



TIPS 4.0

TECHNOLOGY INNOVATION IN
CYBER-PHYSICAL SYSTEMS

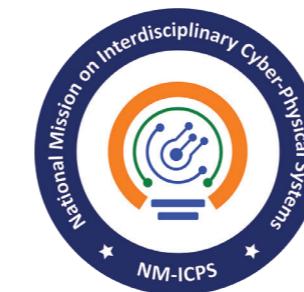


COMPENDIUM OF TECHNOLOGIES

National Mission on Interdisciplinary
Cyber-Physical Systems (NM-ICPS)



विज्ञान एवं प्रौद्योगिकी विभाग
DEPARTMENT OF
SCIENCE & TECHNOLOGY
सत्यमेव जयते





Dr. Kris Gopalakrishnan

Chairman, MGB, NM-ICPS

“ I am confident that through collective efforts involving the Government, Industry & Academia, India will be able to take a leadership position in the areas of CPS in times to come.

The Department of Science & Technology (DST), being the nodal department for the promotion of Science & Technology in the country, is implementing National Mission on Interdisciplinary Cyber- Physical Systems (NM-ICPS). The 25 Technology Innovation Hubs (TIHs) set up as a part of the Mission in leading technology institutions across the country function at the core of implementation of the Mission.

The Mission is aimed at fostering translational research in these academic institutions. The Mission has not only promoted the convergence of various disciplines but has also catalyzed the development of cutting-edge technologies in the realm of Cyber-Physical Systems (CPS).

The 4th National Workshop on Technology Innovation in Cyber-Physical Systems (TIPS 4.0) is a platform for each TIH to demonstrate the progress and achievements made during the last six months.

The workshop brings together all TIHs with a mandate to share cutting edge technologies developed in their respective technology vertical.

I am confident that through collective efforts involving the Government, Industry & Academia, India will be able to take a leadership position in the areas of CPS in times to come.



Prof. Abhay Karandikar
Secretary, Department of Science & Technology

“ I convey my best wishes to all participants of the workshop for meaningful discussions and successful implementation of the ideas exchanged during the workshop.

The National Mission on Interdisciplinary Cyber-Physical Systems (NM-ICPS) is being implemented by Department of Science & Technology (DST) through 25 Technology Innovation Hubs (TIHs) set up in academic institutions of repute (Host Institutes) across the country. Through these hubs, an ecosystem has been created that fosters Technology Development, Human Resource Development, Entrepreneurship and Translational Research to aid key sectors of Indian Economy. The Mission aims at the development of technology platforms to carry out R&D, translational research, product development, incubating & supporting start-ups as well as commercialization.

It gives me an immense pleasure to note that the 4th National Workshop on Technology Innovation in Cyber-Physical Systems (TIPS 4.0) is being organized by Department of Science & Technology, Government of India and hosted by TIH Foundation for IoT and IoE at IIT Bombay. The workshop focuses on the progress and achievements made by each TIH of the Mission in respective technology verticals, exchange of the ideas and best practices.

‘Investor Pitch’, an event to promote innovation and entrepreneurship in the CPS domain is a part of the TIPS 4.0, wherein a few DeepTech start-ups working in CPS domain will be pitching to venture capitalists and angel investors for funding. The start-up exhibition “Tech Expo” is also a part of this National workshop, wherein the start-ups from each TIH will exhibit and demonstrate their cutting-edge technology to stakeholders from the Government and Investor community.

The present compendium collates the breakthrough technologies developed under NM-ICPS with a potential to create a national impact.

• About the Technology

A LoRaWAN based smart IoT solution for monitoring crop and soil health. It is based on a low powered device which can operate for up to three years on its battery.

• Why is it needed?

SOHAM is used to remotely monitors soil, and crop parameters in the field by integrating various sensors and provides various timely advisories to the farmer on the iSARATHI mobile app.

• Innovation in the Technology

A LoRaWAN based smart and compact IoT solution for monitoring the farm ecosystem.

• Breakthrough nature of the technology and product

Application of LoRaWAN based communication technology integrated into a compact system with no use of internet for transferring the data.

• Socio Economic Impact

The farmer can view and visualize the data on a mobile application which also provide recommendations to manage crop health. SOHAM will help in optimization of the resources like pesticides, fertilizer and irrigation requirements and improve the quality of yield which will benefit increasing the income for the farmers.

• Application Sector

Agriculture

• Commercialization Status

Deployed at 7 locations in Satara District.

• TRL

7



FeetWings :

Smart patch for early warning and management of diabetes and related complications

- **About the Technology**

Our technology employs resonators and receiver to detect shifts in resonant frequencies caused by changes in blood glucose levels, leveraging variations in the dielectric properties of human tissues

- **Why is it needed?**

Critical for real-time glucose monitoring and intervention, enhancing diabetes management and preventing complications.

- **Innovation in the Technology**

Utilises gigahertz frequencies to monitor blood glucose non-invasively through changes in dielectric properties of human tissues.

- **Breakthrough nature of the technology and product**

Needle-free glucose monitoring, enhancing user comfort and encouraging more consistent diabetes management

- **Socio Economic Impact**

Enhances patient well-being, reduces emergency healthcare interventions, and lowers long-term treatment costs.

- **Application Sector**

Healthcare, specifically in the management of diabetes and wearable health technologies.

- **Commercialization Status**

Product development, currently raising funds to meet manufacturers MOQ and commercialisation.

- **TRL**

7



TIH Foundation
for IoT & IoE, IIT Bombay



IIT Bombay



IT-OT Security Operation Center



C3iHub, IIT Kanpur



IIT KANPUR

- **About the Technology**

Facility within an organization allowing automated 24/7 monitoring of cyber threats

- **Why Needed**

To avoid any cyberattack on organizations

- **Innovation in the Technology**

Indigenous Security Incident and Event Management Solution integrated with Remediation Workflow. Integration of C3iHub-developed defensive security solutions - intrusion detection, malware analysis, deception technology.

- **Socio Economic Impact**

Helps running operations in industries/organizations smoothly & securely

- **Application Sector**

Any sector

- **Commercialization Status**

Deployed at NHAI, IPA, BIT-Mesra

- **TRL**

9



Blockchain-based Transferable Development Rights (TDR) System



C3iHub, IIT Kanpur



IIT KANPUR

- **About the Technology**

Unique Blockchain Technology-based System for secure, transparent, & tamper-proof storage and management of Development Rights Certificates (DRCs) in cities

- **Why Needed**

To resolve existing property ownership related issues (litigation, frauds, scams etc) in cities

- **Innovation in the Technology**

Secure wallet linked with Aadhaar for storing DRCs TDR Portal integrated with building plan approval portal Automatically calculation of available DRs allowing monitoring of land trading by development authorities

- **Socio Economic Impact**

Enables transparency and ease-in-business contributing to real estate sector growth

- **Application Sector**

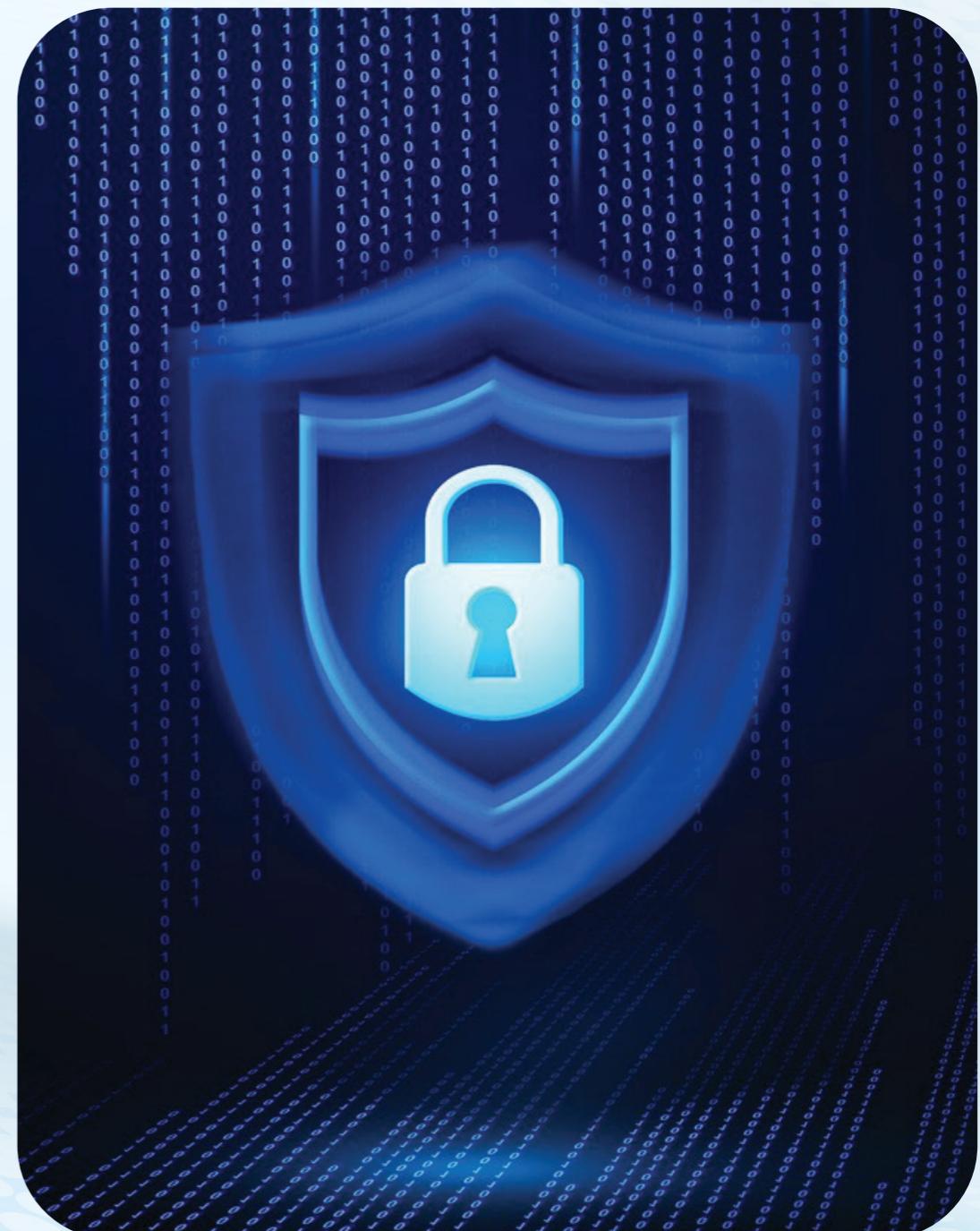
Real Estate

- **Commercialization Status**

Under deployment with KDA

- **TRL**

8



5G Lab and Standardization Effect

IITM Pravartak OTIC

- **About the Technology**

The state-of-the-art IITM PTF OTIC IN INDIA aims to establish itself as the 5G network Security, focusing on Open RAN and 5G core network functions

- **Why Needed**

The IITM PTF OTIC IN INDIA will serve as part of the global OTIC networks specialized on security to the global Open RAN ecosystem.

