altitude and return to Earth after three days, will follow.

In 1984, Wing Commander Rakesh Sharma became the first Indian in space when he flew to the Salyut 7 space station on a Soviet spacecraft. In 2006, India started work on an orbital vehicle mission that was later named Gaganyaan. As the astronauts-designate are named, here's where the various aspects of the mission stand.

Human rating of launch vehicle

ISRO will use its LVM3 rocket for all of Gaganyaan missions. LVM3, earlier called GSLV-MkIII, is the Indian space agency's most powerful launch vehicle that has flown seven times without failure. The rocket consists of liquid stage, solid stage, and cryogenic stage. ISRO has reconfigured all components of LVM3 to meet human rating requirements.

On February 14, final tests on the cryogenic engine, known as CE20, were performed. The engine successfully passed the test and was certified for missions that would transport humans to space.

The Vikas engine to be used in the liquid stage, and the solid booster, which is part of the solid stage, have already qualified for the missions.

The special flight engine, which ignites as the rocket lifts off, has completed acceptance tests. These tests certify/ qualify the test performance of the hardware according to the mission requirement. The technology or development is then applied in the final mission.

Crew module and escape system

Preparations for the human space flight includes development of life support systems to provide an Earth-like environment for the crew in space, provisions for emergency escape, and evolving crew management aspects for training, recovery, and rehabilitation of the crew.

Precursor missions such as Gaganyaan-1 will demonstrate the levels of technology preparedness before the manned mission. The unmanned mission will carry an unpressurised crew module — the capsule in which the astronauts will be seated during the human flight — to space and back.

The Gaganyaan-1 mission's crew module will not have the Environment Control and Life Support System, which ensures an Earth-like environment inside the module. ISRO is currently developing and testing the various components of the system at its labs.

Gaganyaan-1 will mainly test the safe re-entry of the crew module and proper orientation of the module when it splashes down in the sea.

A second unmanned flight is planned with a pressurised crew module, in which the complete life support system will be tested. This flight will carry the robot Vyommitra which will record all parameters to study the impact of the flight on humans.

In October last year, ISRO successfully conducted the first test of a basic crew module and crew escape system (CES). The CES is a part of the module that ensures "the crew is taken to a safe distance in case of any emergency either at launch pad or during ascent phase," according to ISRO.

The test also demonstrated the success of the deployment of drogue chutes at the desired angle. Drogue chutes play an essential role in stabilising the crew module and reducing its velocity to a safe level during re-entry. They bring the crew module from a height of 17 km and speed of 150 metres/ second to 2.5 km from the sea surface and a speed of 63 metres/ sec.

ISRO has also been experimenting with a crew module uprighting system, which ensures that the module remains upright after splashdown in the sea.

Training of the astronauts

The four astronauts completed their generic training at Russia's Yuri Gagarin Cosmonaut Training Centre between February 2020 and March 2021. ISRO signed a Memorandum of Understanding with Glavkosmos, a subsidiary of the Russian space agency Roscosmos, for the training in June 2019.

The astronauts are currently training at ISRO's astronaut training facility in Bengaluru. One of the four astronauts is expected to be trained by the American space agency NASA. Bill Nelson, administrator of NASA, had made this announcement during a visit to New Delhi in 2023. This astronaut would likely be chosen from among the four who are preparing for the Gaganyaan mission.

Relevance: GS Prelims & Mains Paper III; Science & Technology
Source: The Indian Express

3. How much do developed countries spend on research and development? Has the Ministry of Science and Technology consistently under-utilised its budget? How much does the private sector contribute to India's R&D funding?

