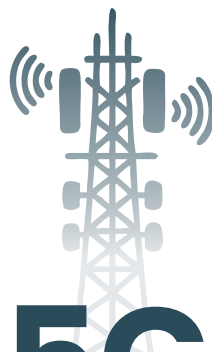


5G



100 5G LAB

Infrastructure to Innovations

Edition – 1

PREFACE

The establishment of 5G Use Case Labs across 100 academic institutions marks a transformative stride in India's pursuit of technological leadership. By bringing state-of-the-art telecom testing and development facilities directly to campuses — including those located in Tier-2 and Tier-3 cities — the initiative ensures that access to advanced research infrastructure is no longer limited to select metropolitan hubs. This localized empowerment is designed to unlock the innovative potential of students, researchers, startups and MSMEs nationwide, enabling them to develop solutions relevant to India and competitive at a global scale.

The 5G Labs initiative is not only a technological program but also a capacity-building mission to cultivate a 6G-ready ecosystem. Through hands-on exposure, live experimentation and prototype development, academia is being prepared to adopt emerging technologies at par with global standards, thereby strengthening India's long-term talent pipeline for next-generation communication systems.

To maximize the impact of the laboratories, a set of supportive and enabling frameworks has been introduced. The Competition Framework, anchored by annual national-level hackathons, fuels innovation by encouraging young talent to conceptualize and build 5G-powered applications for real-world use cases. Complementing this, the Gradation Framework recognizes and incentivizes institutions for their innovation output, student participation, outreach activities and overall lab utilization, fostering healthy competition and continuous improvement.

Together, the 5G Lab architecture and its associated frameworks form a robust platform for discovery, learning and entrepreneurship — transforming campuses into dynamic hubs of deep-tech innovation and laying a strong foundation for India's journey from 5G to 6G.

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01 National Vision towards 5G and Beyond

India is experiencing a new wave of technological transformation powered by 5G – a technology that is revolutionizing how the people connect, learn, and innovate. With its high-speed data transfer, ultra-low latency, and massive connectivity, 5G is enabling breakthroughs across key sectors such as education, healthcare, agriculture, industry, and governance, driving inclusive and sustainable growth.

As a landmark step in this journey, the Hon'ble Prime Minister awarded 100 '5G Use Case Labs' to 100 higher educational institutions across the country during the India Mobile Congress (IMC) 2023.

The initiative transforms these premier institutions into centres of excellence for capacity building, research, experimentation, and application development in 5G technologies; and create ecosystem 6G ready. These labs serve as open innovation platforms for collaborative efforts among students, faculty, researchers, startups, and actively design, develop, and test indigenous 5G solutions tailored to India's unique needs while addressing global challenges.

02 Objective

The 100 5G Use Case Labs Initiative is designed to transform India's higher education and innovation ecosystem by fostering learning, research, and entrepreneurship in next-generation communication technologies.

The key objectives of the program are to:

- ▶ To build competencies and engagement in 5G technologies in students and academic fraternity.
- ▶ To enable projects at under-graduation and post-graduation level for students using 5G environment.
- ▶ To Encourage academia-industry engagement to ideate and develop 5G use cases.
- ▶ To Provide local access to 5G test setup for Startups and MSMEs around the institution.
- ▶ Making Indian academia & startup ecosystem 6G ready

5G Labs Geographical Spread

The 100 5G Labs have been setup in the top technical institutions of India along with the institutions in the areas of health, power, agriculture, mining, and textile trying to leverage emerging technologies such as 5G/IoT/M2M to cater to the needs of various socio-economic sectors. The labs have been set up in all 28 states and 4 Union Territories. The State-wise geographical spread is shown below.

“The list of institutions with 5G Use Case Labs is at **Annexure I**”.



From Concept to Commissioning

The SRI Division of the Department of Telecommunications (DoT) functions as the Project Management Unit (PMU), responsible for project conception, implementation guidelines, fund disbursement, milestone monitoring, and necessary approvals, for coordinating with the Project Review and Steering Group (PRSG)—chaired by the Additional Secretary (Telecom)—for quarterly or biannual program reviews.

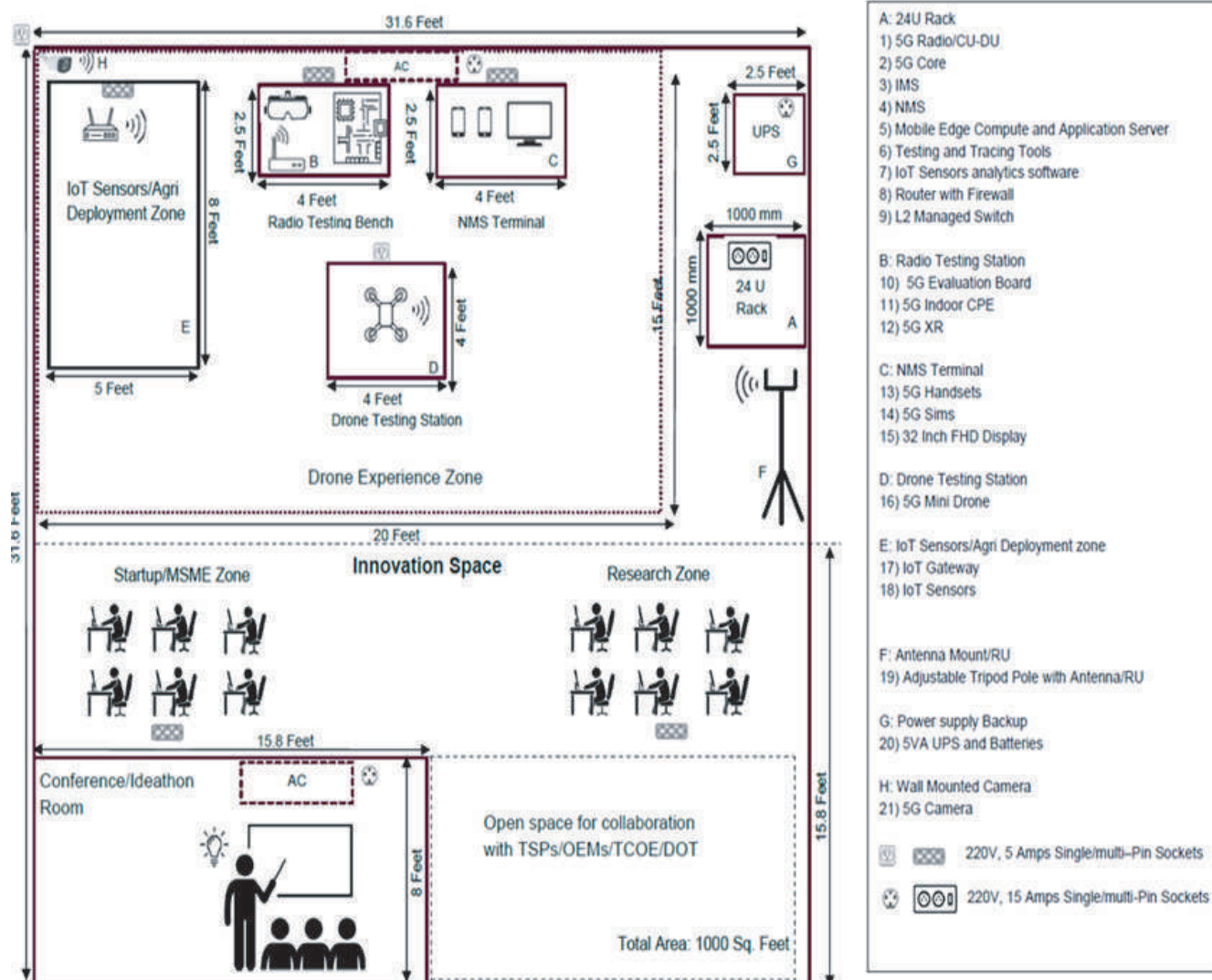
The implementation of the 100 5G Use Case Labs Project involves coordinated efforts across multiple institutional and governance levels to ensure transparent execution, efficient monitoring, and timely delivery. The work was awarded to Telecommunications Consultants India Limited (TCIL) on 27th March 2023 as the Implementing Agency, with a scope encompassing the selection of institutions and 5G equipment vendors, coordination, installation, testing, and commissioning of 5G infrastructure, milestone-based release of installments, operations and maintenance (O&M) of the equipment, organization of the 5G Innovation Hackathon, providing digital platform for networking and utilization of labs, knowledge disseminating platform on use-cases being tested/developed/demonstrated, and database of 5G domestic vendors available, 5G devices (incl IoT), successful 5G projects/pilots related to Health, Agri, intelligent Transport systems, Industry 4.0 etc.

An Institute Selection Committee, chaired by DG (NTIPRIT) and comprising members from TCIL, the Department of Higher Education, NTIPRIT, DoT, and WPC, was constituted on 4th May 2023 to identify suitable institutions. Based on an online call for applications launched in June 2023, 574 proposals were received from academic, R&D, Centers of Excellence under Central Government/State Government/ Government Agencies, and sector specific institutions with domain expertise in Health, Agriculture, Transportation, Industry 4.0, Fintech, Mining, Smart Cities. 100 higher educational institutions were selected under this initiative based on NIRF rankings, availability of infrastructure, institution's readiness for utilization of the labs including collaborative works with industry, and nationwide distribution.

A Technical Evaluation Committee (TEC), headed by Sr. DDG (TEC) with representation from TEC, C-DOT, IISc Bengaluru, Capgemini, and TCIL, was established on 5th May 2023 to evaluate vendor Proof of Concepts (PoCs) as per the Standard Operating Procedure (SOP) of DoT.

State-of-the-Art 5G Testbed Environment

All 100 5G labs were provided with the basic 5G Core, Radio, equipment such as 5G camera, 5G drone, evaluation board, sensors, and CPE/gateway to connect sensors; to conduct 5G experiments. Lab layout was provided to facilitate student and industry collaboration.



Technical Specifications of the 5G Use Case Lab

Radio & Core Network

 Radio Configurations	Integrated RAN (gNB) Disintegrated RAN (RU, DU, CU)	3GPP Release	Rel 15 complian & upgradable to Rel 16
 Data Rate (DL+UL)	≥ 200 Mbps		≤ 15 ms
 Max no. Active Devices	30(min)	 Radio Power	Up to 100 mW
 Duplexing Mode	TDD	 Channel Bandwidth	20 MHz, 40 MHz, 60 MHz, 80 MHz, 100 MHz
 Band Support	n78 (Tunable to centre frequency with desired channel bandwidth–100 MHz in the whole n78 band i.e. 3300 MHz to 3800 MHz)	 MIMO Configuration	2T2R (min)

Transmission & Synchronization

 Synchronization	IEEE 1588	 Antenna	External or Internal
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Network & Application Capabilities:

 Network Slicing	Support for slicing, preconfigured 3 different slices (min). Support for configuring slices by institutions.
 Use Case Scenarios	eMBB (Rel15), URLLC (Rel16), mMTC (Rel16)
 MEC	Should support integration with edge compute and cloud platforms.
 VoNR	Should support VoNR
 APIs	Should support APIs – e.g. any NMS, MEC platform integration, OTT/IT integrations.
 NMS	Integrated with Core / Radio / other IT devices.
 5G Devices	All 5G devices to support private PLMN IDs
 IP Communication	IP V4 and IP V6 should be supported

5G Lab Capability

The 5G Use Case Lab enables testing and validation of various aspects of 5G technology, including integrated and disaggregated RAN configurations, throughput and latency performance, device connectivity, radio parameters, and synchronization. It supports experiments on MIMO configurations, network slicing, and use case scenarios such as eMBB, URLLC, and mMTC. The lab allows testing of MEC and cloud integration, VoNR functionality, API interoperability, and network security features. Environmental and reliability testing can also be carried out as per IP54/QM333 standards, along with validation of 5G devices supporting private PLMN IDs and IPv4/IPv6 communication.

06

Status of Implementation

The vendor empanelment process was undertaken by TCIL, including the floating of technical RFPs, PoC testing, and selection of indigenous vendors for lab implementation in accordance with the approved implementation guidelines.

Four vendors, with indigenous 5G OEMs, were selected to setup and serve 100 labs in four zones of the country. The zone wise vendors are as follows:

- ▶ Coral Networks: North Zone
- ▶ Signaltron: South Zone
- ▶ VVDN: West Zone
- ▶ W4S: East Zone

All the labs were setup and operationalized in FY 2024-25. User Acceptance Testing (UAT) of North, West, and East zones were accepted from 31 March 2025, whereas, UAT of South Zone was accepted from September 25.

On completion of UAT, the labs are under one-year warranty period and four years AMC.

07

Enabling Frameworks

To ensure that the 100 5G Use Case Labs Initiative evolves into a sustainable and innovation-driven ecosystem, the Department of Telecommunications (DoT) has introduced three key enabling frameworks that strengthen capacity building, innovation, and industry collaboration. The Frameworks are:

i. Gradation Framework

A Gradation Framework with 11 key parameters has been introduced to ensure effective utilization and continuous performance improvement in the labs. The framework assesses student and faculty engagement; project implementation; collaboration with other institutions, Atal Tinkering Labs, startups, MSMEs, and industry partners; creation of IPRs, contribution in standards, and pilot/commercialization of products. Detailed Parameters of the Gradation Framework is at **Annexure-II**.

The outcome on Gradation Parameters is received regularly from the labs and reviewed on quarterly basis. The best labs are felicitated with Certificate of Appreciation. Based on 6 months' gradation report, following top 3 labs have been awarded for outstanding performance by Honourable Minister of State for Communications during IMC 2025.

Punjab Engineering College



Indian Institute of Roorkee



Birla Institute of Technology and Science:



ii. Competition Framework

Annual Hackathon is an integral part of 100 5G lab project. This program is to create 5G use case solutions under collaborative efforts among students, faculty, and industry.

In the Competition Framework, the Hackathon is an intensive six-month program designed to engage participants in developing innovative prototypes that leverage 5G technology. Through funding, mentorship, and access to 5G Use Case Labs, the program aims to deliver solutions aligned with societal and industrial needs.

Participants receive additional support for commercialization, including Intellectual Property Rights (IPR) assistance and startup funding under the Telecom Technology Development Fund (TTDF) scheme.

The Hackathon is Open to Undergraduate (UG)/Postgraduate (PG) students, Startups and professionals. The program stages includes proposal submission; institutional, regional and national shortlisting; prototype development; and final evaluation with access to 100 5G Use Case Labs for prototyping and validation.

This years' Hackathon, named 5G Innovation Hackathon 2025, was conducted from 15 March -01 October 2025. The focus areas were:

- AI-driven network maintenance, IoT-enabled applications, 5G broadcasting, smart health, smart agriculture, smart education, industrial automation, non-terrestrial networks (NTN), D2M, V2X, and quantum communication.
- Creation of prototype using the various aspects of 5G Technology such as call-flow scenarios, Quality of Service (QoS), Network Slicing etc.

The initiative received an overwhelming response from institutions nationwide. A total of 1018 proposals were received across the nation with 100 5G lab institutions as the nodal for call for proposals. Out of these 1018 proposals received at the institutional level (from 100 5G Use Case Labs), 348 proposals were selected at the institution level. During the second-level evaluation, the Regional Committees reviewed the 348 proposals based on the online submissions and shortlisted 183 proposals for further evaluation by the National-level Technical Expert Committees (TECs) through applicant presentations. Following the national-level evaluation, 51 proposals were selected, and seed funding of ₹1 lakh was provided to 48 teams (3 teams withdrew from the Hackathon) to further develop their prototypes. The detailed physical demonstration of the 48 prototype-level proposals was conducted by two committees at NCA-T Ghaziabad, and IISc Bangalore.