- **Innovation in the Technology**

The lab is equipped with a wide range of test equipment and infrastructure to support a variety of 5G testing requirements.

The IITM PTF OTIC IN INDIA located in the IITM Pravartak Technologies Foundation offers a secured, safe, and conducive environment for operators and vendors to collaborate, test and optimize vendors' O RAN solutions while ensuring each operator's and vendor's confidential information and IPRs (Intellectual property rights) are well protected as they operate in the OTIC lab facility either through on site or remote activities.

- **Socio Economic Impact**

To be the First OTIC in INDIA and going to be the third lab in the world for Security

- **Application Sector**

Critical Infrastructure

- **Commercialization Status**

The IITM PTF OTIC IN INDIA plans to offer world-class testing services, focusing on the Security testing of multi-vendor O-RAN solutions (this will be the focus at the launch of the OTIC)

- **TRL**

9



Optimized Mobile Surgical Unit for Cataract Surgeries in Remote Areas

- **About the Technology**

A first-of-its-kind technology in the country that targets the huge unaddressed need for cataract surgeries in rural India.

- **Why Needed**

The mobile eye surgical unit (MESU) is conceptualized to emulate the typical facilities in any quality land-based cataract surgery theatre, in a unit which could be moved to various locations across the country

- **Innovation in the Technology**

Twin vehicle design adopted, having two vehicles instead of one large vehicle to enable the surgery unit to access rural areas with narrow roads. These two vehicles travel independently and are connected at the camp site through a retractable vestibule for movement of people and equipment during the surgery camps

- **Socio Economic Impact**

Better access to cataract surgeries in rural areas, which might cause permanent blindness if left untreated

- **Application Sector**

Healthcare

- **Commercialization Status**

MESU has conducted 22,000+ surgeries in over 100 rural location in India

- **TRL**

9



Autonomous Vehicles - Map-based Navigation



TiHAN Foundation,
IIT Hyderabad



IIT Hyderabad

- **About the Technology**

Autonomous vehicle executing environment perception, path planning, and vehicle control as per safety standards, based on multimodal sensor fusion with point-to-point navigation

- **Why is it needed?**

Technology verification for advanced transportation technologies.

- **Innovation in the Technology**

Driverless transportation, TiAND multimodal driving dataset (Camera, Lidar, Radar and GNSS), Indigenous multi-sensor fusion autonomous driving stack, In-house developed Drive-by-wire (DBW) Technology, Digital-Twin map-based navigation technology, and Collision - Avoidance as per the ISO standards, Autonomous Parking and vehicles platooning.

- **Socio Economic Impact**

Enhanced Road Safety and Transportation Efficiency, Cost-effective and Sustainable Developmental Goals - Reduced Carbon footprint.

Breakthrough nature of the technology and product

Autonomous Campus Shuttle deployed at IITH campus since August 2023 with Indigenous multi-sensor fusion autonomous driving stack, Digital-Twin, Global & Local Path Planning, Cost-effective DBW solution for Autonomous vehicles, Obstacle Detection & Object Avoidance technologies.

- **Application Sector**

Transportation, Defense/Security, Agriculture, Ports & Container terminals.

- **Commercialization Status**

IIT Hyderabad, Naval Dockyard - Vizag, LBSNAA Campus - Mussorie, Tata Motors

- **TRL**

9



Biodiversity Sensor



TIF AWaDH, IIT Ropar



IIT Ropar

- **About the Technology**

The Biodiversity sensor is an IoT device using a cellular link, with an industrial-grade high-speed camera sensor for insect motion analysis. These devices are deployed in Bee farms in : Germany, France, USA, India (in Nashik, Maharashtra)

- **Why is it needed?**

Biodiversity sensors play a crucial role in monitoring and protecting Earth's diverse ecosystems, contributing to conservation efforts, sustainable management practices, and our understanding of the natural world.

- **Innovation in the Technology**

Our innovative solution seamlessly merges advanced weather sensor technology with cutting-edge AI- driven camera systems, creating a powerful tool for ecological monitoring and conservation efforts.

- **Socio Economic Impact**

The ability to accurately detect and analyze insect populations (pollinators) using high-speed camera sensors enables more targeted and effective pest management strategies. Effective conservation and environmental management can lead to economic benefits such as increased ecotourism opportunities. Researchers can utilize the wealth of real- time data provided by these sensors to advance scientific knowledge about various species' behaviors, ecological interactions, and responses to environmental changes.

- **Breakthrough nature of the technology and product**

The breakthrough nature of biodiversity sensors lies in their transformative potential to advance our understanding of ecosystems, biodiversity, and the environment, while empowering stakeholders to make informed decisions that promote sustainability, resilience, and equity in a rapidly changing world.

- **Application Sector**

Agriculture, Environment, Biodiversity Management

- **Commercialization Status**

Developed in Collaboration with Syngenta Global Switzerland, INRAE France & Fraunhofer Germany
(International Collaborations)

- **TRL**

9



CowHealth Monitor



TIF AWaDH, IIT Ropar



IIT Ropar

- **About the Technology**

An AI - powered livestock management CPS to monitor the behavior (Standing/lying duration; Feed intake and feeding duration; Rummation duration, etc.) of the livestock.

- **Why is it needed?**

Biodiversity sensors play a crucial role in monitoring and protecting Earth's diverse ecosystems, contributing to conservation efforts, sustainable management practices, and our understanding of the natural world.

- **Innovation in the Technology**

Low Power Consumption: BLE allows the sensors to function for extended periods for 5 years on a single battery charge. Compact Size: BLE technology enables the creation of small and lightweight sensors that can be comfortably worn by cows without hindering their movement or causing discomfort.

Data Transmission Efficiency: BLE facilitates efficient data transmission between the sensor collars and the gateway, even in potentially challenging farm environments.

- **Socio Economic Impact**

Dairy farms will progress as their livestock keep increasing and result in economy uplift in the country.

- **Breakthrough nature of the technology and product**

our system detects Heat and other health problems in advance and alert farmer about any future health issue.

- **Application Sector**

Dairy Industry : The focus on cow health, movement The focus on cow health, movement, and, and potentially milk production aligns perfectly with the needs of dairy farms for optimizing milk yield and cow well-being.

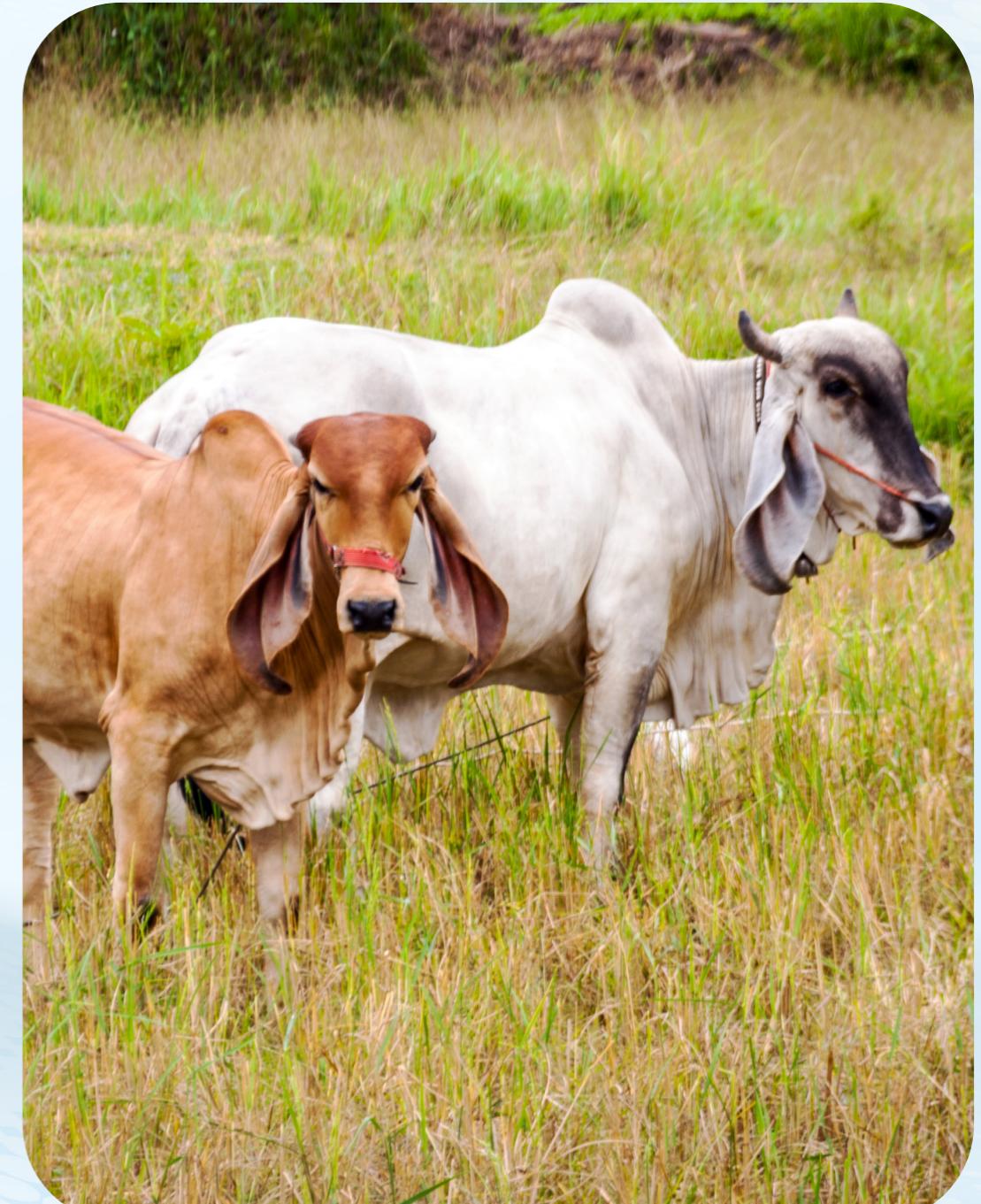
- **Commercialization Status**

Technology Transferred to Industry Mooofarm

Livestock monitoring devices in India are available at an average cost of INR 15000-18000. The Moosense 2.0 is placed with costing of INR 3500, the Gateway at INR 50,000 (300 channels).