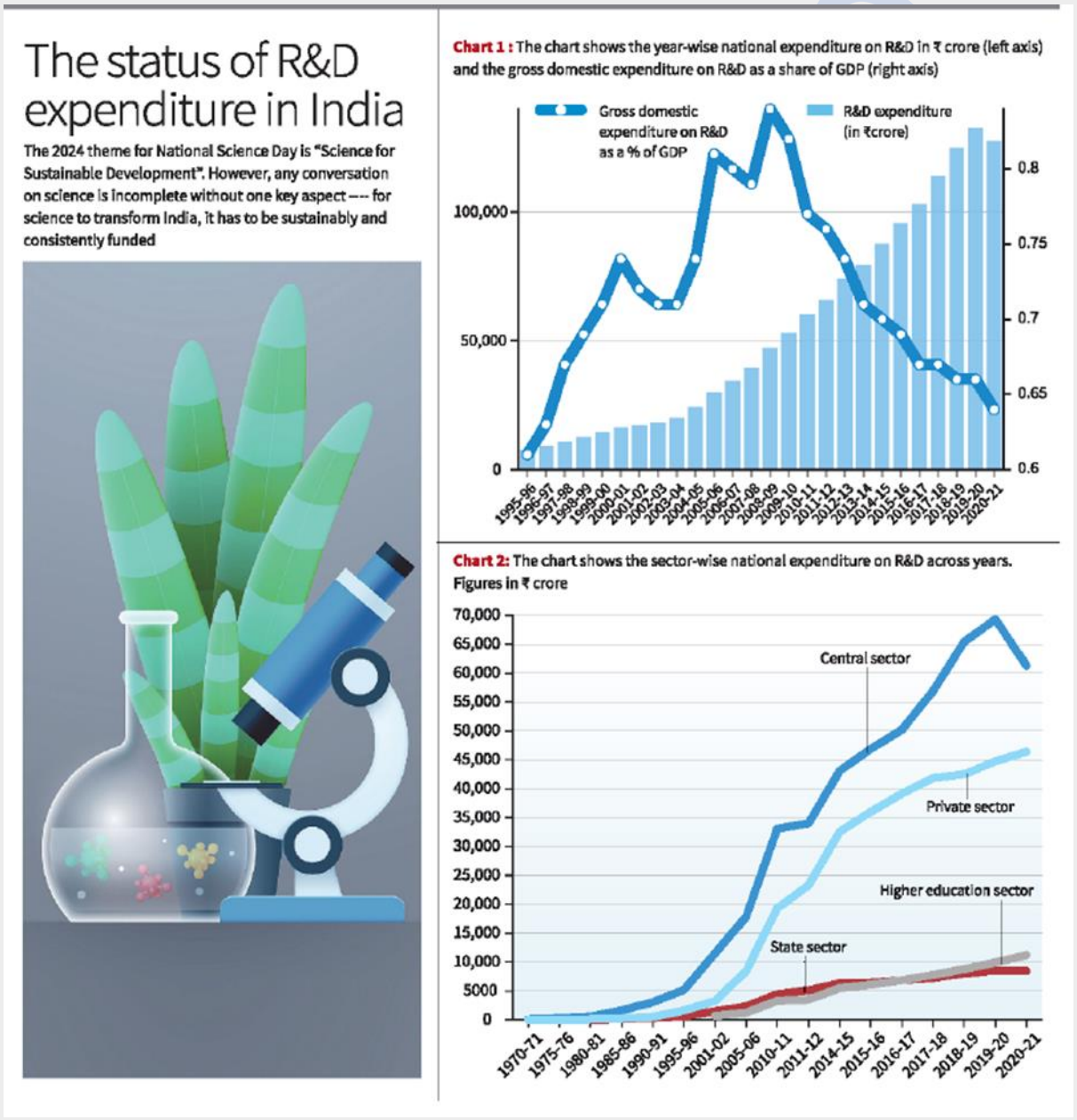
Why in news?

The 2024 theme for National Science Day, which India celebrates every year on February 28, is "Science for Sustainable Development". Science and technological developments are key drivers of India's journey towards becoming a developed country by 2047. Any conversation on science is incomplete without setting one key expectation — for science to transform India, it has to be sustainably and consistently funded.

How much is India spending on research and development?

Funding for fundamental research in India is amongst the world's lowest, particularly for a country with high science and technology ambitions. In the recent past, India's research and development (R&D) expenditure has dropped to the current 0.64% of GDP from 0.8% in 2008-2009 and 0.7% in 2017-2018.

Most developed countries spend between 2% and 4% of their respective GDPs on R&D. In 2021, member-countries of the Organisation for Economic Co-operation and Development (OECD) on average spent 2.7% of their GDP on R&D. The U.S. and the U.K. have consistently spent more than 2% of their GDPs on R&D for the past decade. Many experts have called for India to spend at least 1%, but ideally 3%, of its GDP every year until 2047 on R&D for science to have a meaningful impact on development.



How can India improve its R&D spending?

Science requires consistent, large-scale investment to bear fruit. For India to reach the 'developed nation' status, it needs to spend more to scale R&D than developed countries spend to maintain that status. This is the foundation of the demand to spend at least 3% of the GDP on R&D annually until 2047.

And beyond the current spending being inadequate, its primary dependence on public money signals an immature financing system and weak domestic market. In 2020-2021, the private sector industry contributed 36.4% whereas the Union government's share was 43.7%. State governments (6.7%), higher education (8.8%), and the public sector industry (4.4%) were the other major contributors.

In economically developed countries, a major share — 70% on average — of R&D investment comes from the private sector. The hesitancy of private-sector funding may be because of the poor capacity to evaluate R&D in India, ambiguous regulatory roadmaps that can deter investors, lack of clear exit options for investors in sectors such as biotechnology, and fears of intellectual property rights theft.

How is the R&D budget utilised?

While the need for India to at least double its R&D investment has been expressed several times, the question of how effectively the allocated money is spent is explored less often. The Union Ministry of Science and Technology has consistently under-utilised its budget. So, while the calls for increased funding — through both government and private sources — are legitimate, a strengthened budget utilisation is also required to affect science outcomes.

In 2022-2023, the Department of Biotechnology (DBT) used 72% of its estimated budget allocation on centrally sponsored schemes/projects while the Department of Science and Technology (DST) used only 61%. The Department of Scientific and Industrial Research (DSIR), which receives the lowest allocation for centrally sponsored schemes, spent 69% of its allocation.

Relevance: GS Prelims & Mains Paper III; Economics
Source: The Hindu