After detailed Technology Demonstration, 3 teams were shortlisted in Startup/MSMEs category, 4 teams shortlisted in Academia/Student and 4 teams were shortlisted for best idea.

Over 15 teams showcased their innovative solutions during IMC 2025. The winning teams were felicitated during IMC 2025 by Honorable Minister of State for Communication Dr Pemmasani Chandra Sekhar.

iii. Training and Mentoring

Training and mentoring have been the continuous feature of the 100 5G Lab project. A month long (36 hours) Faculty Development Program (FDP) program was conducted from March-April 24 for faculty of 100 5G labs during implementation of the project. Since then, following multiple training and mentoring programs have been conducted for capacity building, and to enable participants to understand the technology and engage students and researchers for use case development:

- ▶ Three day's online training by vendors of each zone from March – April 25. The videos of the trainings have been shared with all the labs.
- ▶ Five days physical training at 19 labs across India were conducted by vendors from July–December 2025.
- ▶ Qualcomm had mentored 20 institutes from March –September 2025 during hackathon. The list of 20 labs is at **Annexure–III**.
- ▶ Mentoring by ITU expert from April–September 2025 during Hackathon.

Apart from the trainings and mentoring of the 100 5G Lab institutes and hackathon participants from other institutes/startups. DoT had collaboration with Ericsson and QUALCOMM to provide following specialized courses in 5G.

5G Certification Programmes

Ericsson Educate Program

DoT has collaborated with Ericsson for the "Ericsson Educate" program, designed to enhance digital skills for students in the universities where 5G Use case labs have been established. The curriculum, tailored for telecommunication subjects, supplements technical studies with practical knowledge using 100 5G use case labs, crucial for the telecom sector. The collaboration aims to strengthen capacity building and skill development in the 100 5G use case labs, enabling institutes to mentor students and faculties in creating innovative 5G products and use cases. The program is exclusively tailored for these 5G use case labs and includes a three-month accredited course by Ericsson offering learning materials on key technologies such as Automation, Telecommunications, AI, IoT, 5G, and Machine Learning. It is planned for training around 10000 students in the two years. 7209 students have enrolled under this program.

Qualcomm certification Programmes

Qualcomm has provided following two Certification Program on 5G free of cost for 100 5G lab students

- ▶ 5G University Program and
- ▶ 5G Associate–Level Certification Program

Success Stories:

DoT is regularly receiving inputs on Gradation parameters which provides details on labs engagement with students, faculty, start-ups, other institutions, publication of research papers, contribution in standards, development of products, creation of IPRs, pilots and commercialisation. On this basis, DoT prepares reports on performance of the labs. This helps in understanding the areas of engagement and support to the institutions based on their classification with excellent, very good, and satisfactory performing labs. This also helps in arranging experience sharing among labs for mutual learning.

Excellent Labs

Excellent labs have been engaging the stakeholders to achieve outcomes. A brief on the excellent labs based on gradation report prepared in July and October 25 is as follows:

1. Punjab Engineering College

i. Developed Use Cases

a. IoT-Based Smart Greenhouse Monitoring and Control System with 5G Integration

- The system is equipped with environmental sensors to measure key parameters such as temperature, humidity, soil moisture, and light intensity.
- These readings are used to autonomously control actuators like water pumps, cooling fans, and grow lights, ensuring optimal growing conditions at all times.
- A user-friendly web dashboard is developed to visualize sensor data and control devices, bringing the greenhouse under complete digital supervision.
- It enhances precision agriculture by enabling timely interventions, saving water, optimizing energy usage, and reducing human dependency.



b. 5G-Powered Intrusion Detection and Human Verification System

- ▶ The 5G Camera video stream was processed in real-time using Python with OpenCV and multithreading to efficiently handle continuous frame capture and analysis.
- ▶ The system integrates the InsightFace deep learning framework for facial recognition, allowing it to accurately detect and classify faces as known, unknown, or suspicious by comparing them against a pre-trained dataset.
- ▶ Once a human is detected and classified as a threat or unidentified individual, the system sends a trigger signal to an ESP32 microcontroller

ii. Engagement Activities

a. AICTE-ATAL FDP on “Hands on Training, Research Aspects and demonstration in 5G Use Case Lab”

b. Short term training provided to the delegates from:

- ▶ Ministry of Home Affairs, GOI
- ▶ Guru Nanak Dev Engineering College, Ludhiana
- ▶ Lovely Professional University, Jalandhar
- ▶ Chandigarh University, Mohali
- ▶ Government Polytechnic, Nanakpur (Haryana)

iii. Number of Publications/ Journals/ Conference papers: 15

iv. Industry Engagements:

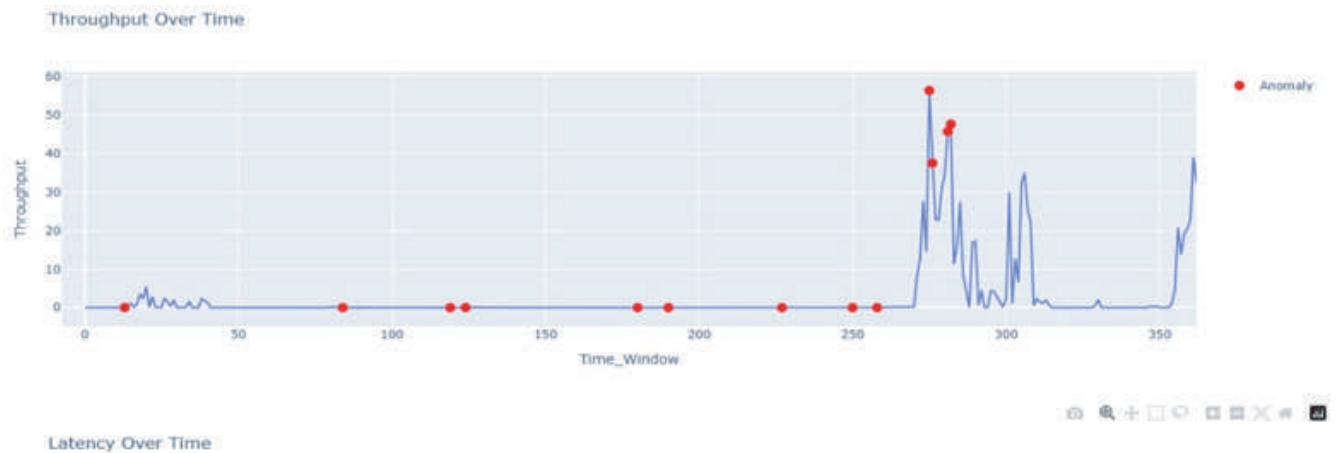
Industrial Talks



2. Banasthali Vidyapeeth

i. Developed Use Cases:

a. Real-Time Detection of Anomalies and QoS Deviations in Multi-Service Traffic over 5G Private Networks using AI Techniques



This prototype presents an AI-based anomaly detection system for private 5G networks, analysing key QoS parameters using Wireshark and Isolation Forest with LIME for explainability.

b. MEC- Enabled Microclimate Fault Analytics for Smart Mining Infrastructure over a 5G Private Network

- This Use Case is introducing a next-generation safety ecosystem for industries and mines, allowing for the real-time recognition of risks such as toxic gases, fire, rockfall over a private 5G network.
- By combining AI-driven sensing with fault-tolerant monitoring, it upgrades the safety of workers and continuity of operations.

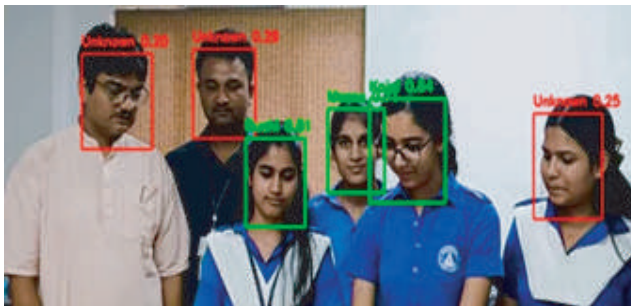


c. Real time Suspicious activity Detection in High- Security Zones Using 5G-Enabled Drone Feed with MEC and Docker-Based YOLO Deployment

- This project implements real-time surveillance using a 5G-enabled drone camera stream integrated with Raspberry Pi.
- Video is transmitted through ZMQ socket communication and routed via gNodeB and UPF into the MEC environment.
- At the edge server, Docker containers host the YOLO model to perform low-latency object detection. All processing occurs on MEC instead of cloud, achieving ultra-low latency and high throughput.

d. **Integrated Smart Attendance System using AI and IoT to automate real-time attendance tracking**

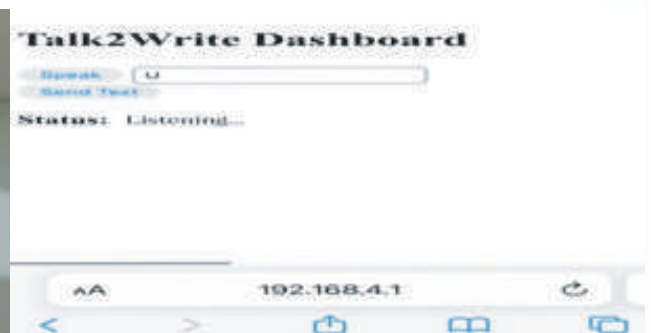
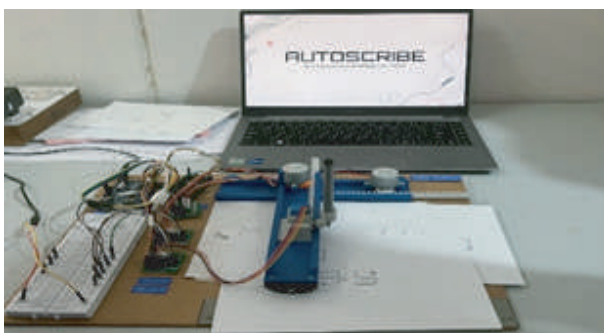
- This Use Case presents a Smart Attendance System that leverages AI and IoT to automate real-time attendance tracking.
- When the teacher opens the camera, the system performs live student recognition and records attendance instantly. Each entry is systematically logged on a dashboard with the student's name, date, and timestamp, and a corresponding CSV file is automatically generated for easy access and documentation.
- This solution ensures accurate, efficient, and seamless attendance management while minimizing manual effort.



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2	Armaan	2024-11-20-00:00	C:\Users\harsh\Desktop\log\2024-11-20-00:00.jpg
3	Rishi	2024-11-20-00:00	C:\Users\harsh\Desktop\log\2024-11-20-00:00.jpg
4	Adi	2024-11-20-00:00	C:\Users\harsh\Desktop\log\2024-11-20-00:00.jpg
5	Aditya	2024-11-20-00:00	C:\Users\harsh\Desktop\log\2024-11-20-00:00.jpg

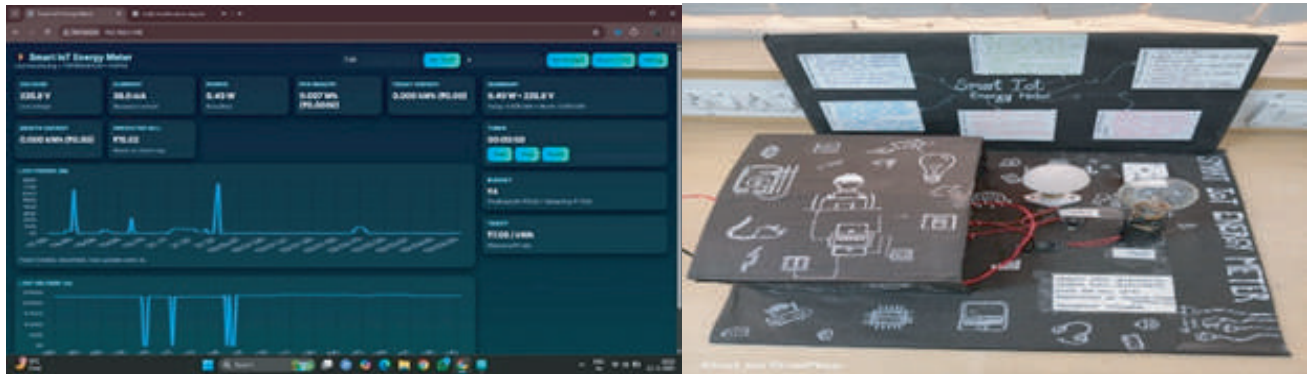
e. **AutoScribe: A 5G-enabled IoT based speech-text CNC plotter**

- AUTOSCRIBE is an assistive speech-to-handwriting system that converts spoken words into neatly handwritten text on paper using 5G-enabled IoT protocols, speech recognition, and CNC robotic control.
- It is especially useful for physically challenged individuals, enabling them to write independently without assistance during exams or personalised handwritten text is required.



f. Smart IoT based Energy Meter

- ▶ This project uses the Internet of Things (IoT), featuring 5G connectivity, to measure exactly how much electricity you're using in real-time.
- ▶ The use of 5G ensures ultra-fast and reliable transmission of the detailed consumption data to a central cloud, allowing you to track your costs, spot unusual usage instantly, and even control devices remotely.
- ▶ This system is crucial for enabling large-scale, low-latency communication within a future Smart Grids.



3. IIT Roorkee

Advanced Mobile & Radio Infrastructure for Telecom (AMRIT)

a. Research & Projects utilizing the lab

- ▶ RIS-aided Communication Prototypes and RIS-aided D2D Networks.
- ▶ 5G Advanced ORAN Massive MIMO Base Station.
- ▶ Inter-AP Coordinated Cell-Free 6G Communication for Ubiquitous Connectivity.
- ▶ Terahertz Communication: Prototype Development and Algorithm Design.
- ▶ Ultra-low Power Pilot IC for IoT Devices.

b. Number of Publications/ Journals/ Conference papers: 13

c. Filed patents: 2

d. Commercialized solutions:

- ▶ AI on the Edge product launched by a startup.
- ▶ RIS technology transferred and deployed through startup ecosystem.
- ▶ Developed AI-enabled Drone and Video Surveillance use cases.

4. BITS Pilani

i. Developed Use Cases

a UAV-Assisted 5G Portable Network with Spectrum Sensing for Disaster

This is an AI-based spectrum sensing framework that uses drones to provide resilient connectivity in disasters and remote areas, enabled through real-world data collected from the USRP devices.

b Visual-SLAM for Collaborative AAV Applications in Army Surveillance using 5G

This project is a collaborative SLAM framework powered by 5G and edge computing, allowing multiple agents to build unified 3D maps in real time by offloading heavy computation to MEC servers, with strong applications in disaster response, autonomous mobility, and public safety.

c Adaptive Traffic Light System Using 5G Infrastructure”

The project is an adaptive traffic control system that leverages real-time video analytics and 5G connectivity to dynamically manage signal timings, thereby reducing congestion, fuel use, and emissions while improving commuter safety and experience.