Deployed in 6 Farms in Punjab. Another one will be deployed in NDRI Haryana

- **TRL**



Web-based platform for asset monitoring and management using satellite remote sensing

- **About the Technology**

RemSensing has a tool of Google Earth Engine like interface, which users can use to send the query.

- **Why is it needed?**

Remote sensing terminates the need for physical presence, reduces operational costs, and allows for extensive coverage of areas that are otherwise difficult to access.

- **Innovation in the Technology**

Innovative Solutions- Capable of providing valuable and actionable insights of the resources on earth surface through the use of remote sensing and ML, AI technologies

- **Socio Economic Impact**

These technologies can explore, map, monitor and educate about resources (e.g., farms, urban areas) and changes in earth surface. They can save time, efforts and money of these stakeholders as they provide legit and established scientific information produced by processing satellite data.

- **Breakthrough nature of the technology and product**

Website features a clean, user-friendly design, free from flashy and obstructive elements. Access critical information about the website, our team, and contact details for user-specific requests on other website pages with ease.

- **Application Sector**

Infrastructure, Agriculture.

- **Commercialization Status**

First Spin-off through Technology Development Project

- **TRL**

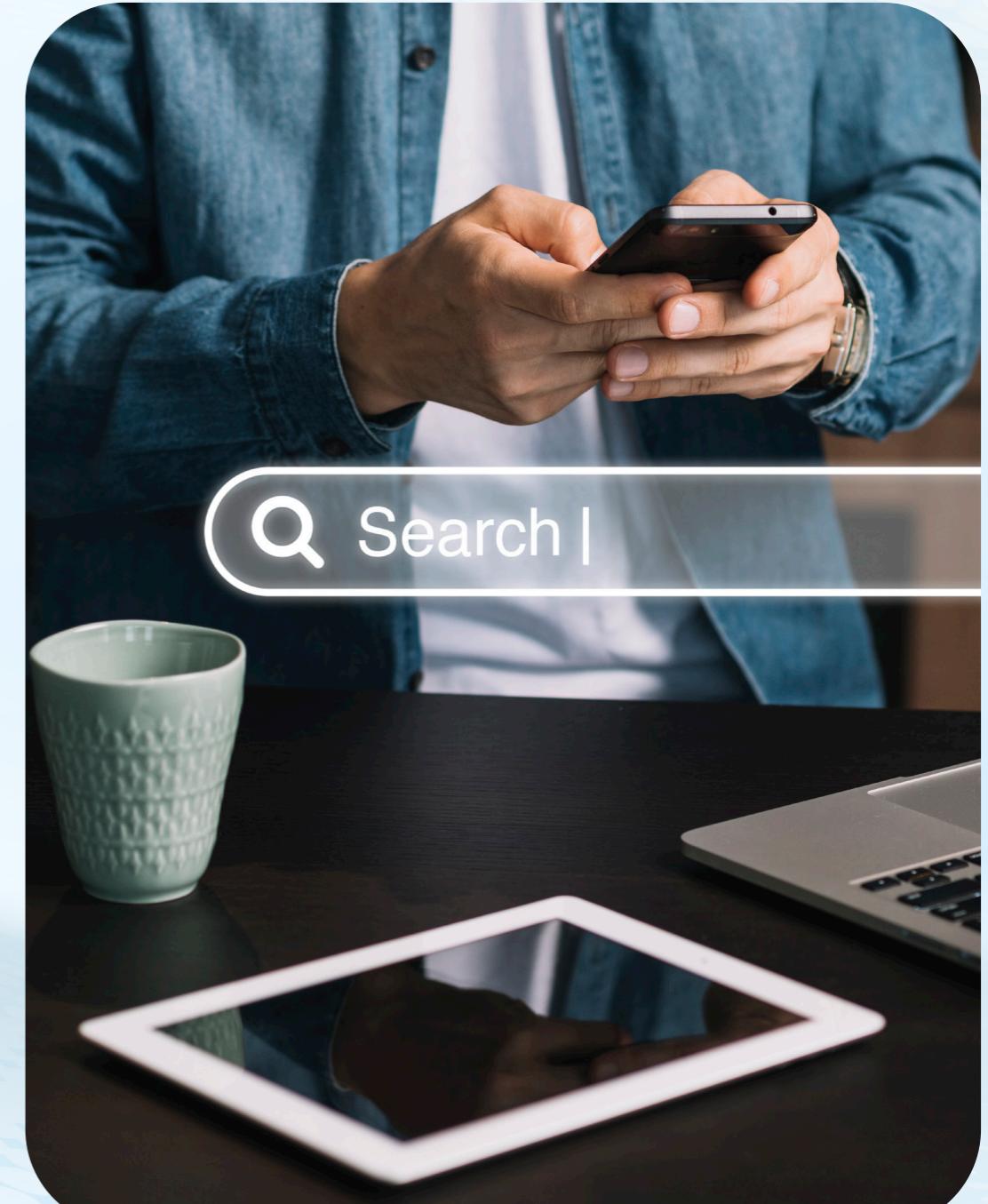
8



iHub DivyaSampark,
IIT Roorkee



IIT Roorkee



Deployment of T-CPS for intelligent mobility & efficient traffic control in smart cities: A promising future



iHub DivyaSampark,
IIT Roorkee



• About the Technology

Development of a traffic signal controller embedded with GPS and sensors for efficient, adaptive traffic signal system and development of an efficient routing and assistance system for emergency vehicles.

• Why is it needed?

Transportation plays a vital role in boosting the economy of the country by providing accessibility to goods, emergency services as well as mobility to the services.

• Innovation in the Technology

The emphasis of the project is the use of the CPS and IoT to simplify the complex issues of traffic and transportation planning, which eventually reduces the negative transport externalities.

• Socio Economic Impact

The project is envisaged in compliance with national missions like Digital India, Smart Cities Mission, AMRUT, Safer India, Make in India. The application of the developed devices and technologies will benefit not only the immediate end user but also the policymakers, planners as well as the infrastructure development authorities.

• Breakthrough nature of the technology and product

This project offers a cost effective and adaptive solution. With real time data and a novel algorithm, it outperforms traditional method, showcasing potential for broader IoT integration and promising prospects for future smart city developments.

• Application Sector

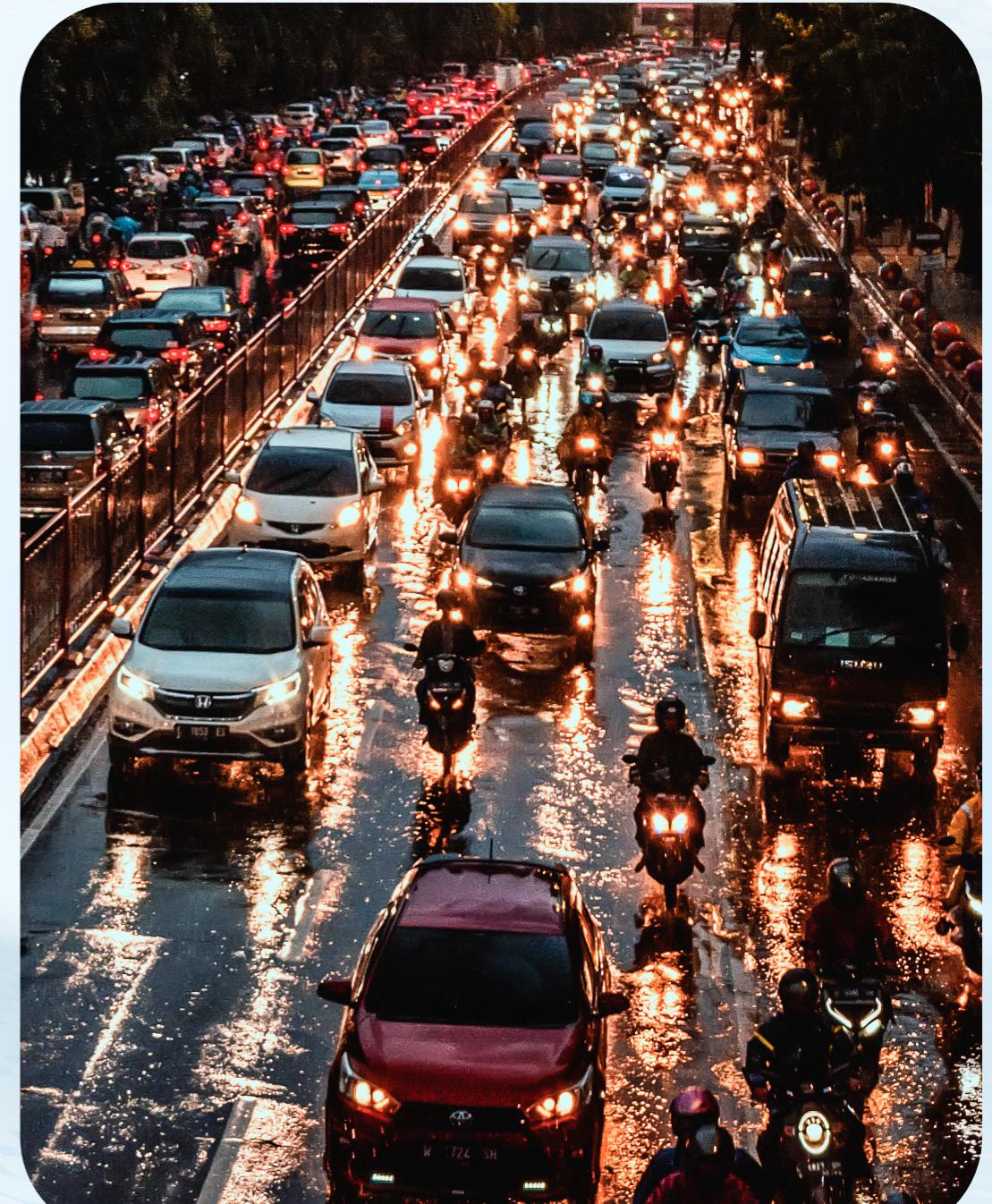
Smart Cities

• Commercialization Status

Second Spin-off through Technology Development Project Company Registration in Process

• TRL

8



EMG Controlled Prosthetic Hand (ENRICH)



IHFC, IIT Delhi



IIT Delhi

- **About the Technology**

Cost effective prosthetic hand is useful for upper limb amputees from wars, road accidents and industry mishaps.

It can help them in multiple grasping of objects in daily activities.

