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Now, 'digital twin' to predict health risks, simulate treatment outcomes

Meenakshi.Sharma
@timesofindia.com

IIT-I'S TECH TONIC

- The technology is being developed under a ₹150-crore project
- The system creates dynamic digital representations of organs using multiple layers of patient data
- The virtual models enable doctors to track disease progression and forecast how patients may respond to therapies
- For patients, it translates to treatment plans tailored to their unique biology rather than generic approaches

Indore: Imagine a future where your doctor can test treatment on a virtual version of your heart or lungs before administering it to your actual body, or where a life-threatening complication is flagged hours before it ever becomes critical. This predictive and preventive health monitoring is the promise of the 'Digital Twin' technology being developed by the Indian Institute of Technology (IIT) Indore — a system that creates virtual replicas of human organs using artificial intelligence (AI).

By integrating patient records, diagnostic scans, laboratory reports and real-time physiological signals into AI models, IIT Indore is building 'digital copies' that can predict disease progression, simulate treatment outcomes and alert doctors to life-threatening complications before they occur.

The technology is being developed under a Rs 150-crore project supported by the Department of Science and Technology (DST) in collaboration with AIIMS Delhi, AIIMS Bhopal and AIIMS Raipur. It is already being tested in ICU risk prediction, cancer treatment planning, infant health monitoring and AR/VR-assisted surgical simulation — areas where the stakes are highest and the impact on ordinary patients can be most profound.

Developed by IITI Drishti CPS Foundation under the National Mission on Interdisciplinary Cyber-Physical Systems (NM-ICPS), the system creates dynamic digital representations of organs using multiple layers of patient data. These virtual models continuously update themselves using clinical and physiological information, enabling doctors to track disease progression and forecast how patients may respond to therapies. For patients, this translates to treatment plans tailored to their unique biology rather than generic approaches.

IIT Indore director Suhas S Joshi said, "The focus is on building systems that can directly support doctors in decision-making by combining engineering, medicine and data science. Such platforms have the potential to move beyond research and become integral to everyday clinical practice."

Researchers said Digital Twin lung models can simulate responses to infections and treatments, helping clinicians anticipate complications such as ventilator-associated pneumonia. For a patient in critical care, this could mean avoiding a deadly infection that once would have gone undetected until it was too late. The initiative is now expanding into cardiovascular systems, where researchers aim to identify risks such as heart failure and cardiac arrest at an earlier stage. The programme is also exploring applications in critical care, respiratory diseases and other major clinical areas.

"Our focus is on moving Digital Twin technology from research labs to clinically validated healthcare environments capable of supporting real-time decision-making in critical care and advanced disease management," said Principal Engineer at Drishti CPS Foundation, Dr Dheeraj Rane.

"The organ-wise and disease-specific approach is designed to ensure clinical relevance and accuracy," said Senior Scientific Officer at the Foundation, Dr Atreyee Ghosh. "The models are being developed for respiratory and cardiovascular diseases, intensive care monitoring and critical-care complications to support early risk prediction and personalised treatment planning," he said.

Researchers said the platform is being validated in AIIMS hospitals and could eventually evolve into consent-based personalised healthcare systems, allowing individuals to opt for predictive and preventive health monitoring through participating healthcare institutions as the technology matures and becomes operational.

Associate Vice President of the Foundation, Vaibhav Jain, said the initiative highlights the importance of building an integrated digital healthcare ecosystem where technology development, clinical validation, startup innovation and institutional collaboration work together to create scalable healthcare solutions with real-world societal impact.