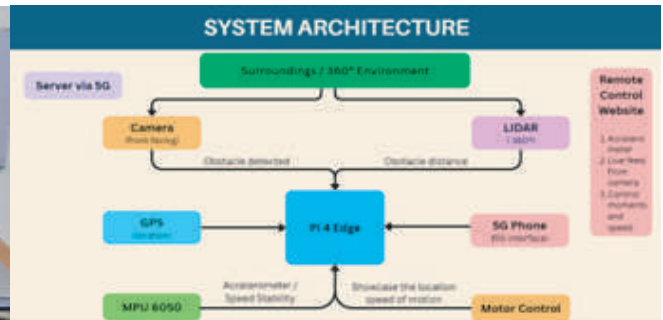
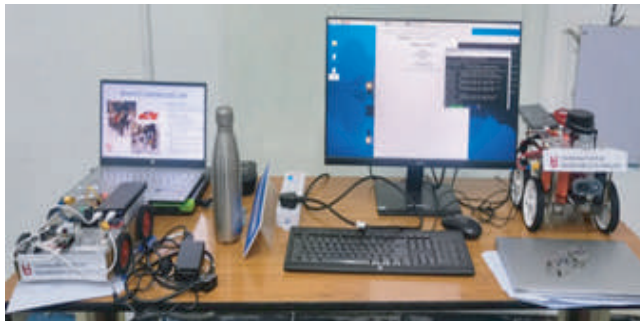
The adaptive traffic control system addresses one of the most visible urban challenge, traffic congestion, by using real-time analytics and 5G connectivity to dynamically manage signals, reducing delays, fuel consumption, and emissions while improving commuter safety and experience.

ii. IPR generated: 3

5. Thapar Institute of Engineering and Technology

i. Developed use cases

a Autonomous V2X Car Crash Prevention System



- The project facilitates real-time obstacle detection using sensors and vision modules for collision avoidance.
- It provides automatic braking & vehicle halt upon detecting nearby obstacles.
- Remote control and monitoring of the vehicle through a 5G network.

b Touchwords

- The project empowers especially abled person by providing Braille Education through 5G Connectivity
- A real-time, 5G-enabled assistive device that captures printed text through a webcam, performs OCR, and instantly converts it into Braille for tactile reading.
- Uses IoT + 5G for seamless, fast communication between master and slave devices, offering an affordable, scalable, and reliable alternative to costly Braille technologies

ii. IP generated: 2

iii. Number of Publications/ Journals/ Conference papers: 7

iv. Pilot/ deployed products: 2

Success stories : 5G innovation hackathon 2025

Final Hackathon winners

Winner/ Runner-up in Student/Academia Category

S. No.	Final/Rank	Proposal/ Project Description	Institute
01	Winner	Drone-Based 5G Non-Terrestrial Network for Dynamic, On-Demand and Emergency Connectivity (Project ID: HAC-2025-0407).	Vellore Institute of Technology, Chennai
02	1 st Runner Up	TouchWords : Empowering Braille Education through 5G Connectivity (Project ID: HAC-2025-0547).	Thapar Institute of Engineering and Technology
03	Joint 2 nd Runner Up	5G-ENHANCED CRIME SCENE INVESTIGATION WITH XR & AI (Project ID: HAC-2025-1095).	National Institute of Technology, Tiruchirappalli
04	Joint 2 nd Runner Up	Cultivating Pure Hearts, Growing Green Future (GreenHeart) (Project ID: HAC-2025-491).	University Institute of Engineering and Technology Punjab University

Winner / Runner-up in MSME/Startup Category

01	Winner	LifeCircuit: Hyperconnected Emergency Care Ecosystem (Project ID: HAC-2025-0997)	INDIAN INSTITUTE OF SCIENCE, Bangalore
02	1 st Runner Up	Padmakosham IoT SecureBox: The Future of Secure Document Handling with 5G (Project ID: HAC-2025-0102)	Visvesvaraya National Institute of Technology, Nagpur
03	2 nd runner up	Enhanced Automated Security System for Mobile Telecom Network against Cloning and unauthorised access (Project ID: HAC-2025-1426).	Malaviya National Institute of Technology Jaipur

Special Mention for the Best Ideas.

01	Winner	RIDE: RAN Intelligent Drift-Handling Enabler (Project ID: HAC-2025-1859)	National Institute of Technology Calicut
02	1 st Runner Up	5G-Enabled Smart Onion Spoilage Detection and Alert System (Project ID: HAC-2025-0740)	Dr. Babasaheb Ambedkar Technological University Ionare and Savitribai Phule Pune University
03	Joint 2 nd Runner Up	Smart Sprinkle Using 5G (Project ID: HAC-2025-0613)	National Institute of Technology Silchar
04	Joint 2 nd Runner Up	Mentor Mitra AI: Redefining Learning Experiences with 5G and Edge AI (Project ID: HAC-2025-0864)	Jaypee Institute of Information Technology, Noida

Proposal No : HAC-2025-0407

WINNER IN STUDENT/ACADEMIA CATEGORY

Drone-Based 5G Non-Terrestrial Network for Dynamic, On-Demand and Emergency Connectivity

Team Leader B Jayant

Mentor Dr Richards Joe Stanislaus, Associate Professor,
School of Electronics Engineering, VIT Chennai



Institute

Vellore Institute of Technology,
Chennai

Problem Statement

In disaster-stricken areas, large-scale events, and remote regions, network congestion and connectivity issues pose significant challenges. Existing communication networks face multiple limitations like Slow Deployment, High Cost, Limited Coverage, Disaster Vulnerability etc. These issues create a communication gap that affects emergency response, public safety, and everyday connectivity in underdeveloped regions. A rapidly deployable and flexible solution is necessary to ensure uninterrupted communication in these scenarios.



Solution /Architecture

This project demonstrates a drone-based 5G network that can provide temporary, high-speed communication coverage using an adaptable, decentralized architecture. The core components of this solution include:

- ▶ **1x4 Phased Array Antenna:** The drone will carry a custom-designed 1x4 phased array antenna capable of dynamic beamforming, offering efficient signal transmission and reception in 5G mid-band frequencies.
- ▶ **Real-time Ad Hoc Network Deployment:** In addition to acting as a mobile base station, each drone will function as a node in a dynamic ad hoc network, autonomously establishing connections with nearby drones without relying on a centralized ground-based controller. This decentralized approach ensures self-organizing and self-healing communication links in case of drone failure, signal obstruction, or changing requirements.
- ▶ **Scalability and Mesh Networking:** Multiple drones can be quickly deployed to create a distributed mesh network where each drone communicates with its nearest neighbours. This enhances coverage, reduces bottlenecks, and improves resilience against single points of failure – critical for disaster zones and large-scale events.
- ▶ **Efficient Resource Utilization:** The system will leverage institutional facilities such as Vector Network Analyzers, Anechoic Chambers, and Spectrum Analyzers for antenna calibration and communication performance optimization before deployment.

Field Testing in Dynamic Environments: Real-world testing will include multi-drone ad hoc networking scenarios to evaluate link stability, latency, handoff efficiency, and seamless coverage management.

This project stands apart from conventional temporary network solutions by introducing several novel aspects:

- ▶ **Drone-Based 5G Network with Ad Hoc Functionality:** Unlike traditional mobile base stations, this system integrates ad hoc networking capabilities into drone-mounted 5G nodes, enabling dynamic, self-organizing network formation without fixed infrastructure.
- ▶ **Dynamic Beamforming Antenna:** The phased array design allows precise control over signal direction, enabling high-quality point-to-point and point-to-multipoint communication between drones and ground users within the ad hoc framework.
- ▶ **Rapid Deployment and Scalability:** The ad hoc-enabled drones can be deployed individually or in groups, instantly establishing a peer-to-peer mesh network for coverage in complex terrains or crowded spaces.
- ▶ **Self-Healing Network:** If a drone leaves the network or fails, neighbouring drones autonomously reconfigure routing paths and adjust coverage beams, ensuring uninterrupted communication.

Conclusion

This project presents an innovative and practical solution to the challenge of temporary and emergency 5G network deployment. By integrating a 1×4 phased array antenna on a drone, the proposed system provides a highly mobile, cost-effective, and rapidly deployable communication solution. It directly addresses network coverage gaps in disaster-stricken areas, large-scale events, and remote rural regions. The successful implementation of this project will not only enhance emergency response capabilities and public safety but also create new business opportunities for telecom providers and disaster management agencies. With rigorous testing and optimization, this drone-based 5G network has the potential to revolutionize on-demand network deployment, making high-speed connectivity accessible where it is needed most.

The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-0547

1ST RUNNER-UP IN STUDENT/ACADEMIA CATEGORY

Touchwords Empowering Braille Education through 5G Connectivity

Team Members

Ms. Mokshda Malhotra , Dr. Surbhi Sharma



Institute

Thapar Institute of Engineering and Technology, Patiala, Punjab

Problem Statement

Despite notable advancements in assistive technology, existing refreshable Braille displays remain largely inaccessible due to high costs, limited scalability, and complex hardware requirements. Most current systems rely on piezoelectric actuators, which, while precise, are expensive, fragile, and limited to single-line outputs, making real-time reading of longer texts inefficient and impractical. Furthermore, real-time implementation of Braille displays is often constrained by delays in text recognition, translation, and tactile feedback, especially when dependent on cloud-based services or limited connectivity.

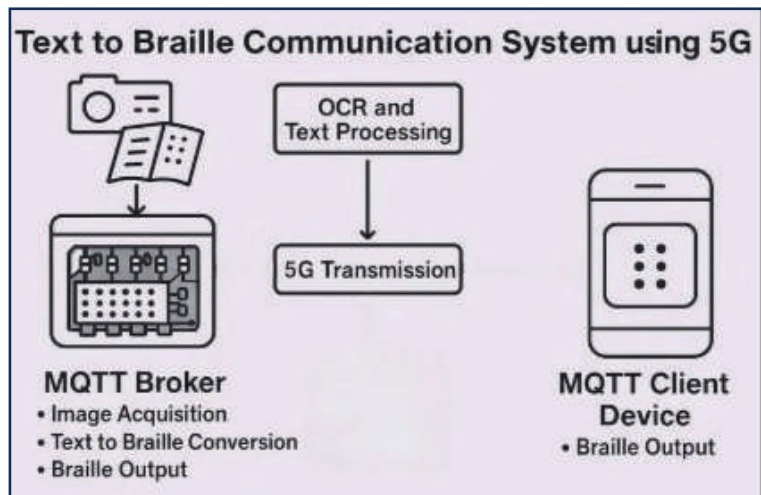
This project proposes a cost-effective and reliable real-time refreshable Braille display that overcomes these limitations by adopting a master-slave device model powered by 5G communication. This architecture enables low-latency, synchronized data transfer from a central processing unit to multiple Braille output units. By utilizing electronic push-pull solenoids instead of piezoelectric cells, the hardware design is simplified while ensuring durability and responsiveness. The result is a scalable, robust system capable of delivering high-speed Braille output for printed and digital text, making real-time accessibility more practical and affordable for visually impaired users.

Solution /Architecture

This project suggests an improved access for people who are blind or deaf, through a real-time and low-cost assistive device. The device incorporates a modular system that transcribes printed text to Braille and audio, and, sign language gestures to audio.

The device allows subscribers to receive over-the-air software updates and is intended to integrate with a variety of other programs. This whole system can be developed using commercially available components and while relying on the Raspberry Pi and ESP32 as the building block. The project addresses the major design limitations of current stage assistive technologies, namely, cost, portability, and limited use of audio outputs. It is designed to meet accessibility guidelines and could be certified and used in libraries, schools, smart homes, or NGOs. The mobility of this system promotes digital inclusion and the opportunity for users to control more of their lives and gain opportunities for learning and employment.

The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at National Communications Academy-Technology, Ghaziabad.



Conclusion

The integration of 5G technology in Braille learning enables real-time, low-latency transmission of educational content to tactile displays. It supports remote teaching, where a teacher's lesson or text is transmitted as an image and instantly converted into Braille for learners using the proposed solution. This seamless, synchronized experience enhances interactive and inclusive education for visually impaired students. By combining edge processing and 5G connectivity, the system bridges the digital divide and empowers independent learning through smart Braille technology.

Proposal No : HAC-2025-1095

JOINT 2ND RUNNER-UP IN STUDENT/ACADEMIA CATEGORY

5G- ENHANCED CRIME SCENE INVESTIGATION WITH XR & AI

Team Members

Mr. Suresh Kumar K, Mr. Krishnaveni A

Institute

NATIONAL INSTITUTE OF TECHNOLOGY,
TIRUCHIRAPPALLI



Problem Statement

To revolutionize crime scene investigation using 5G and Extended Reality (XR)

Dual Purpose : Enhances the quality and efficiency of crime scene investigations and serves as a training tool for officers.

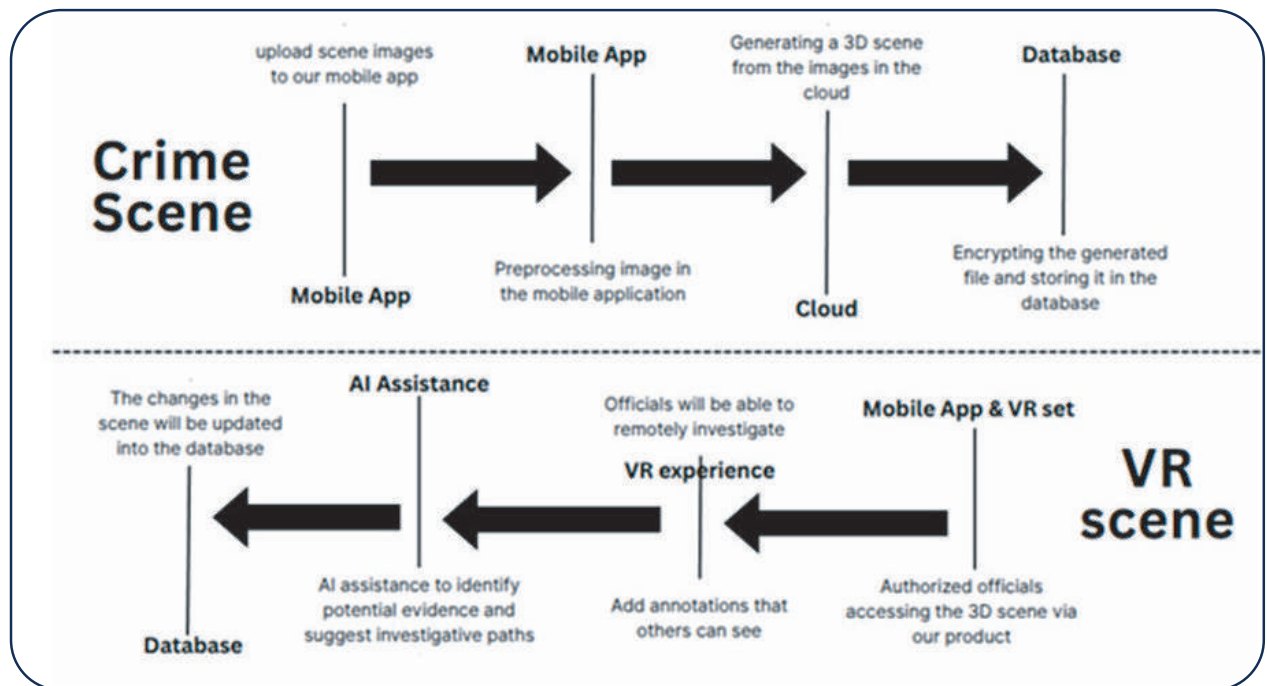
2Functionality : Allows investigators to create detailed 3D models of crime scenes for remote examination, annotation, and sharing.

Collaboration : Using high-speed 5G networks for seamless collaboration between field officers and remote specialists, ensuring expertise is available regardless of location.