- **Why is it needed?**

Upper limb amputees are severely debilitated to carry out daily tasks and earn a livelihood.

- **Innovation in the Technology**

EMG controlled. Prosthetic hand mimics its natural counterpart with 14 degrees of freedom.

- **Breakthrough nature of the technology and product**

Affordability, lightweight design characteristics, operates effectively with only one EMG channel, thereby fostering greater usability.

- **Socio Economic Impact**

The prosthetic hand provides a source of cost- effective prosthetic hands to amputees in the country. It will provide opportunities for amputees to work and help gain employment for them.

- **Application Sector**

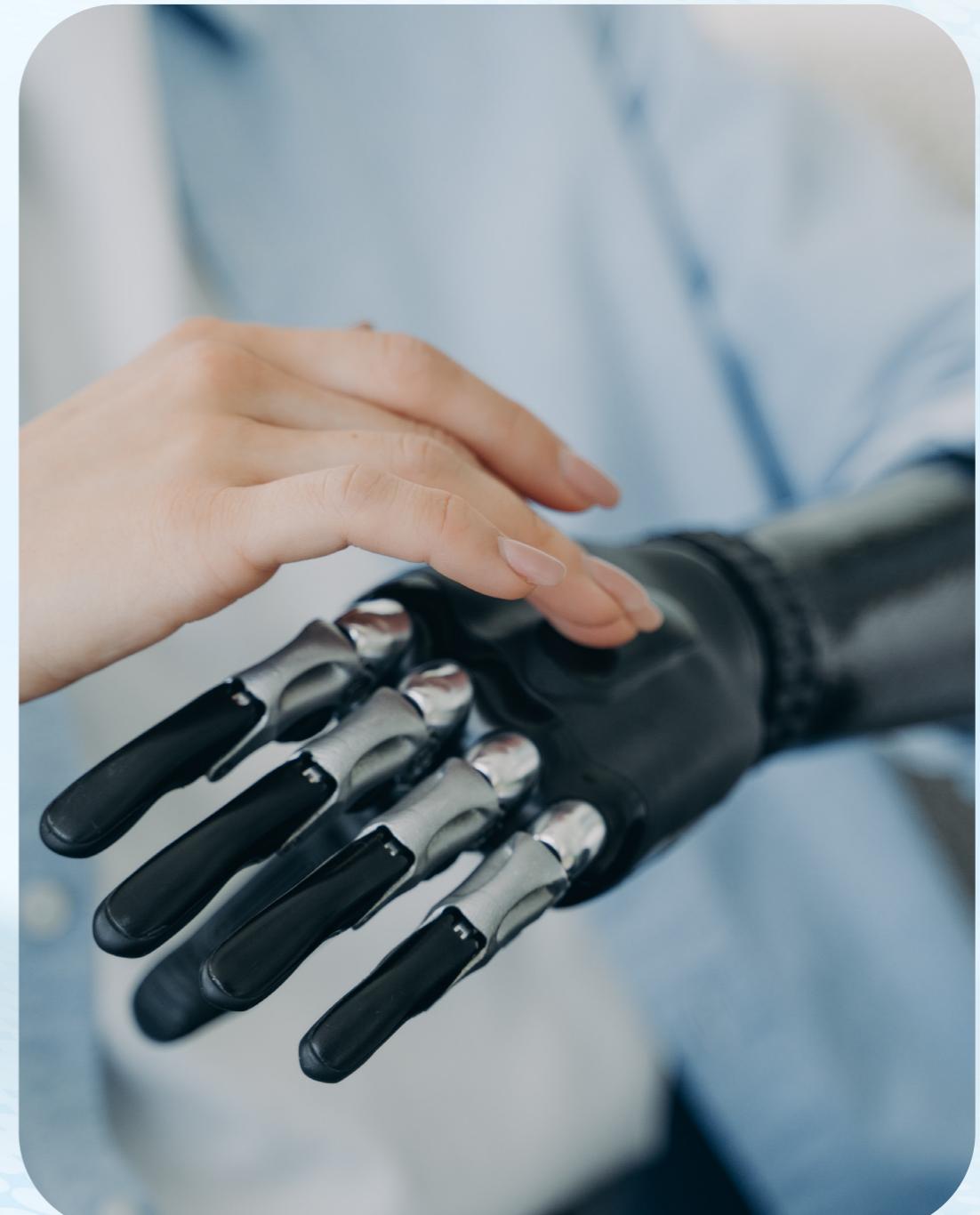
Health

- **Commercialization Status**

In Clinical Trials

- **TRL**

7



Large-scale, Open-Source Indic Language Datasets & AI models



Artpark, IISc



IISc Bangalore

- **About the Technology**

BhashaSetu is an AI-powered API designed to bridge the language gap for applications that only support English. Without appropriate language AI, users are limited to interacting with the application solely in English. With BhashaSetu, the possibilities expand!

- **Why Needed**

India's spoken language diversity is such that most models, including top performing models have low performance with natural spontaneous speech in majority of dialects. Without such data, AI models will never learn, and Digital India will not be inclusive.

- **Breakthrough nature of the technology and product**

Dataset collection and curation platform and involved innovations including ML-based checking on various factors.

For the first time spontaneous (unscripted) speech + transcribed text has been collected scientifically across ~200 districts (in 10 states) of India. Many languages such as Mythili and Santhali, and diversity of dialects is not available in any other dataset.

These datasets will be Open-sourced under Bhashini and will be used for all researchers, startups and innovators.

Early results from training using this data show improved performance of ASR (Automatic Speech Recognition) models across all dialects.

- **Application Sector**

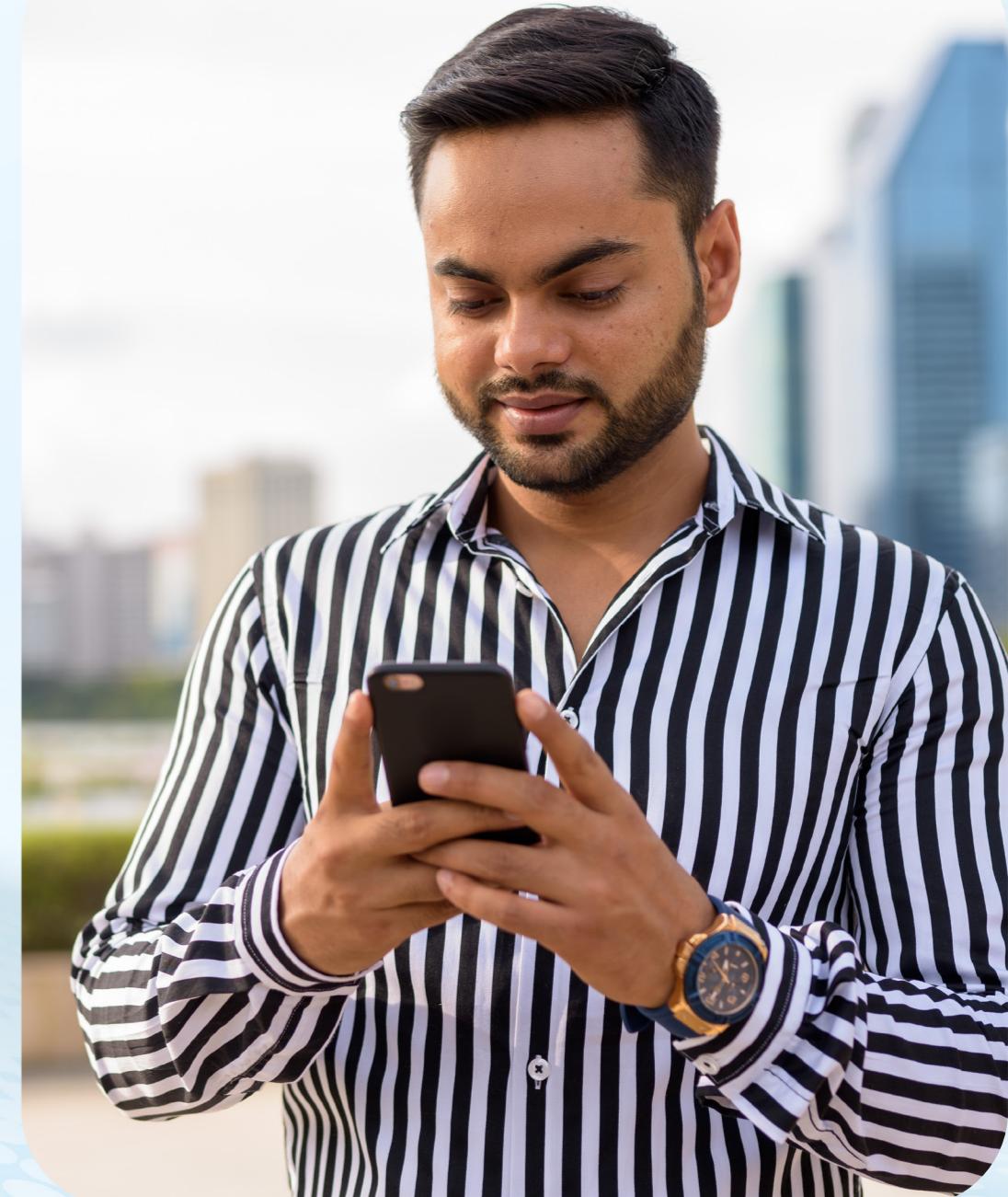
Health, Defense/Security, Infrastructure, Agriculture, Environment, Finance, Governance, Services

- **Commercialization Status**

Over 20,000 hours soon to be open-sourced via Bhashini.

- **TRL**

8



Generative AI with Retrieval Augmentation Generation (RAG)

- **About the Technology**

Based on Large Language Models and integrates with databases and documents with a UI based on popular chat interfaces

- **Why Needed**

Generative AI with Retrieval-Augmented Generation (RAG) is a cutting-edge approach that combines the strengths of generative AI models with the ability to pull in external information dynamically during the generation process. This makes it particularly useful across a range of applications where the integration of up-to-date information or specific knowledge is crucial. Here are several areas where RAG is or can be used effectively.

- **Innovation in the Technology**

A novel biochip device fabrication technology and sensitive detection method meeting FSSAI, USFDA And EU Standards.