Solution/ Architecture

- ▶ **Mobile App Workflow:** Investigators at the scene use a mobile app to capture multiple images from various angles. The app performs initial image preprocessing (e.g., filtering, noise reduction) and uploads them securely to the cloud via 5G. Investigators receive live feedback on whether additional angles or better lighting is needed, guided by AI suggestions.
- ▶ **Cloud and AI Integration:** Uploaded images are processed on the cloud to reconstruct a photorealistic 3D model of the scene using Structure-from-Motion and neural rendering techniques.
- ▶ **Visualization and Collaboration:** Authorized officials can view and interact with the crime scene in AR/VR. Annotations made by one investigator are visible to all collaborators. Remote experts can log in, review evidence, and make live suggestions.



Conclusion

- **Enhanced Efficiency:** Reduces time to analyze and investigate scenes, Using IG URLLT Feature
- **Remote Accessibility:** Expertise can be brought in from anywhere using 5G.
- **Improved Training:** Empowers training institutes with real-world, interactive datasets.
- **Evidence Integrity:** Strong audit trail helps in court admissibility.
- **Scalable Solution:** Easily adapted by police departments nationwide.

Proposal No : HAC-2025-0491

JOINT 2ND RUNNER-UP IN STUDENT/ACADEMIA CATEGORY

Cultivating Pure Hearts Growing Green Future (GreenHeart)

Team Leader

Mr. Garvit Saluja

Institute

University Institute of Engineering and Technology, Punjab University



Problem Statement

Farmers are struggling to optimize crop production due to a lack of real-time access to critical data on soil health, climate conditions, disease outbreaks, and fluctuating market trends. This information gap not only affects their yield and profitability but also contributes to inefficiencies in resource usage. On the flip side, consumers are increasingly distanced from the origins of their food, craving transparency and a direct connection with local farmers. This disconnect leads to a lack of trust and a missed opportunity for sustainable, **locally-driven food systems**.



Solution /Architecture

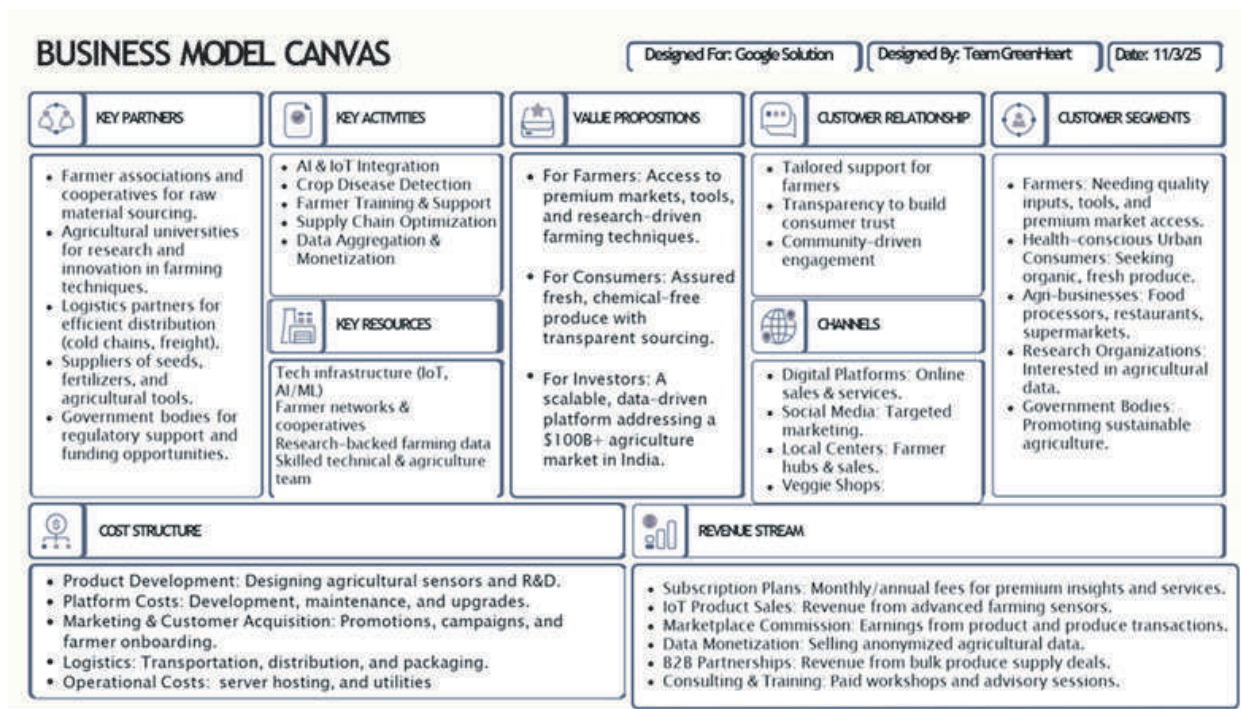
Introducing GreenHeart, a cutting-edge dual platform app that revolutionizes the connection between farmers and consumers. For farmers, GreenHeart harnesses the power of IoT and AI to deliver real-time insights into soil health, climate conditions, and crop vitality, empowering them to make informed decisions and boost yields sustainably. Consumers, on the other hand, enjoy a direct link to fresh, locally sourced produce, enhancing transparency and supporting local farming communities. By seamlessly intertwining the worlds of agriculture and consumerism, GreenHeart cultivates a vibrant, transparent, and thriving food ecosystem

GreenHeart combines farming-as-a service, education, fintech, and market access in one seamless platform.

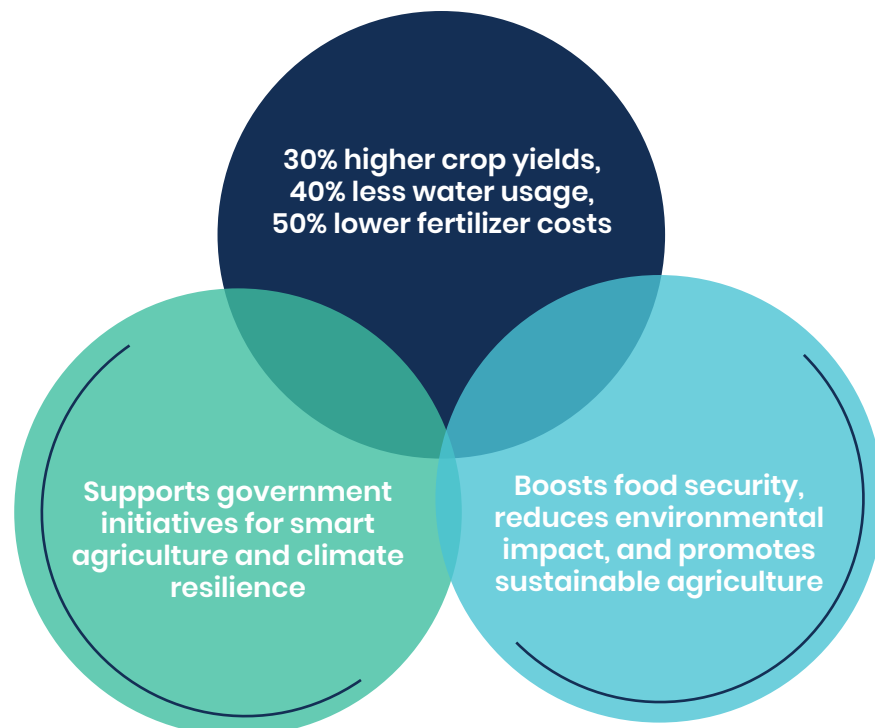
GreenHeart is an advanced AI, IoT, and 5G-powered precision farming solution designed to enhance both land-based and underwater farming. This system integrates real-time smart sensors, AI-driven analytics, and high-speed 5G connectivity to optimize agricultural productivity, resource efficiency, and sustainability.

- ▶ **Ultra-Low Latency (1ms):** Enables instant AI decision-making, improving farm automation & efficiency.
- ▶ **Massive IoT Connectivity:** Supports millions of AI-powered sensors, drones, and submarines for seamless operation.
- ▶ **Edge AI + Cloud Hybrid Computing:** Ensures low-cost processing, making the solution scalable & affordable.

- Underwater & Remote Farming Expansion: 5G NTN + Acoustic Networks enable AI-driven marine agriculture & deep-sea monitoring.
- Data-Driven Smart Agriculture: 5G enables AI-powered decision-making for sustainable, climate-resilient farming.



Conclusion



The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at National Communications Academy Technology, Ghaziabad.

Proposal No : HAC-2025-0997

WINNER IN STARTUP/ MSME CATEGORY

Lifecircuit Hyperconnected Emergency Care Ecosystem

Team Leader

Dr. Bhaskar Rajakumar



Institute

Indian Institute of Science, Bangalore

Problem Statement

Cardiac-related deaths are the number one killer in India, accounting for 27% of all causes. Cardiac arrests and heart attacks have seen a sharp rise, particularly among younger age groups. Many of these lifethreatening events occur in public spaces like gyms, bus stands, and sports grounds—yet lives are lost due to a lack of immediate Basic Life Support (BLS), Automated External Defibrillators (AEDs), and trained responders. Data suggests that timely CPR can double or triple survival chances. The golden hour—crucial for survival—is often wasted due to delayed intervention, lack of training, and poor coordination.

Solution/Architecture

LifeCircuit is an integrated, tech-driven ecosystem designed to drastically improve cardiac arrest outcomes through rapid response and real-time care. The system includes:

- ▶ **Mass BLS Training using AR/VR:** Scalable training of police, students, security personnel, delivery staff, and drivers.
- ▶ **Widespread AED Installation:** Smart AED stations deployed every 2 km in public spaces.
- ▶ **Remote Support via AR Glasses:** AED stations equipped with smart glasses for real-time ER guidance.
- ▶ **LifeCircuit Mobile App:**
 - Triggers Code Blue alerts.
 - Notifies trained responders nearby (like Uber for CPR).
 - Maps route to incident + AED locations.
 - Enables remote connection with emergency physicians.
 - Integrates live vitals via IoT devices and connects ambulance + ER.
 - Links patient data with ABHA ID, ensuring continuity of care by syncing with ABDM (Ayushman Bharat Digital Mission)-enabled health records.
 - Enables automatic retrieval of past cardiac history and critical data from Personal Health Records stored under ABDM for faster clinical decision-making.

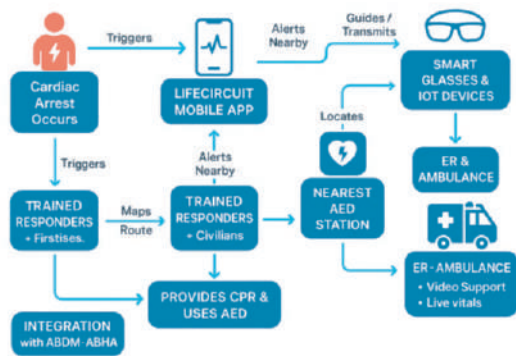


Figure 1: Flow Chart of tech integrated response during an event

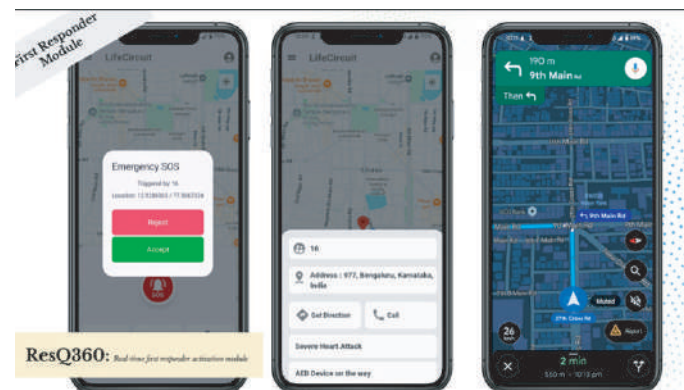


Figure 2: Second Responder Module

Key Technologies Used

- Augmented/Virtual Reality (AR/VR): Scalable training platform for BLS/ALS
- 5G Connectivity: Real-time, high-speed communication and data transfer
- Internet of Things (IoT): Pulse, BP, and AED monitoring
- Geolocation & Mapping: For nearest responder, AED, and ambulance routing
- Smart Wearables / AR Glasses: Real-time remote support during CPR
- AI Algorithms: For optimal response coordination and predictive alerts
- ABDM-ABHA Integration Real-time syncing of health data with the Ayushman Bharat Health Account (ABHA).

Conclusion

Project LifeCircuit was demonstrated during 5G innovation Hackathon at National Communications Academy-Technology at Ghaziabad. Project presents a transformative and scalable cardiac emergency response ecosystem that bridges the critical gap between sudden cardiac arrest and timely life-saving intervention. By integrating AR/VR-based mass BLS training, widespread smart AED deployment, remote expert support, and a real-time 5G-enabled coordination platform, the solution ensures rapid action within the golden minutes.

Proposal No : HAC-2025-0102 Bangalore

1ST RUNNER-UP IN MSME/STARTUP CATEGORY

Padmakosham IoT SecureBox: The Future of Secure Document Handling with 5G

Team Leader

Mr. Anand Vardhan Tiwary



Institute

Visvesvaraya National Institute
of Technology, Nagpur

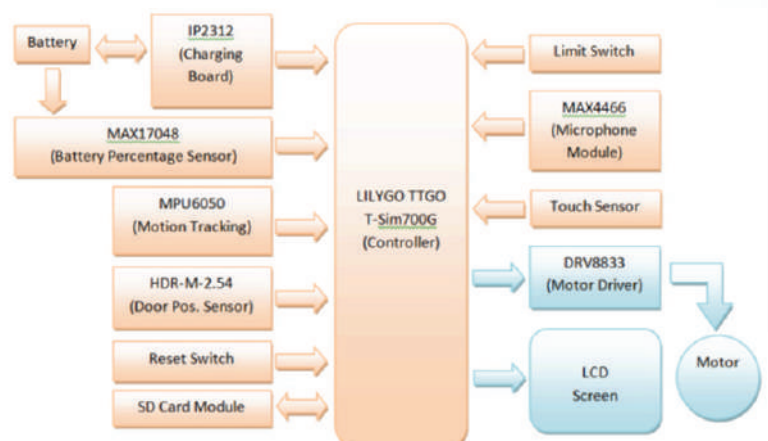
Problem Statement

IoT SecureBox (named पद्मकोशम्) is an innovative secure container that leverages 5G connectivity and advanced security features to protect sensitive materials in transit.

Solution /Architecture

- ▶ **Tamper-Proof Design:** SecureBox has no physical keys, keypads, or biometric locks. It can only be unlocked remotely via a secure server, eliminating any local tampering possibilities.
- ▶ **5G Real-Time Tracking:** Built-in 5G connectivity continuously streams GPS location, temperature, vibration, and door angle data to the cloud. This provides live monitoring and instant alerts for anomalies or route deviations, ensuring end-to-end security.
- ▶ **Offline Data Resilience:** In no-connectivity zones, SecureBox stores all sensor and location data internally. Once 5G coverage is restored, it automatically syncs the buffered data to the cloud, ensuring no gaps in the security audit trail.
- ▶ **ML-Based Intrusion Detection:** Machine learning algorithms analyze movement and environmental data to detect unauthorized access attempts. Any suspicious activity triggers immediate alerts.
- ▶ **Industry Applications:** SecureBox's robust security and 5G connectivity make it ideal for safeguarding exam paper shipments, preserving an unbroken audit trail when transporting legal evidence, and securely moving classified documents.

Fig:1 Block Diagram of
Modules & Components



The IoT SecureBox is a transformative solution addressing security vulnerabilities in high-stakes logistics. By preventing tampering, unauthorized access, and data leaks, it enhances trust, compliance, and operational efficiency across multiple sectors.

- ▶ Education Sector : Ensuring Examination Integrity
- ▶ Judiciary & Law Enforcement : Secure Chain of Custody for Legal Evidence
- ▶ Banking & Finance : Secure Transport of Confidential Financial Data
- ▶ Logistics & Supply Chain : Enhanced Security for High-Value Asset Transportation
- ▶ Government Operations : Secure Handling of Classified Documents & Records



Conclusion

IoT SecureBox solution was demonstrated during the final evaluation round of 5G Innovation Hackathon held at IISc Bangalore. The solution presented is not just a novel gadget but it is also a timely answer to India's pressing security challenges in the physical realm of data and document handling. It can be scaled to the gigantic needs of Indian institutions, provide a precise market fit for critical sectors, align with every relevant law and guideline, remain affordable through smart procurement, and outshine any existing approach with its innovative edge.

Proposal No : HAC-2025-1426

2ND RUNNER-UP IN MSME/STARTUP CATEGORY

Enhanced Automated Security System for Mobile Telecom Network against Cloning and unauthorised access

Team Leader

Mr. Vinay Bhardwaj

Institute

Malaviya National Institute of Technology,
Jaipur



Problem Statement

As mobile networks evolve and expand, so do the associated cybersecurity threats. Existing security solutions such as Equipment Identity Register (EIR), which is used by mobile network operators to manage and secure mobile device on the network. EIR stores the device IMEI and categorised them into three lists i.e. White (Authorized), Grey (Unknown) and Blacklist (Blocked from network access). It is primarily used for blocking stolen devices, tracking suspicious devices

using IMEI. However, it lacks the ability to address multiple and/or simultaneous threats such as IMEI spoofing, SIM cloning, unauthorized device usage, and device cloning. These issues compromise the security of telecom networks, leaving both users and network operators vulnerable. There are no standards in 3GPP for telecom network which can automatically detect IMEI spoofing and other cloning threats of handsets.

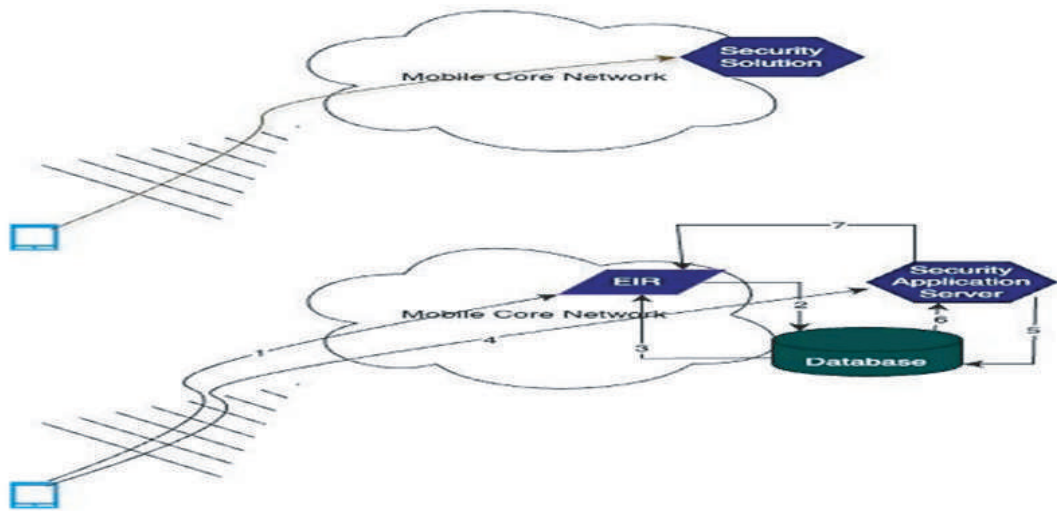


Solution/Architecture

This solution introduces a solution beyond the existing EIR capabilities and 3GPP telecom standard to address the challenges of Device cloning/IMEI spoofing/SIM cloning. This solution employs multi-factor device authentication approach by aggregating combination of multiple device-specific parameters to validate and authenticate devices in real-time with the mobile network. If the validation of the device parameters fails on the server, as a deterrence method the proposed solution will have an automated blacklisting of the vulnerable device by integrating into telecom networks, unauthorized access and cloning threats can be effectively mitigated. This comprehensive solution will move beyond sole reliance on IMEI, incorporating additional device attributes to ensure enhanced security and accuracy.

The solution demonstrated a security solution for telecom network that leverages a multi-parameter authentication model to combat unauthorized device access. This model combines unique device identifiers including IMSI, ICCID, Software binary version, MAC IDs, Android ID, IMEI etc. The combined identifier will be authenticated at server by communicating in a secure way by encrypting the hash value of the combined identifier to ensure authenticity. A multi-layered verification system, consisting of mobile and server applications and a 3GPP-compliant Equipment Identity Register (EIR) database, supports real-time monitoring and validation of devices within the network.

ARCHITECTURE OVERVIEW (HIGH LEVEL)



Conclusion

The solution provides an automated security solution to safeguard telecom networks from unauthorized device access, specifically addressing threats like IMEI spoofing, SIM cloning, and device cloning. Through a multi-parameter authentication approach, the solution combines IMSI, ICCID, Software binary version, MAC IDs, IMEI etc identifiers to validate device authenticity. The proposed security solution includes a mobile application, server application, and an EIR database, employing encrypted data transmission and periodic re-verification to ensure continuous security. This robust approach enhances telecom network resilience against identity cloning threats.

The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at National Communications Academy-Technology, Ghaziabad.

Proposal No : HAC-2025-1859

SPECIAL MENTION FOR THE BEST IDEAS

RAN Intelligent Drift Handling Enabler

Team Leader

Dr. Koteswara Rao Kondepu

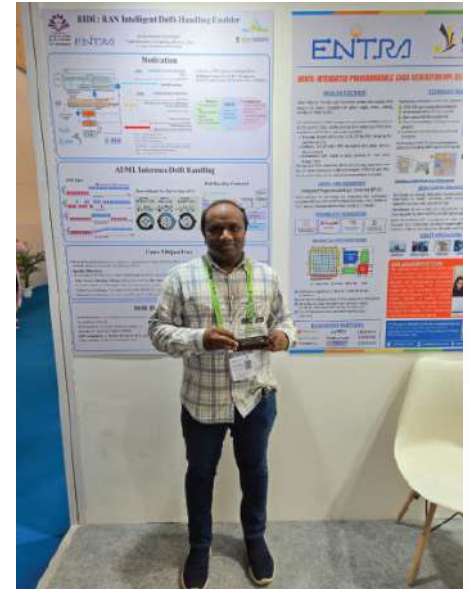


Institute

National Institute of Technology Calicut

Problem Statement

The project focuses on developing an end-to-end drift detection and handling framework within the Radio Intelligent Controllers (RICs) for 6G networks, aiming to enhance Open RAN networks performance, reliability, and adaptability. The goal is to effectively manage Artificial Intelligence/Machine Learning (AI/ML) models deployed within the RICs to ensure consistent performance levels despite dynamic changes in user traffic patterns.



Solution /Architecture

The potential of Radio Access Network intelligence depends on effective AI/ML model management to ensure consistent performance. AI/ML model accuracy relies heavily on the quality and relevance of the training or observed datasets, and their inferences can be deployed as rApps/xApps/dApps via the RAN Intelligent Controllers (RICs) to optimize network behavior.

The arrival of new user traffic patterns, driven by dynamic service demands or network changes, may cause the performance of these models to degrade—a phenomenon known as drift. From a model perspective, performance degradation is the most immediate and critical consequence of drift; however, its impact becomes even more severe in highly adaptive and complex environments such as 6G networks. To remain effective, Open RAN must incorporate an adaptation strategy based on analyzing and mitigating drift caused by evolving user traffic. To our knowledge, no dedicated drift handling framework is tailored for the Open RAN ecosystem.

This project addresses that gap by developing a real-time drift detection and mitigation framework that dynamically adapts to user traffic changes, ensuring sustained AI/ML model performance and maintaining optimal RAN operation.

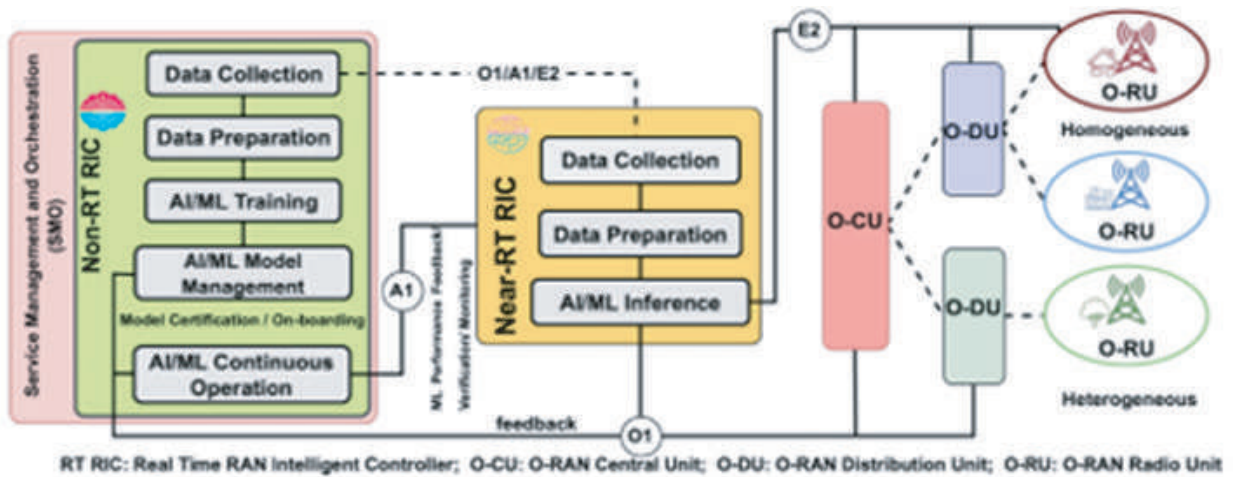


Figure 1: System Architecture [2]

Conclusion

Implementing real-time drift handling in Open RAN environments marks a transformative step for the socio-economic and telecommunication sectors, due to controlling the over/under-provisioning of the resource. From an Industry viewpoint, the functionality of detecting and adapting to drift in real time boosts progress towards self-optimizing RAN systems that are fully autonomous, alleviating the need for manual model retraining. This improvement lowers the Operational Expenditure (OpEx) of Mobile Network Operators (MNOs) and makes service delivery more responsive. The framework gives the vendors a distinct advantage by enabling the preservation of AI model integrity to retain their value based on shifts in network traffic for intelligence functions. The proposed solution provides better management of resources and leads to lower-footprint.

The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-0740

SPECIAL MENTION FOR THE BEST IDEAS

5G- Enabled Smart Onion Spoilage Detection and Alert System

Team Members

Mr. Abhijit Pingale ,Mr. Shaunak Thigale,
Mrs. Monika Kamtamkar, Dr. Pranoti Bansode-Gaikwad

Institute

Dr. Babasaheb Ambedkar
Technological University and
Savitribai Phule Pune University

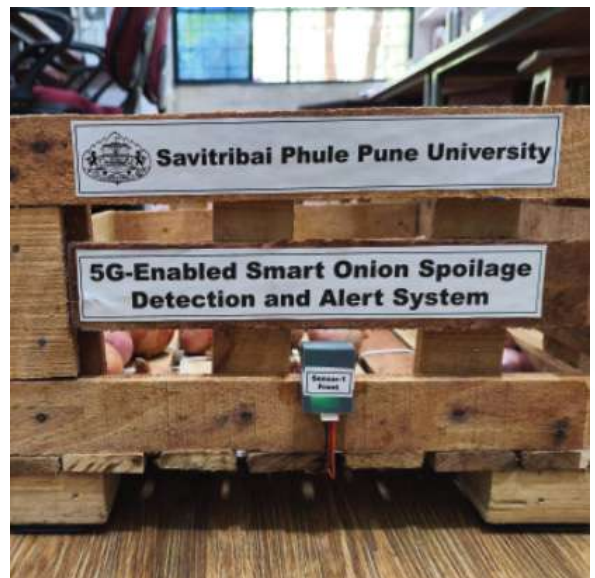


Problem Statement

Onions are a staple vegetable in most regions of the world, including in Indian cuisine. In India, onions rank as the second-largest commercial vegetable crop globally, following China.

While storage plays a key role in post-harvest losses in India experiences about 42% of its total onion losses during storage and marketing stages. Several factors contribute to these losses, including poorly designed storage structures, improper storage temperatures, fluctuating relative humidity, inadequate handling practices,

and prolonged storage durations. Common challenges include sprouting, quality deterioration, and physiological weight loss. To address these issues, the adoption of improved post-harvest technologies and scientifically designed storage systems is crucial.



Solution /Architecture

The 5G-enabled Smart Onion Spoilage Detection System uses IoT sensors such as gas, temperature, and humidity sensors placed inside storage racks to monitor onion freshness in real time. Sensor data is transmitted over a 5G network and displayed on a user-friendly MQTT dashboard and mobile app with a clear graphical interface for farmers. Spoiled onions release higher concentrations of sulphur-based volatile organic compounds (VOCs) like ammonia and ethylene, which can rapidly damage nearby onions. By detecting these gases early, the system provides alerts for timely intervention, preventing chain-reaction spoilage, reducing post-harvest losses, and supporting better storage management and overall farm profitability.