- **Socio Economic Impact**

Increased productivity, Cost savings, Better Citizen and Customer Experience

- **Application Sector**

Health, Citizen Services, Banks, Retail, IT, Customer Support

- **Commercialization Status**

2 chatbots have been Deployed in Production Supported on WhatsApp, Slack and Telegram

- **TRL**

9



iHub Anubhuti,
IIIT Delhi



IIIT Delhi



Digital Mining Infrastructure for Indian Mines



TEXMiN, IIT Dhanbad



ISM Dhanbad

- **About the Technology**

End-to-end solution for the addressed problem which includes setting up of Private 5G Infrastructure, Platform for monitoring various (high bandwidth- low latency) mining and allied activities in remote areas (Surface mines)

- **Why Needed**

Expanding 4.0 technologies to last mile of remote Indian mines

- **Innovation in the Technology**

Several specific Mining 4.0 use cases for enabling Safe, smart and sustainable mines developed. Indigenous platform being developed to usher even 5G use cases for Indian mines - Future ready.

- **Breakthrough nature of the technology and product**

Device agnostic platform with technologies like holographic visualization, Edge computing, and AI enabled solutions for mining industry.

- **Application Sector**

Geospatial Technologies

- **Commercialization Status**

In Development state

- **TRL 7**



Geo-spatial technologies



TEXMiN, IIT Dhanbad



ISM Dhanbad

- **About the Technology**

For operations and compliances as per requirement of Indian mining regulations ; effective land utilization and land record management. This platform is capable of handling multiple geospatial related use cases.

- **Why Needed**

For operations and compliances as per requirement of Indian mining regulations :

Planning & Survey of Mines | Mine Monitoring

Volume Estimation | Haul Road Analytics

Features extraction based on Point cloud segmentation

- **Innovation in the Technology**

A cloud-based data management and monitoring system GIS-based platform for real-time monitoring of mining activities(drone data, mine development, boundary pillars, land scheduling, exploration, mineral beneficiation, mining, stacking & dumping, and mine closure plan).

Pointcloud architecture achieved convergence after approximately 120 epochs, yielding impressive test scores with a maximum macro-F1-Score of 0.82 and an accuracy of around 0.89.

- **Breakthrough nature of the technology and product**

Indigenous data processing platform capable of processing drone and satellite data

- **Application Sector**

Geospatial Technologies

- **Commercialization Status**

Commercialized

- **TRL 9**



Accessible banking functionalities for **Divyang (Visually Impaired) using smart ATM.**



IBITF, IIT Bhilai



IIT Bhilai

- **About the Technology**

Easily accessible to people with disabilities, especially visually impaired individuals. It eliminates the need for physical PIN entry and enhances security through mobile app-based voice commands and QR code scanning.

- **Why Needed**

Despite features in traditional ATMs aimed at assisting visually impaired individuals, a survey reveals that less than 18% of ATMs in India are accessible to people with disabilities, primarily due to issues such as inadequate voice quality and security concerns.

Visually impaired individuals and PRMs (Persons with Reduced Mobility) are a very small component of the customer base for financial institutions to adopt changes to existing ATMs

- **Innovation in the Technology**

Touch-free technology and voice-guided interface for smooth access and advanced security features in the ATM, namely, multi-factor authentication using ATM cards, mobile numbers, location, Aadhar-based face, and voice recognition using mobile phones.

Detect the presence of multiple individuals within the ATM room and promptly relay warning messages and relevant information to the appropriate authorities in cases of potential intrusions or attempted theft.

- **Socio Economic Impact**

Making Divyang people self-reliant to use financial services

Reduce fraud and improve security for a Divyang person using ATMs

Promote financial inclusion among people with disabilities.

- **Application Sector**

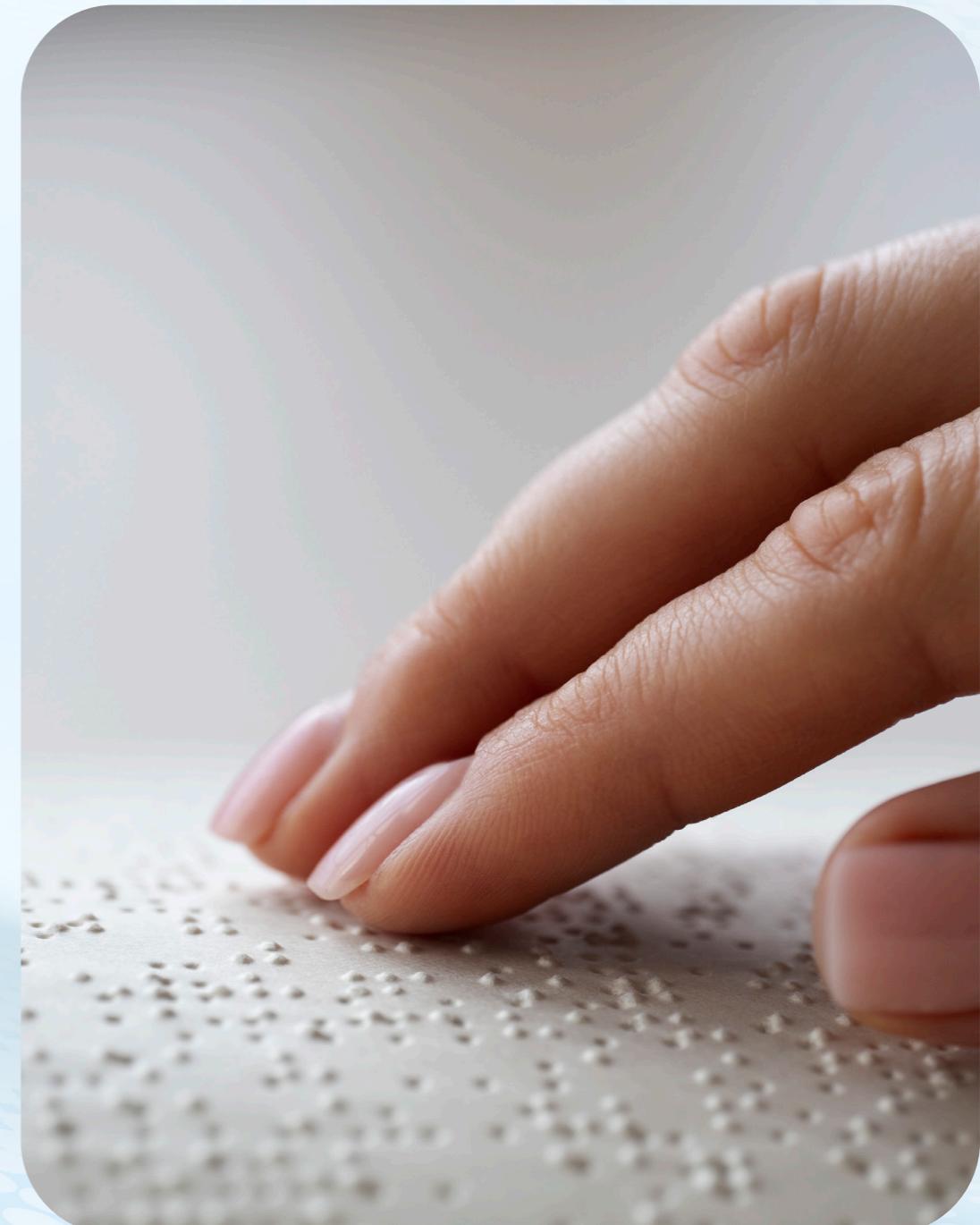
Infrastructure and Fintech

- **Commercialization Status**

Prototype Deployed and Validation

Prototype Deployed in IIT Bhilai and National Association for the Blind (NAB). The solution is being improved in collaboration with the earning members of the NAB to ensure easy rollout and adoption

- **TRL**



Seamless integration

of payment and activities
in an educational campus through smart card and
behavioral analysis of collected data



IBITF, IIT Bhilai



IIT Bhilai

• About the Technology

Easily accessible to people with disabilities, especially visually impaired individuals. It eliminates the need for physical PIN entry and enhances security through mobile app-based voice commands and QR code scanning.

• Why Needed

Detection of behavioral anomalies to provide early assistance to students, avoiding drastic measures such as suicide

Enhances campus experience through seamless integration of access to campus activities and payments like library membership, attendance, payment, access control, etc.

• Innovation in the Technology

Identify students' anomalous behavior in diverse time-series data.

Define anomalies as significant deviations from most student data, considering different thresholds and granularity levels.

A model is trained to spot differences between actual and predicted data points, triggering alarms when such deviations occur consistently.

No Indian educational campus has a unified system incorporating financial and non-financial activities.

• Socio Economic Impact

No previous studies classify the data that constitutes anomalous behavior among students.

Aims to restrict student suicide through early detection of traits and providing timely intervention

• Application Sector

Infrastructure and Fintech

• Commercialization Status

Operational in IIT Bhilai Main Campus

Vidya Samiksha Kandra, Raipur- Project worth 4.5 Cr for development and Deployment

Discussions with banks and Financial institutions for deployment as a solution in other campuses are underway.

• TRL



IoT Based Smart Grid



IDAPT Hub, IIT (BHU)
Varanasi



IIT BHU

- **About the Technology**

IoT Based 2.5 kW solar-integrated smart grid is installed at the library building of IIT BHU. The installed system is empowered with IoT-enabled technologies which enable the devices can be controlled remotely.

- **Why is it needed?**

A new type of converter topology has been developed that can take power from solar PV and give three simultaneous outputs i.e. 1) 230V, 50 Hz AC, 2) 90 V dc, and 3) 5V DC.

- **Innovation in the Technology**

This technology avoids the use of dedicated charger for laptops and mobile phone, and optimizing the load and source, and improve the efficiency of operations.

- **Socio Economic Impact**

Technology is under Testing and Trial phase

- **Application Sector**

Power

- **Commercialization Status**

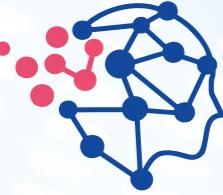
Technology is developed and installed at the IIT (BHU) Library Balding for the field testing before approaching to commercialization.

- **TRL**

7



AI/ML For Mobility



- **About the Technology**

iRASTE (Intelligent Solutions for Road Safety through Technology & Engineering) brings together Artificial Intelligence (AI) scientists and Road Engineering experts to transform road safety engineering leveraging the predictive power of AI.

- **Why Needed**

To reduce fatalities and road accidents by 50% by 2030.

- **Innovation in the Technology**

Prediction of Accident-Prone locations using the data from ADAS installed Vehicles.

- **Breakthrough nature of the technology and product**

First of its kind ADAS deployment in India (Nagpur and Telangana)

- **Socio Economic Impact**

31% Reduction in Road Accidents using AI/ML Technology for mass scale implementation achieved.

41 lives saved in the last 4 months using Trystander cells.

- **Application Sector**

Mobility and Transportation Safety

- **Commercialization Status**

Largest ADAS Pilot in India (450 buses in Nagpur and Telangana) primarily intended to reduce road accidents.