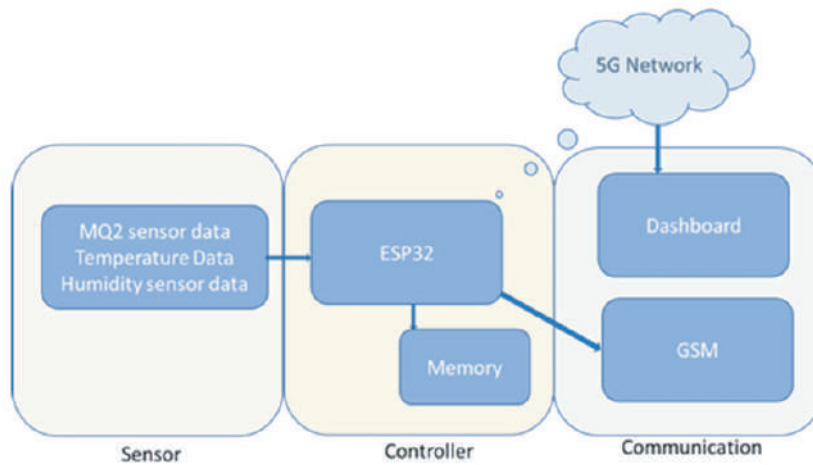
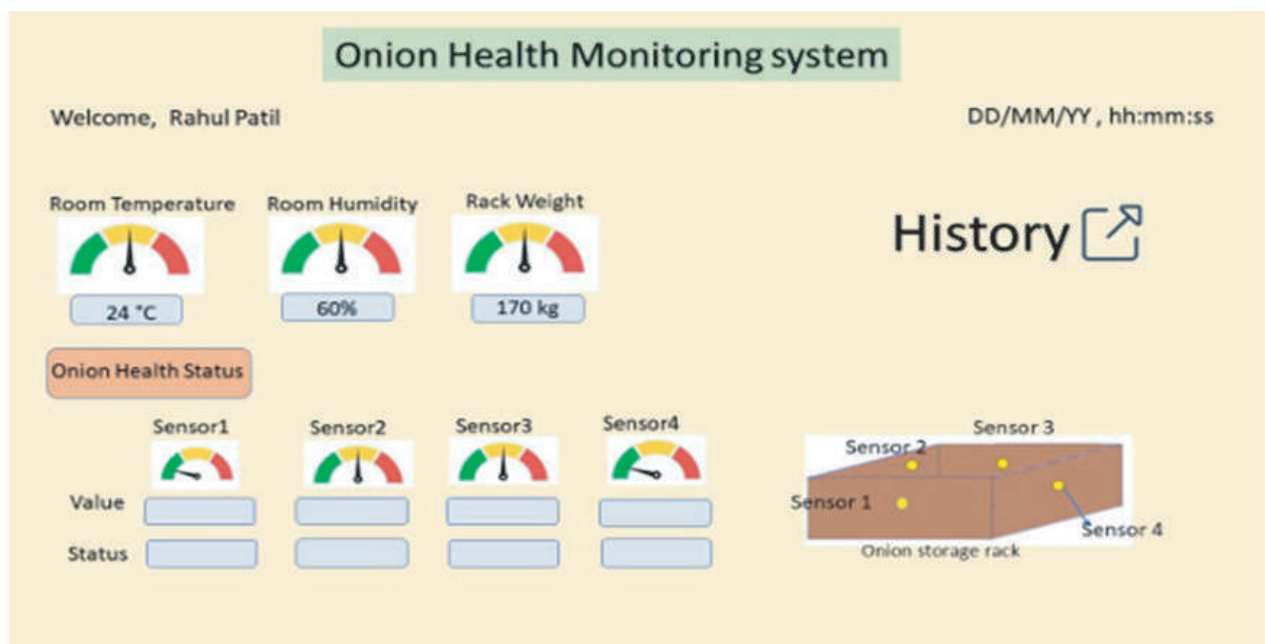


Fig1 : Architure of the system

This project uses an MQ2 gas sensor to detect spoilage in stored onions by monitoring gases released during decay. The ESP32 microcontroller reads sensor values, activates alerts, and communicates with a GSM module. A tri-color LED system indicates spoilage levels—green for fresh, orange for moderate spoilage, and red for severe spoilage—along with a buzzer for high-risk alerts. Collected data is transmitted wirelessly to a dashboard over a 5G network and to the farmer's mobile phone for remote monitoring. This solution enables early detection, reduces wastage, and supports timely action to protect onion storage quality and farmer profits.



Conclusion

The implementation of a spoilage detection system in the agricultural sector significantly reduces losses during storage and transportation by enabling early identification of decaying produce. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, bangalore.

Proposal No : HAC-2025-0613

SPECIAL MENTION FOR THE BEST IDEAS

Smart Sprinkle Using 5G

Team Leader

Mr. Shashank Kukreti

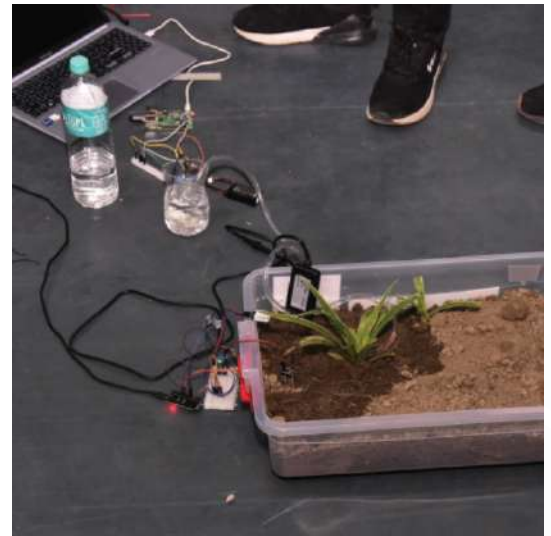
Institute

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

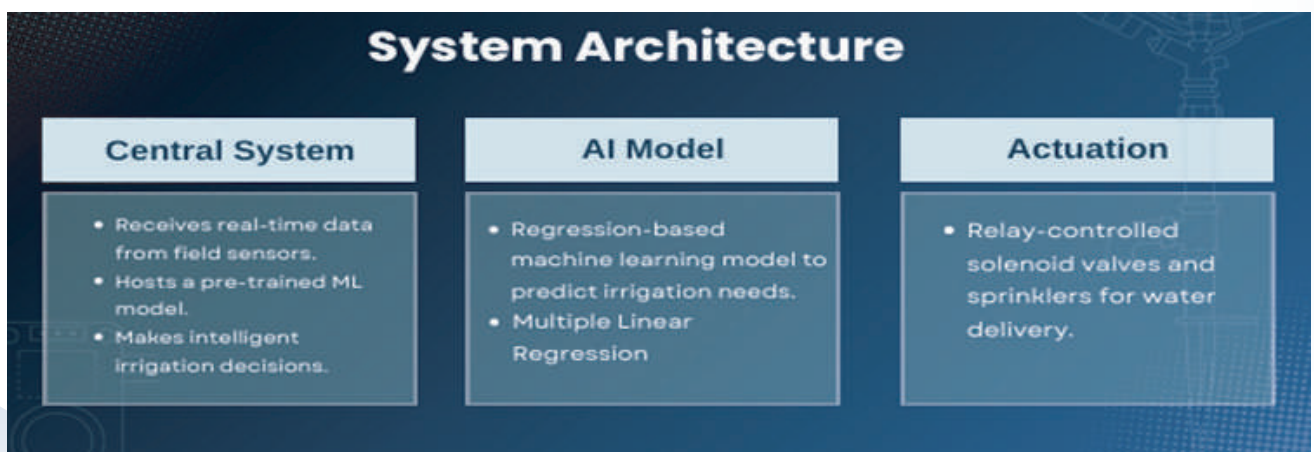
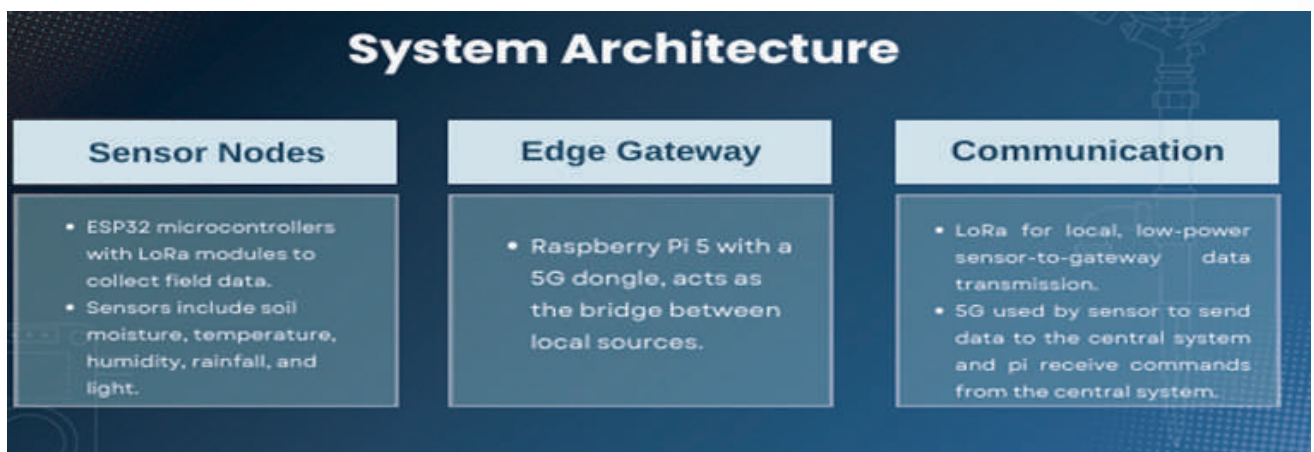


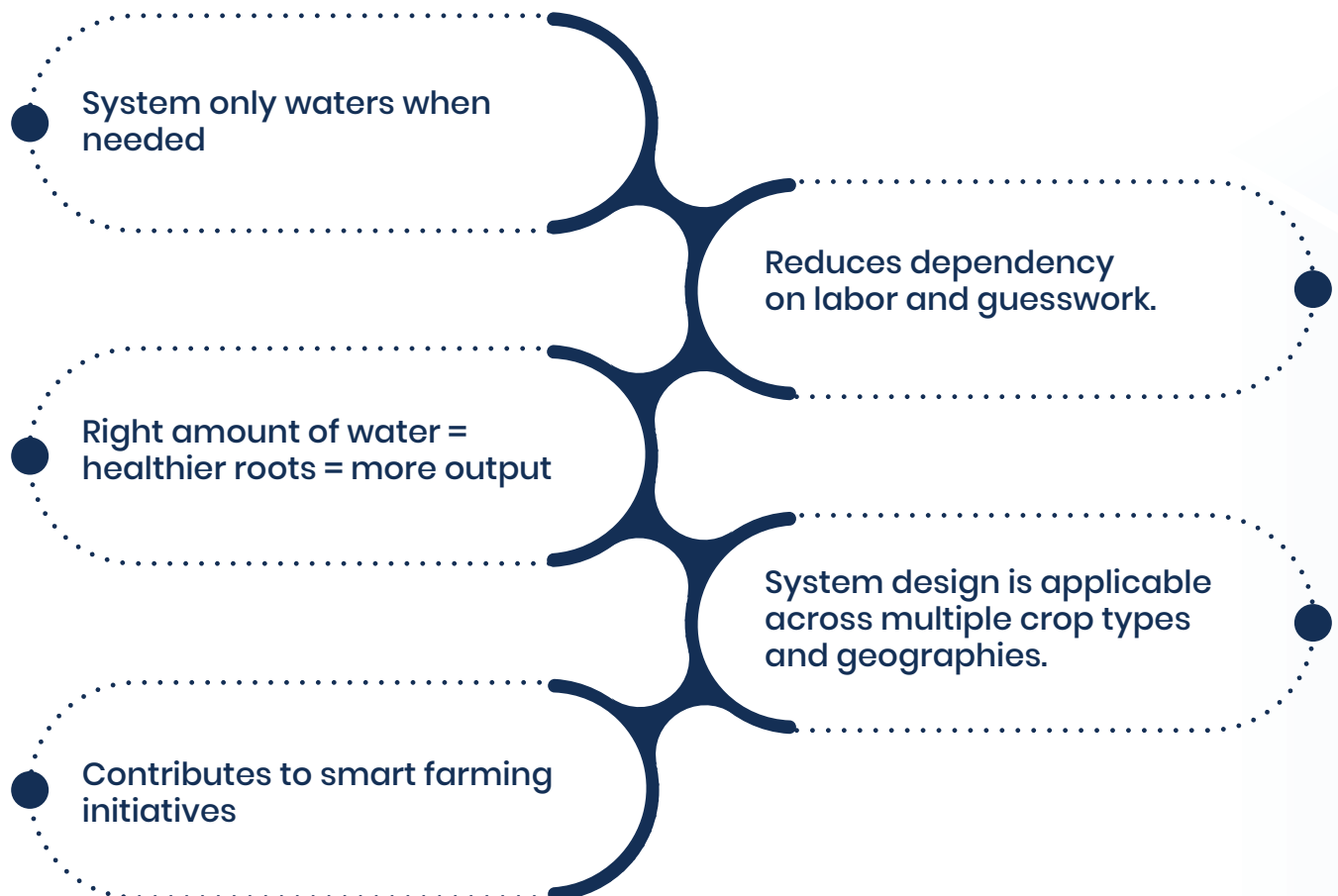
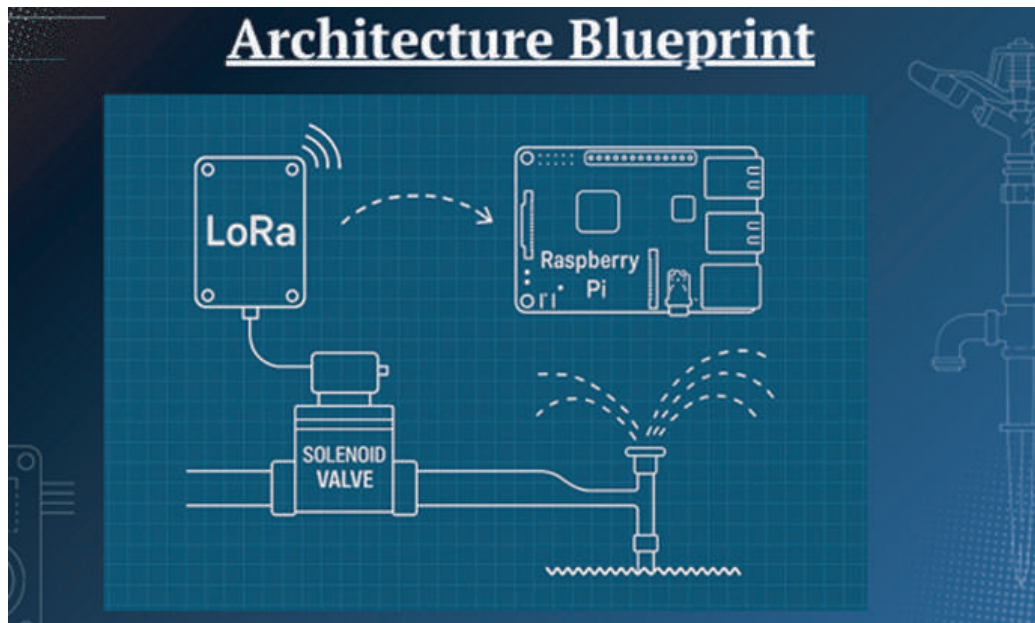
Problem Statement

Traditional irrigation systems in tea gardens and paddy fields are inefficient, often relying on manual methods leading to overwatering, water wastage, and crop damage. Current automated sprinkler systems lack intelligent decision-making and rely on local, often inaccurate data.



Solution /Architecture





Conclusion

AI-powered smart irrigation system using 5G-enabled IoT sensors to intelligently manage water usage in tea gardens and paddy fields. The system aims to enhance water supply efficiency, reduce crop damage, and enable remote and autonomous irrigation based on real-time environmental data.

The project prototype was demonstrated during the final round of 5G Innovation Hackathon at National Communications Academy- Technology.