- **TRL**

9



TiHAN Testbed / Living Lab on Autonomous Navigation (Aerial & Terrestrial)

• About the Technology

Autonomous navigation technologies testing facility in India with test tracks, environment emulators, drone control test centre, 5G, and edge computing facilities.

• Why is it needed?

Technology verification for advanced transportation technologies.

• Innovation in the Technology

Proving Grounds, Test tracks, Mechanical integration facilities like Hangers, Command control stations, state-of-the-art Simulation tools (SIL, HIL, VIL), Test tracks/circuits, Road Infra – Smart Poles, signalized & unsignalized Intersections, Environment Emulators like Rainfall Simulators, Drone Runways & Landing area, e-Propulsion lab, Multi-radio units: WiFi, BVLOS, CV2X, 5G, and Edge Cloud.

• Socio Economic Impact

Autonomous Navigation Testbed aids in realizing sustainable development goals by the advancement of mobility.

• Application Sector

Infrastructure (Transportation), Automotive, Defense, Healthcare, Agriculture, and Environment

• Commercialization Status

Tata Technologies Limited (TTL), Suzuki Motor Corporation, DYSL-AI-DRDO, C-DAC, L&T Technology Services.

• TRL

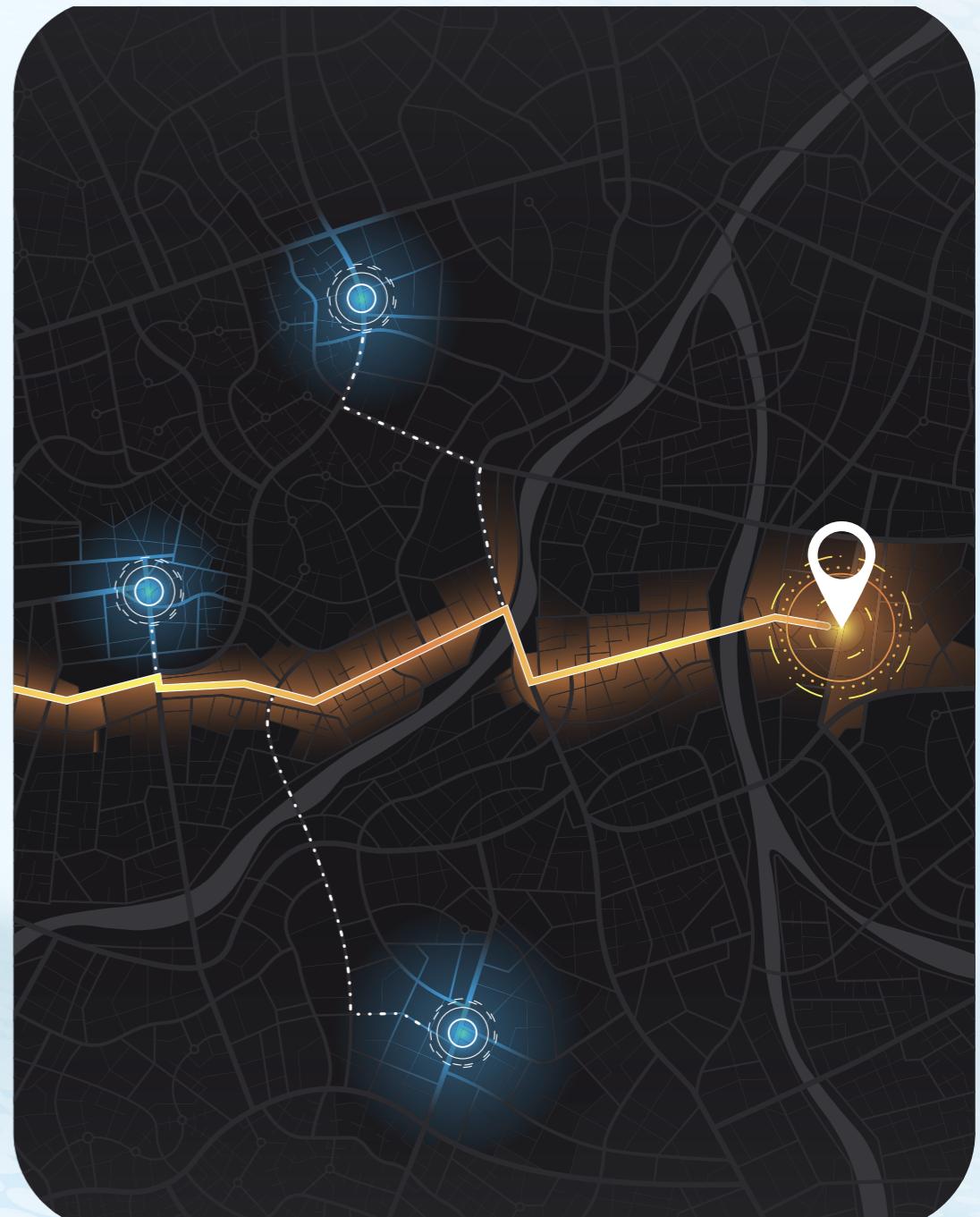
9



IDAPT Hub, IIT (BHU)
Varanasi



IIT BHU



Underwater welding



Technology
Innovation Hub
IITG TIDF

TIDF, IIT Guwahati



IIT Guwahati

- **About the Technology**

Through classroom lectures, simulation exercises, and immersive fieldwork, participants will gain a comprehensive understanding of the intricacies involved in underwater welding.

- **Why is it needed?**

There is a huge demand for skillful underwater welders in India.

- **Innovation in the Technology**

The program integrates theoretical teachings with practical training, covering essential topics such as welding techniques, equipment operation, safety protocols, and underwater construction principles

- **Breakthrough nature of the technology and product**

First of its kind in India: A Certification course on Underwater Welding

- **Socio Economic Impact**

Since there is a huge gap in underwater welding and this is the first of its kind, it opens up a lot of opportunities in terms of job creation and training.

- **Application Sector**

Underwater pipeline industries.

- **Commercialization Status**

Testing and deployed in diving school - Kochi

- **TRL**

7



Digital Museum



TIH
iHub-Drishti

iHub Drishti, IIT Jodhpur



IIT Jodhpur

- **About the Technology**

Five Rajasthan Government museums in the cities of Alwar, Chittorgarh, Baran, Bundi, and Bharatpur in Rajasthan are digitized and uploaded to the Rajasthan Government server

- **Why is it needed?**

Explore the rich heritage culture of India through VR Web-based Virtual Museum Space with interactive and immersive infographic content

- **Innovation in the Technology**

Augmented with 360 degrees Interactive 3D models of the museum artifacts

Pre-defined tours to take through a guided experience with enhanced imagery and descriptions, easy-to-navigate controls

- **Socio Economic Impact**

Building awareness and promoting Indian Heritage

- **Application Sector**

Education and Heritage

- **Commercialization Status**

Deployed at NIC web portal <https://digitalmuseum.rajasthan.gov.in/>

- **TRL**

9



Campus Rakshak



TIH
iHub-Drishti



iHub Drishti, IIT Jodhpur

IIT Jodhpur

- **About the Technology**

Campus Rakshak as a Service (C-RaaS) is a decision support framework and can assist the campus administrators in making an informed decision during the critical transition period as we have seen at the time of the recent pandemic.

- **Why is it needed?**

A badging system, Health Badge, that enables the real-time implementation of interventions for COVID.
The mobile app, GO CORONA GO, that builds an anonymous contact graph, which can aid contact tracing
A novel smart pooling scheme, Tapestry Pooling, to quantitatively screening resulting in considerable savings in screening cost
Multiple Simulators

- **Innovation in the Technology**

Novel smart pooling scheme
Simulation Algorithms

- **Socio Economic Impact**

Monitoring of the COVID-19 spread in gated institutions
Tracing and Tapping of agents

- **Application Sector**

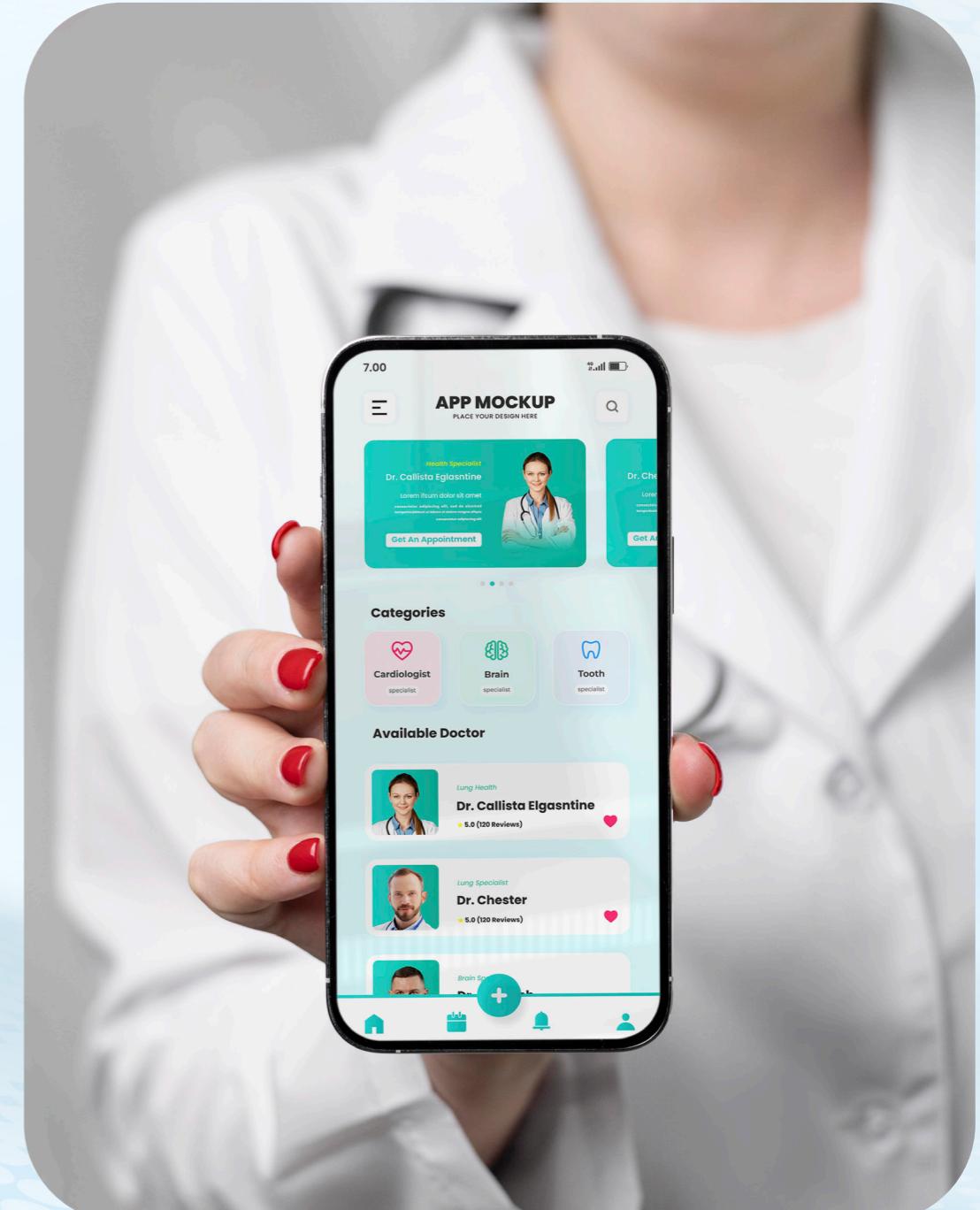
Healthcare

- **Commercialization Status**

Deployed at IIIT Hyderabad and IIT Jodhpur Generalisation of technologies in progress

- **TRL**

9



Driver's Alertness Management System DAMS



iHub and HCI Foundation,
IIT Mandi



IIT Mandi

- **About the Technology**

Using the opensource Indian legal database, creating a domain based legal LLM given the established setup through the pilot project for high court.