Proposal No : HAC-2025-864

SPECIAL MENTION FOR THE BEST IDEAS

Mentor Mitra AI Redefining Learning Experiences with 5G and Edge AI

Team Leader

Mr. Maitreya Agarwal

Institute

Jaypee Institute of Information Technology, Noida

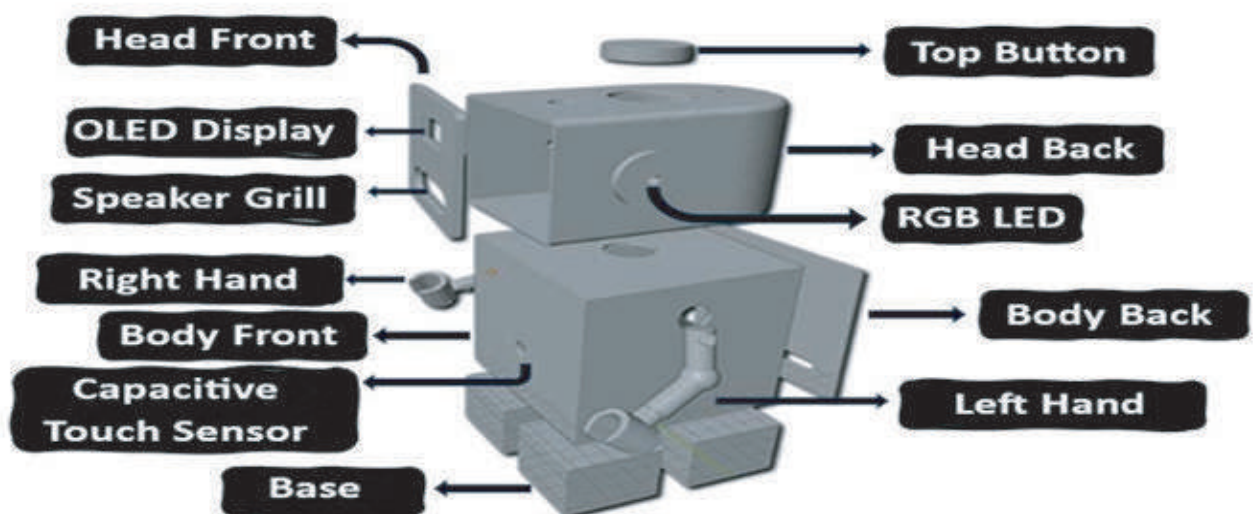


Problem Statement

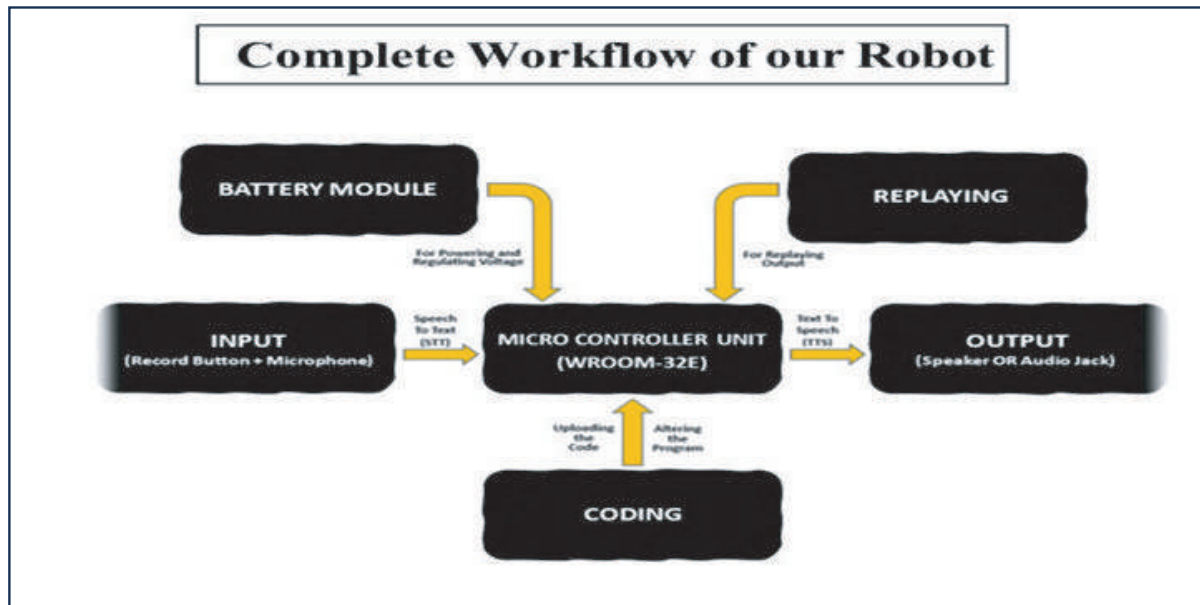
Many children lack engaging, interactive educational tools that adapt to their unique learning styles, leaving them disengaged from traditional learning methods. The objective is to design an innovative educational toy to empower children by combining the excitement of robotics with the supportive capabilities of generative AI.



Architecture/Solution



- ▶ Interactive OLED Display
- ▶ Multi-Sensory Touch Interaction
- ▶ Sound Activation & Response : When sound is detected, the robot moves its arms (servo motors) and activates RGB LED lights.
- ▶ Gemini AI Access Button
- ▶ Motorized Movements
- ▶ Sound Activation & Response



Conclusion

This AI-powered robot serves as an interactive companion for children, promoting learning through emotional engagement, sensory feedback, and playful interactions. The robot helps children develop cognitive, social, and motor skills by responding to touch, sound, and temperature changes. With real time guidance, sensory interaction, and cloud connected content, Mentor Mitra empowers kids to learn, play, and grow—anytime, anywhere— at 5G speed.

The project was successfully demonstrated during the final round of 5G Innovation Hackathon at National Communications Academy-Technology, Ghaziabad

Other Finalists of 5G Innovation Hackathon 2025

EVALUATED AT NATIONAL COMMUNICATIONS ACADEMY – TECHNOLOGY, GHAZIABAD		
S. No.	Proposal/ Project Description	Institute
01	Bridging Communication Barriers with AR Smart Glasses for Deaf and Mute Individuals (Project ID: HAC-2025-0609)	Central University of Haryana
02	AI-Driven Hybrid 5G-Satellite Solutions for Disaster Resilience, Education & Healthcare (Project ID: HAC-2025-0851)	Jaypee Institute of Information Technology, Noida
03	Real-Time Suspicious Activity Detection in High-Security Zones Using 5G-Enabled Drone Feed with MEC and Docker-Based YOLO Deployment (Project Id: HAC-2025-0933)	Banasthali Vidyapith
04	Aerial ISAC Enabled Geospatial Data Extraction for Intelligent Surveillance (Project ID: HAC-2025-1010)	Indian Institute of Technology, BHU
05	5G-Enabled AI-IoT Smart Traffic Management and Enforcement System (Project ID: HAC-2025-1015)	Indian Institute of Information Technology, Manipur
06	Real-Time Detection of Anomalies and QoS Deviations in Multi-Service Traffic over 5G Private Networks using AI techniques (Project ID: HAC-2025-1027)	Banasthali Vidyapith
07	MEC-Enabled Microclimate Fault Analytics for Smart Mining Infrastructure over 5G Private Networks (Project Id: HAC-2025-1029)	Banasthali Vidyapith
08	Adaptive Traffic Signal Control Using Real-Time Video Analytics and 5G-Enabled Edge Computing (Project Id HAC-2025-1157)	Birla Institute of Technology and Science, Pilani
09	Visual-SLAM for Collaborative UAV Applications in Army Surveillance Using 5G (Project ID: HAC-2025-1167)	Birla Institute of Technology and Science, Pilani
10	Real-Time Open Source Face Recognition on CPU Edge Server (Project ID: HAC-2025-1262)	Indian Institute of Science, Bangalore
11	Autonomous Drone For Virtual Intelligent Care Assistance (Project ID: HAC-2025-1419)	Delhi Technological University
12	Crash Prevention through Vehicle-to-Everything (V2X) Communication using 5G Technology (Project ID: HAC-2025-1536)	Thapar Institute of Engineering and Technology, Patiala
13	AgriFlysense: A 5G-Enabled Cost effective SWIPT Drone-Assisted Sensor Node for Smart Agriculture Monitoring (Project ID: HAC-2025-1582)	Indian Institute of Technology Ropar
14	A 5G-Enabled Smart Farming Assistant (Project ID: HAC-2025-1765)	IIIT, Kalyani
15	A Framework for an Autonomous Drone-Based Network Using Digital Twin and AI-Driven Optimization for Disaster Recovery and Infrastructure Management (Project ID: HAC-2025-1817)	National Institute of Technology Hamirpur (H.P.)
16	Empowering 5G and Beyond: Intelligent RIS-Assisted Multi-User Communication with Passive Sensing and Machine Learning (Project ID: HAC-2025-1856)	Delhi Technological University

Bridging Communication Barriers with AR Smart Glasses for Deaf and Mute Individuals

Team Leader

Mr Vishisht Mishra

Institute

Department of Computer Science and Engineering,
Central University of Haryana

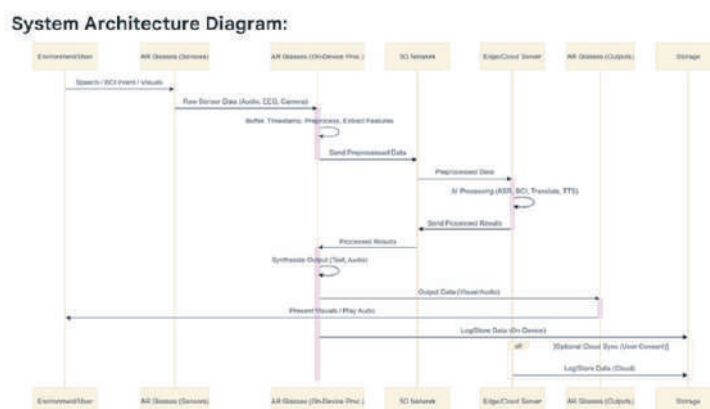


Problem Statement

A substantial portion of the deaf community, relies on visual communication methods, primarily sign language. However, access to qualified sign language interpreters is limited, and communication barriers are exacerbated in diverse, multilingual settings and noisy environments common across India. The scale of this challenge, particularly considering that nearly 69% of people with disabilities reside in rural areas with often limited access to services, highlights a critical unmet need for effective, affordable, and versatile assistive communication technologies tailored to the Indian context.

Solution/Architecture

This project focuses on developing an innovative solution: Augmented Reality (AR) smart glasses designed to bridge communication gaps for deaf and mute individuals in India. This system envisions integrating multiple communication modalities – including Automatic Speech Recognition (ASR), Brain Computer Interface (BCI), Text-to-Speech (TTS), and real-time translation – into a wearable AR platform. The glasses aim to provide real-time communication support by displaying subtitles of spoken conversations, translating languages, vocalizing text input generated via BCI or other methods, and potentially incorporating visual aids like sign language avatars or lip-reading assistance. The system leverages advancements in Artificial Intelligence (AI) for processing these modalities and relies on 5G connectivity, particularly its Ultra-Reliable Low Latency Communication (URLLC) capabilities, to enable the real-time performance crucial for natural conversation flow.



Conclusion

The project was demonstrated at 5G innovation Hackathon at National Communications Academy, Ghaziabad, showed low cost prototype for Augmented Reality (AR) smart glasses designed to bridge communication gaps for deaf and mute individuals.

Proposal No : HAC-2025-0851

AI-Driven Hybrid 5G-Satellite Solutions for Disaster Resilience, Education & Healthcare

Team Leader

Mr. Apoorv Adarsh



Institute

Jaypee Institute of Information Technology, Noida

Problem Statement

Disaster Impact: Floods and cyclones frequently damage terrestrial networks, delaying emergency alerts and rescue coordination. Traditional 5G requires expensive fiber backhaul and is unsuitable for rugged terrains, while satellite-only solutions like Starlink are costly and lack localized edge processing. This results in digital exclusion of rural populations, deepening inequality and vulnerability during disasters.

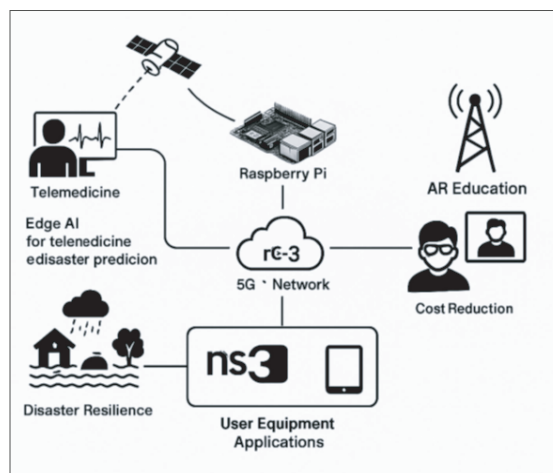
Solution/Architecture

The project proposes an AI-driven hybrid 5G-Satellite Network to deliver resilient, affordable, and intelligent connectivity for rural and disaster-prone regions. The system integrates:

- Low-cost ground stations (Raspberry Pi + LimeSDR) for edge processing,
- ISRO's LEO satellites for reliable non-terrestrial backhaul, and Edge AI models for real-time telemedicine, disaster prediction, and AR/VR-based education.

Hybrid NTN Components: Terrestrial 5G: Ground-based gNodeBs (base stations). Non-Terrestrial: LEO satellites (e.g., ISRO's CMS series) or HAPS (high-altitude platforms). Edge Computing: Local data processing to reduce latency. Gateway Stations: Connect satellites to the 5G core network.

Figure
System Overview



Conclusion

The proposed AI-driven hybrid 5G-Satellite solution addresses the critical need for reliable, affordable, and scalable connectivity in underserved regions. By integrating terrestrial and non-terrestrial networks with edge intelligence, the project ensures continuous service during disasters, enhances rural healthcare and education, and contributes to India's Digital Bharat mission.

The project was demonstrated during the final round with a conceptual framework design by the team.

Proposal No : HAC-2025-0933

Real-Time Suspicious Activity Detection in High-Security Zones Using 5G-Enabled Drone Feed with MEC and Docker-Based YOLO Deployment

Team Leader

Ms. Anisha Riya

Institute

Banasthali Vidyapith



Problem Statement

India's strategic defence zones and border regions are frequently exposed to security threats including illegal infiltration, smuggling, and unauthorized surveillance. Existing security systems rely heavily on manual patrol and outdated surveillance technologies that lack real-time analytics, are bandwidth limited, and are not scalable in rugged or remote areas. Delayed threat identification and response can have severe consequences on national security and public safety

Solution/ Architecture

This project introduces a real-time surveillance system utilizing a 5G-enabled drone, integrated with Multi-access Edge Computing (MEC) and Docker-based object detection. The drone captures video using a camera attached to a Raspberry Pi, which streams the feed via RTSP/RTMP to a 5G core network. The feed is processed on an Ubuntu VM hosted on a MEC server, where YOLO is deployed inside a Docker container. This setup allows immediate detection of threats like unauthorized personnel, vehicles, or weapons and sends annotated output to a monitoring station using Flask and socket programming. This containerized and scalable approach enables the deployment of intelligent monitoring systems even in inaccessible terrains.

Conclusion

This project was demonstrated with a conceptual framework during the final rounds. Through the integration of 5G, MEC, and Dockerized deployment, it ensures rapid detection of unauthorized activities, significantly reducing response time and enhancing the efficiency of defence operations. The use of cost-effective, modular and scalable design allows for easy deployment across diverse terrains. In the long run, such intelligent monitoring systems may contribute to a safer living environment for communities near sensitive zones and support the country's broader goals of security, innovation, and economic resilience.

Proposal No : HAC-2025-1010

Aerial ISAC Enabled Geospatial Data Extraction for Intelligent Surveillance

Team Members

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Mr. Ayush Yadav.



Institute

Indian Institute of Technology, BHU

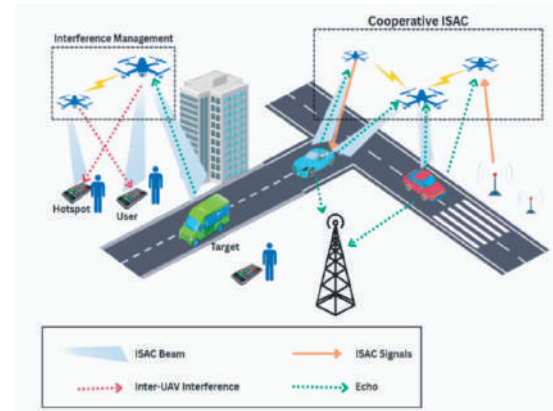
Problem Statement

To cater to the issues int in disaster response, industrial inspection, smart surveillance, and urban air mobility, enabling resilient communication and real-time situational awareness even in low-visibility or GPS-denied environments the 5G system is required to be deployed here.