- **Why is it needed?**

2.2 million Buses owned by the public and private sector across India.

0.46 million Road accidents in India in 2022

0.04 million fatalities and ~ 0.42 million injuries

40% of the total road accidents are caused by driver's fatigue

- **Innovation in the Technology**

Application based on Deep Technologies like Computer Vision and ML algorithms.

- **Socio Economic Impact**

Industry-defining solution in road safety management for public safety in India.

To be deployed across the 3 northern states of India which will impact around 5% of India's population by the year FY 2025-26.

First of its kind - It has been found that none of the public buses in India have been equipped with this safety feature.

- **Breakthrough nature of the technology and product**

Faster Data Rates, Increased Capacity, Improved Power Efficiency, Enhanced Performance,

Extended Coverage which allows faster file transfers of large files with robust

Human-Computer Interaction in dense environments of India.

- **Application Sector**

Digital Infrastructure with Deep-Tech for the transportation industry.

- **Commercialization Status**

To be implemented in 438 buses of CTU in next FY 2024-25

- **TRL**



Domain based Legal LLM for the enterprise

(High court of Punjab and Haryana) with New-Age Digital Infrastructure.

- **About the Technology**

Using the opensource Indian legal database, creating a domain based legal LLM given the established setup through the pilot project for high court.

- **Why is it needed?**

4.3 Cr/5 Cr cases, i.e. more than 85% cases, are pending in district courts as of December 2022. To improve the efficiency, accessibility, and transparency of the Indian judicial system and hence reduce the pending cases.

- **Innovation in the Technology**

Establishment of E-courts with an aim to provide online access (accessibility), automate case management (efficiency) through new age technology intervention like Large Language Model (LLM) to digitize court processes (transparency) thereby reducing pendency.

- **Socio Economic Impact**

Pendency of cases cost 1.5%-2% of India's GDP. Hence, this project of digital infrastructure for LLM in Punjab and Haryana was implemented to be among the first in the Indian government sector.

We are planning to implement our solution in 5 neighboring states in the northern part of country covering around 11% of India's GDP. India is a mobile first country with 95% net connections on mobile. Hence accessibility can be increased through robust networks. Public Wi-Fi networks are needed for mobile performance.(India has 0.5 million PWH – Public Wi-Fi Hotspot for 1.4 Billion)

Wi-Fi allocation in India : 5 % of unlicensed spectrum hence Wi-Fi 6 is used for HCI.

- **Breakthrough nature of the technology and product**

Faster Data Rates, Increased Capacity, Improved Power Efficiency, Enhanced Performance, Extended Coverage which allows faster file transfers of large files with robust Human-Computer Interaction in dense environments of India.

- **Application Sector**

Indian State Judiciary and Legal Sector

- **Commercialization Status**

Digital accessibility established at Punjab and Haryana High Court and automation through LLM is underway

- **TRL**



Underwater robotic vehicle with tilting thrusters for marine applications



IIT PALAKKAD

IIT Palakkad

• About the Technology

A Mid-sized energy efficient Underwater robot with autonomous control for deep sea explorations & defence application. Fabricated a fully ready prototype with aluminium alloy casing for 300 m depth applications & tested in Simulated Motion Basin of NSTL up to 30 m depth and in real environment in the Dam reservoir at Mandi and Sisu lake in Manali. Indian Patent filed on the technology. Closing the technology transfer to a Startup supplying to Navy & also in discussion with Adani Oil & Gas team

• Why is it needed?

Remotely operated underwater vehicles involves man-machine control loops. Robotic vehicles having tilting thrusters to achieve six degrees of freedom with autonomous/semi-autonomous controls are required to perform complex intervention tasks in deep-sea operations.

• Innovation in the Technology

Design with four tilting thrusters, providing 6 DoF for manipulators, & autonomous control systems

• Socio Economic Impact

Very few successful startups & industries in this space

- Interventional class robots are required for various domains in the country for inspection & defence applications
- Import independency, skilled human resources for fabrication & servicing of underwater robots

• Breakthrough nature of the technology and product

High endurance with four tilting thrusters, providing 6 DoF for manipulators & autonomous control systems

• Application Sector

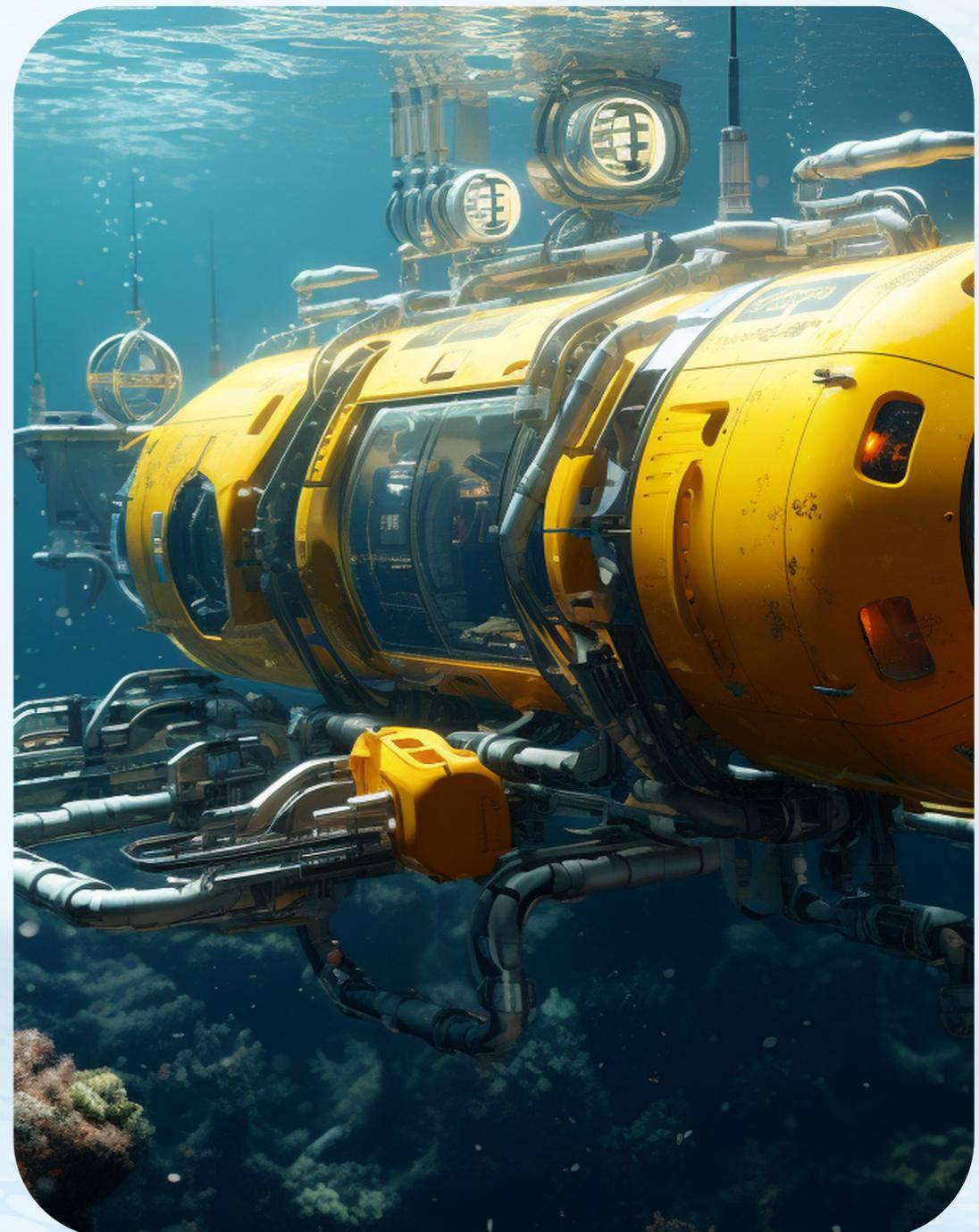
Defence/Marine/Off-shore oil & gas

• Commercialization Status

Technology Transfer Stage

• TRL

Technology IHub Foundation,
IIT Palakkad



TARS: Plug and Play Modular Electronics for enabling SVTA

• About the Technology

The Advanced Innovative Modular Electronics (AIM) is based on the TARS technology that provides absolute freedom to learners (students, diploma students, ITI, Engineering and Entrepreneurs) to rapidly learn, innovate, ideate and productize.

• Why is it needed?

TARS Electronic board series, addressing the challenges inherent in Internet of Things (IoT) and embedded systems development. Traditional approaches often consume significant human-hours in addressing issues like breadboard errors, coding, and soldering during prototype realization. TARS plug-and-play electronic modules emerge as a transformative solution, minimizing time and effort while offering an ideal platform for micro and small-scale enterprises, students, and researchers. Featuring the capability to integrate over fifty sensors and various electronic components, including HDMI, Bluetooth, ZigBee, and IEEE 802.11 Wi-Fi, this board transforms into a cluster of IoT systems, streamlining development processes and fostering innovation. Additionally, it serves as an excellent platform for skill development of the electronics engineering workforce, enhancing proficiency and expertise in emerging technologies.

• Innovation in the Technology

Makes assembling electronics as easy as plugging USB drives into your computer.

Bypasses coding by providing drag and drop code blocks in the firmware of the embedded electronics.

Incorporate AI and ML in embedded systems also known as TinyML: Enabling Speech Text Video Analytics

• Socio Economic Impact

The vision of this technology is to capitalize and Strengthen India's position as the Pharma capital. Introduction of deep technologies will propel the Indian Pharma sector into the Pharma 4.0 thus making drug manufacturing and innovation a highly precision and intelligence driven affair. This also has a deep impact on India's foreign policy and influence on the UN security council.

• Breakthrough nature of the technology and product

Electronics used is Modular. Sensors are being made indigenously Cybersecurity & AI models deployed have come from the indigenous Cybersecurity and AI sector of India

• Application Sector

Health, Defense/Security, Infrastructure, Agriculture, Environment

• Commercialization Status

Full scale Prototype Field Demonstration Completed.

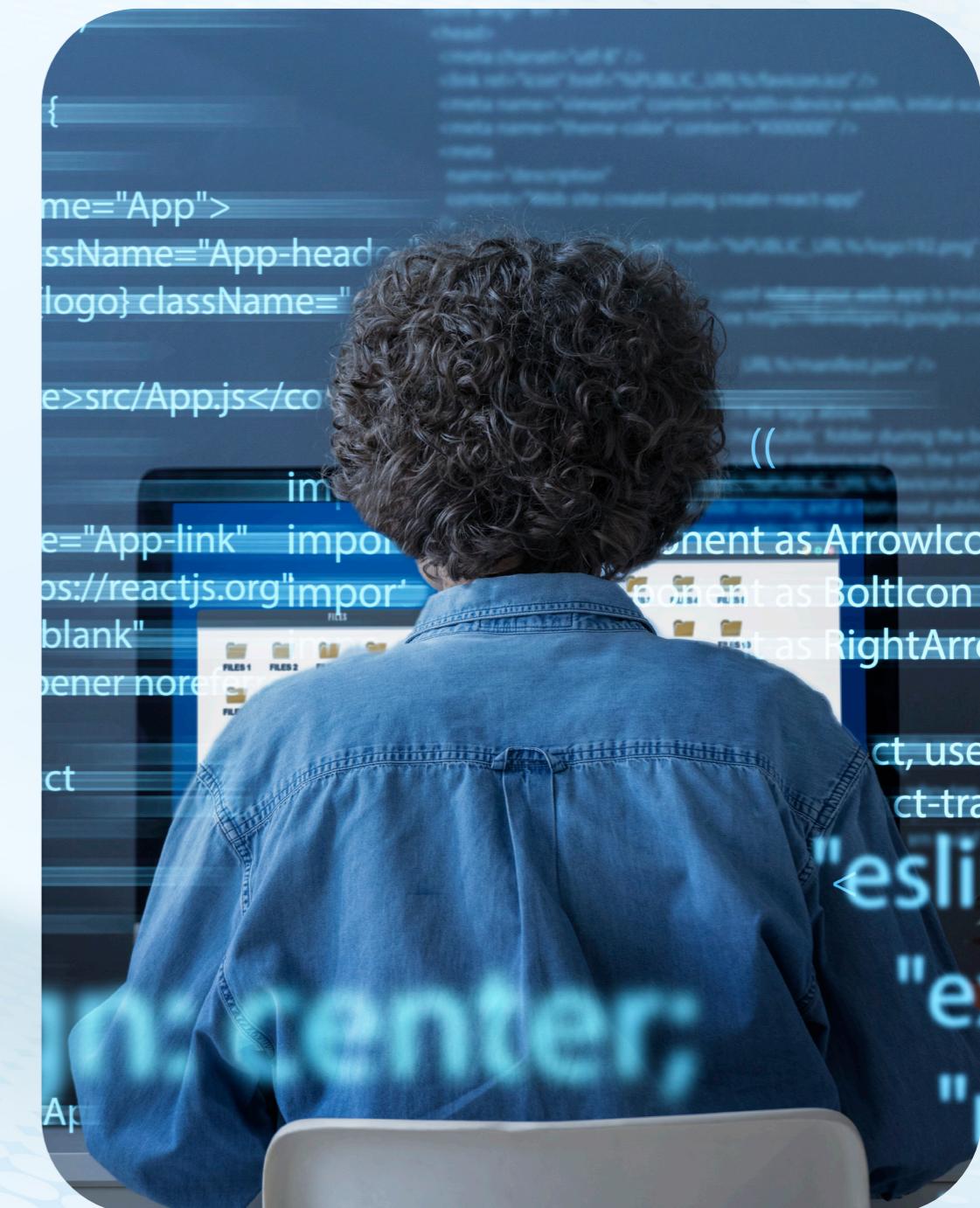
• TRL 9



Vishlesan I hub
Foundation IIT Patna



IIT Patna



Development of the Smart-NLD system



IDEAS, ISI Kolkata



ISI Kolkata

- **Why is it needed?**

Biodiversity sensors play a crucial role in monitoring and protecting Earth's diverse ecosystems, contributing to conservation efforts, sustainable management practices, and our understanding of the natural world.

- **Innovation in the Technology**

The system employs a combination of technological features to create an innovative, ethical, and environmentally conscious solution to specifically target conflict animals and reduce habituation by wild herbivores and carnivores to mitigate wildlife-human conflicts.

- **Socio Economic Impact**

No harm to the animal: Smart-NLD will rely on dual fear evoking stimulus i.e., audio and visual response thus will be comparatively safer than wire fencing and electric fencing.

Animal Recognition using AI: The Smart-NLD system employs AI for species-specific animal recognition. Identification of the conflict animal and generating a specific deterrent response is a novel strategy and will eliminate the habituation of animals and thus ensure its long-term efficiency.

Real-Time Data Processing: The system will collect and analyze a substantial amount of real-time data regarding animal movement, sounds, and other variables.

Case report: Smart-NLD will be equipped to generate case report of conflict animal visit within the vicinity. The data will be shared to the owner, forest department, and implementation partners through GSM module.

Low Habituation: Smart-NLD will use AI powered animal recognition system provide species-specific response with varying intensity of light and sound. Thus, will lower the chances of species habituation and increase the efficiency of the product compared to NS-NLD (Nonspecific-Non lethal deterrent).

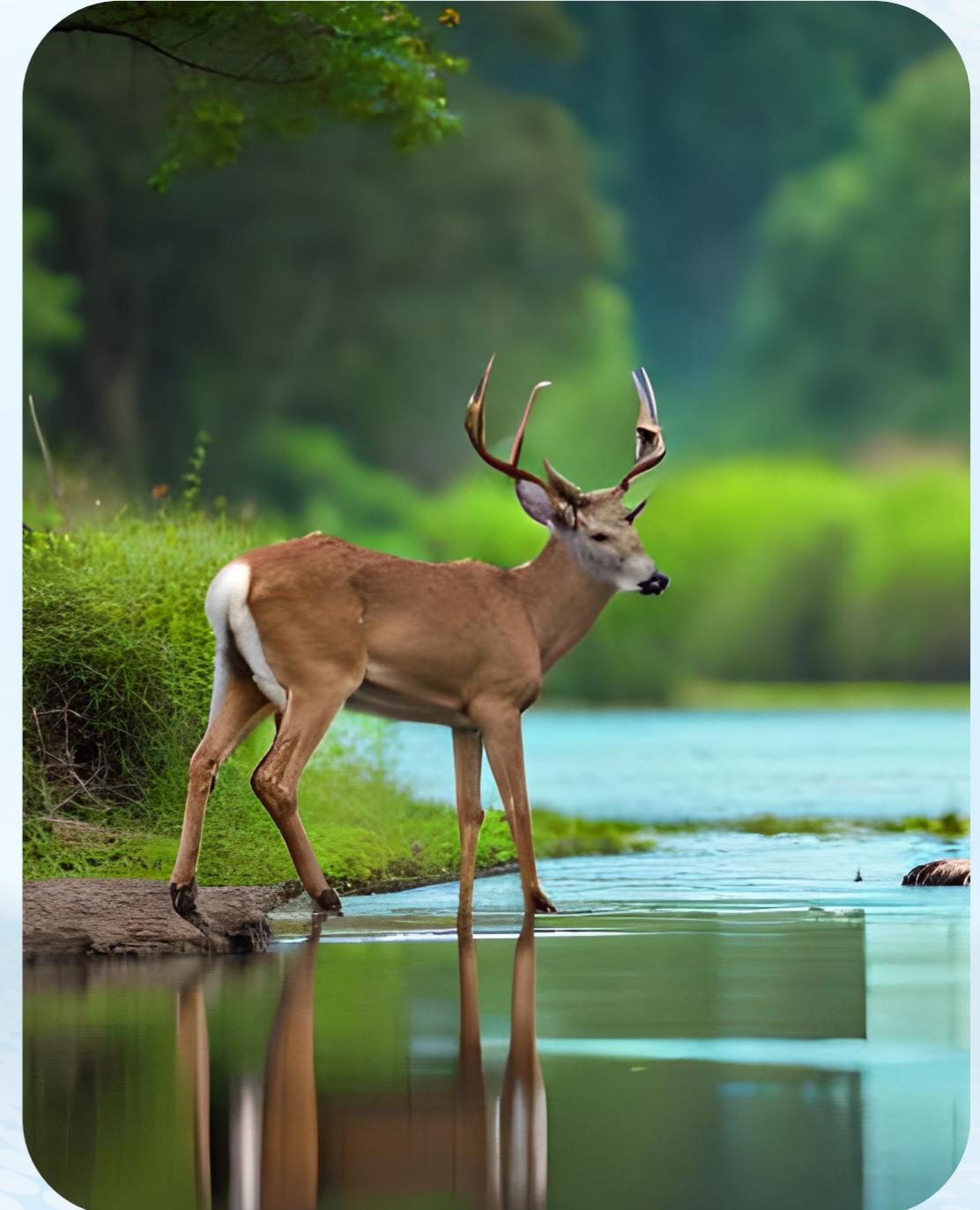
- **Application Sector**

Safety of Humans and Animals

- **Commercialization Status**

The prototype will be implemented in collaboration with West Bengal Wildlife Wing and West Bengal Forest Department

- **TRL**





National Mission on Interdisciplinary Cyber-Physical Systems (NM-ICPS)

Department of Science & Technology
Ministry of Science & Technology
Government of India

2024

Technology Innovation in Cyber-Physical Systems (TIPS) 4.0