The AEGIS 5G project is a UAV-based reconnaissance and disaster management system leveraging 5G New Radio (NR) technology and Integrated Sensing and Communication (ISAC). This innovative approach allows the UAV to perform both high-speed communication and environmental sensing using the same 5G radio signals, eliminating the need for separate LiDAR and optical sensors. The UAV uses adaptive antenna arrays with beamforming to simultaneously transmit and receive data while sensing its surroundings through backscattered 5G signals. The onboard system fuses these radio-based measurements with NavIC/GPS data for precise localization and mapping.

Solution/ Architecture

- ▶ Unmanned Aerial Vehicle (UAV) platform with sufficient payload capacity
- ▶ Multi-directional antenna array with beamforming capability
- ▶ Software Defined Radio (SDR) modules for 5G NR waveform generation
- ▶ Field Programmable Gate Array (FPGA) or System-on-Chip (SoC) for onboard signal processing
- ▶ 5G Base Station (gNodeB) for communication and sensing integration
- ▶ Onboard processors for control, data fusion, and AI-based decision-making
- ▶ Navigation with Indian Constellation (NavIC) and GPS modules
- ▶ 5G Core Network (Non-Standalone, including UPF, SMF, and AMF components)
- ▶ Edge computing and cloud infrastructure for data aggregation and analysis
- ▶ Power management unit and batteries optimized for UAV flight
- ▶ Sensors for telemetry (altitude, velocity, orientation)
- ▶ Ground control station with visualization and data analytics interface



Conclusion

The AEGIS 5G platform showcased the convergence of 5G communication and radar-like sensing through ISAC technology, significantly enhancing UAV capabilities for real-time surveillance, disaster management, and autonomous navigation. By replacing conventional LiDAR and camera systems with RF-based environmental sensing, the project demonstrates reduced cost, lower power consumption, and improved environmental resilience.

5G-Enabled AI-IoT Smart Traffic Management and Enforcement System

Team Leader

Mr. Gannamraju Sai Koushik



Institute

Indian Institute of Information Technology, Manipur

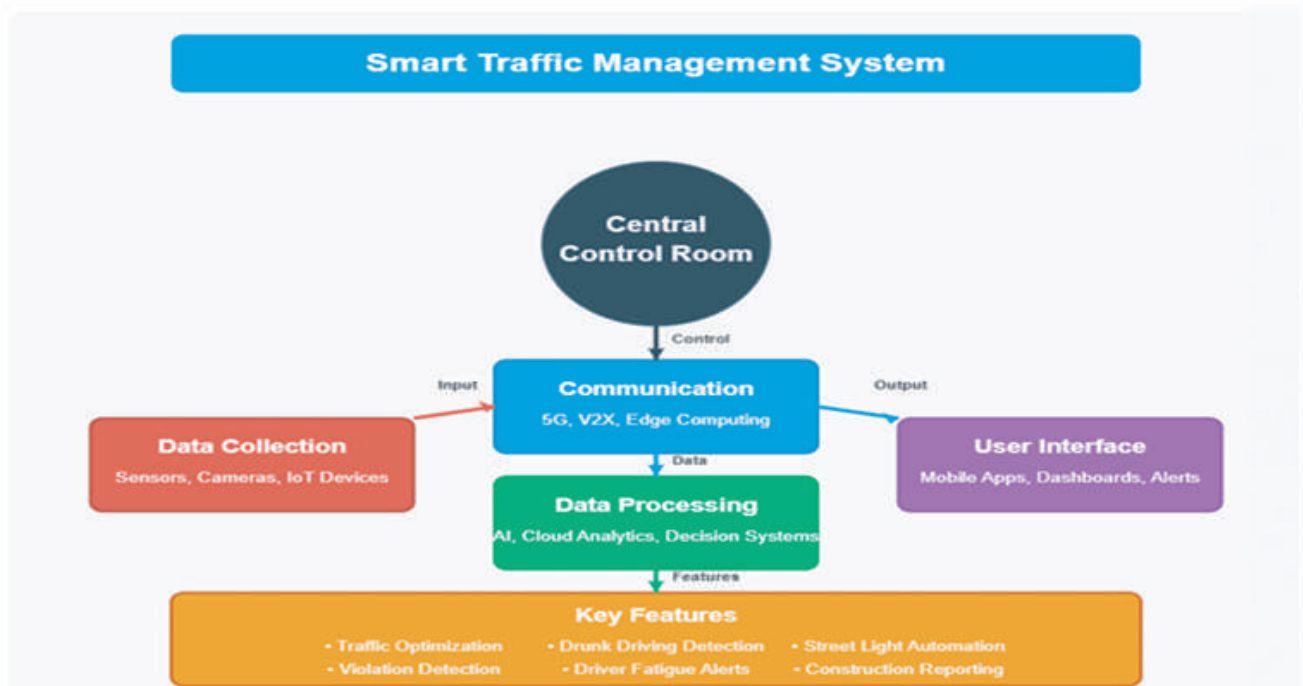
Problem Statement

This project aimed to develop a 5G-enabled AI-IoT-based Smart Traffic Management and Enforcement System to enhance road safety, streamline traffic flow, prioritize emergency vehicles, and detect violations like signal jumping, helmet enforcement, and drunk driving in real time. Additionally, it aimed to optimize street light automation, fault detection, and provide real-time traffic updates and road work information, thereby improving both city infrastructure and public safety

Solution/ Architecture

The system integrates AI, IoT sensors, and V2X communication to monitor traffic, detect violations, and manage signal timing dynamically. A centralized 5G-enabled control room processes real-time data from vehicles, cameras, and infrastructure for immediate action. An AI engine handles fatigue, helmet, and drunk-driving detection, while a mobile app enables public interaction & updates. Edge and cloud architecture ensure fast local decisions and scalable analytics for smarter, safer urban mobility.

FLOW DIAGRAM



Conclusion

- ▶ **Enhanced Road Safety:** AI-driven detection of violations such as drunk driving, speeding, and driver fatigue plays a vital role in preventing accidents, lowering fatality rates, and ensuring safer roads for all.
- ▶ **Improved Traffic Flow:** Real-time traffic optimization and intelligent signal control help reduce congestion, leading to smoother commutes and time savings for citizens.
- ▶ **Public Awareness & Accountability:** A dedicated mobile app provides real-time notifications of traffic violations, road closures, and infrastructure updates—fostering transparency and encouraging responsible driving habits.

The project was demonstrated during the final round of the 5G Innovation Hackathon with a prototype.

Real-Time Detection of Anomalies and QoS Deviations in Multi-Service Traffic over 5G Private Networks using AI techniques

Team Members

Ms Riya Raj, Ms. Muskan



Institute

Banasthali Vidyapith

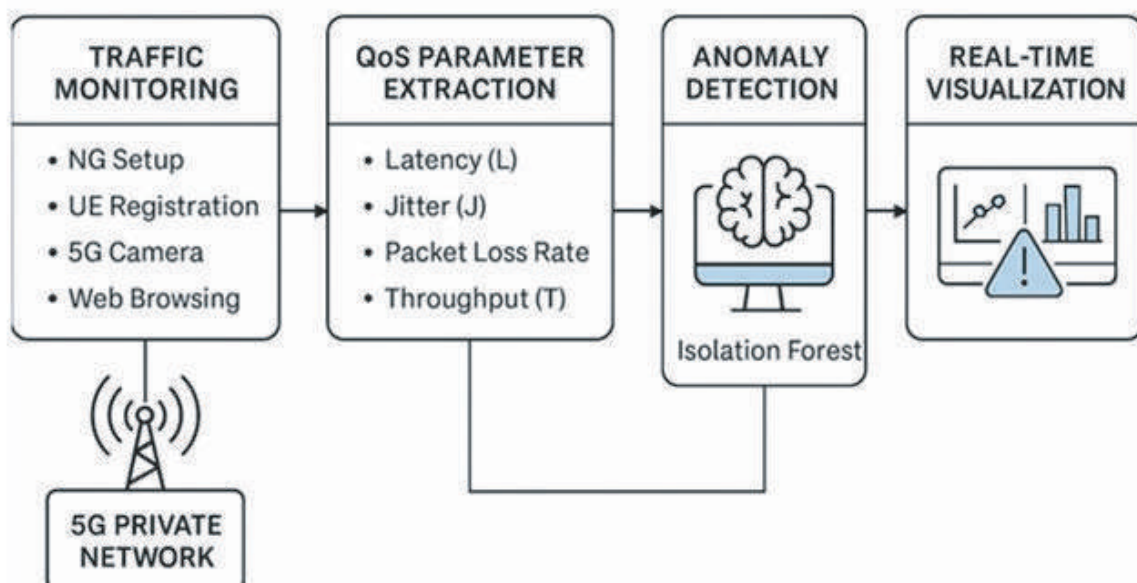
Problem Statement

With the rapid adoption of 5G private networks in industries, healthcare, and smart infrastructure, ensuring consistent Quality of Service (QoS) across multiple applications has become critical. However, the real-time performance of such networks can degrade due to unexpected traffic surges, network misconfigurations, hardware failures, or interference, which can lead to service disruptions.

Solution/Architecture

A real-time QoS deviation analysis and anomaly detection system using AI-based techniques in a 5G private network lab setup has been envisaged focussed on the following:

Step1: Multi-Service Traffic Monitoring. Step2: QoS Parameter Extraction such as Latency (L), Jitter (J), Packet Loss Rate (PLR), and Throughput (T), from the packet data that will be captured. For real-time QoS assessment, Wireshark's comprehensive insights into traffic behaviours allow for accurate measurement of delays, variation, data loss, and transfer rates. Step3: Real time Anomaly Detection Services—such as UE registration, NG setup, real-time camera streaming, voice/video over NR, and general web usage—each generate distinct traffic patterns and introduce specific operational complexities.



Conclusion

- ▶ Improved Reliability in Critical Infrastructure
- ▶ Faster Response to Network Issues By identifying network anomalies before they become more serious, the AI model (Isolation Forest) enables proactive intervention rather than reactive troubleshooting.
- ▶ QoS Assurance Across Diverse Applications Multiple services (such as browsing, AR/VR, high-definition video, and IoT sensor data) operate simultaneously in real-world private networks. The system ensures consistent performance across all of them, helping maintain Service-Level Agreements (SLAs) and user satisfaction.

The project was demonstrated during the final round of Hackathon with a working model.

MEC-Enabled Microclimate Fault Analytics for Smart Mining Infrastructure over 5G Private Networks

Team Leader

Ms. Mukta Dhar



Institute

Banasthali Vidyapith

Problem Statement

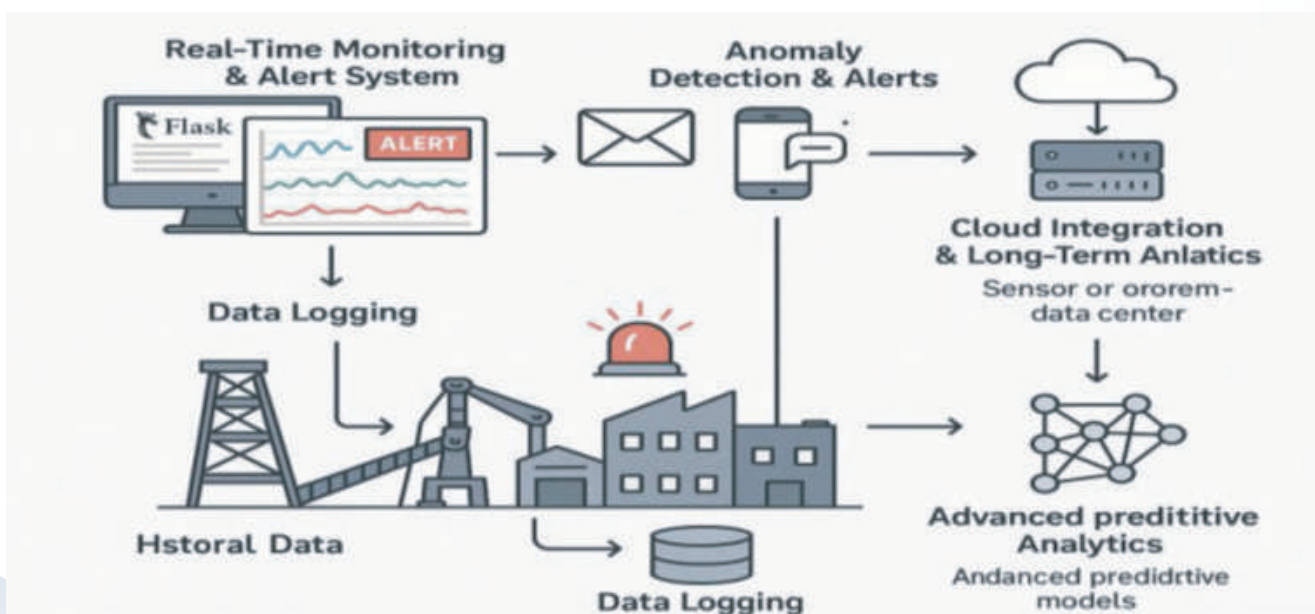
This project proposed a real-time microclimate fault detection system for underground mining environments using Multi-access Edge Computing (MEC) and 5G private networks.

Underground mines faces extreme environmental conditions—temperature, humidity, and gas concentration fluctuations—that can quickly escalate into safety hazards. Traditional systems depend on centralized processing, causing delays in response.

Solution/ Architecture

The proposed solution uses:

- IoT sensors to monitor temperature, humidity, gas, and vibration.
- 5G-enabled gateways to ensure ultra-reliable, low-latency data transmission.
- Edge-based AI/ML models (LSTM/CNN-LSTM) deployed on MEC servers to analyze data locally and detect anomalies in real-time.
- Flask-based dashboards for visualization and alerting (via SMS, email, and notifications).
- Cloud storage for long-term data analysis and predictive maintenance. This approach ensures quick detection of hazards, reduced downtime, enhanced worker safety, and compliance with mining safety regulations.



Conclusion

The MEC-enabled microclimate fault analytics system revolutionizes underground mining safety and monitoring by integrating AI-driven anomaly detection, 5G connectivity, and edge computing. By processing sensor data locally at the edge, the system achieves real-time fault detection and ultra-low latency response, significantly improving worker safety, operational reliability, and maintenance efficiency.

The project was demonstrated successfully with a working prototype during the final rounds of Innovation Hackathon.

Adaptive Traffic Signal Control Using Real-Time Video Analytics and 5G-Enabled Edge Computing

Team Leader

Mr. Projeet Roy, Mr. Kanwardeep Singh Gahlot,
Ms. Neha Choudhary



Institute

Birla Institute of Technology and Science,
Pilani

Problem Statement

Traffic congestion is a significant challenge in urban areas, leading to increased travel time, fuel consumption, and air pollution. One of the primary causes of this congestion is the use of traditional traffic light systems that operate on pre-set, fixed timers, regardless of the actual traffic conditions at any given time.

Solution/ Architecture

The project aimed to develop an intelligent traffic light control system that dynamically adjusts signal timings based on live traffic data using real-time video analytics and edge computing. The core functionality involves dynamic signal timing, where green light durations are calculated in real-time based on the number of vehicles detected in each direction using video analytics. Leveraging 5G connectivity, the system enables ultra-low latency communication between intersections, traffic cameras, and cloud-based edge servers, allowing for immediate processing and decision-making.

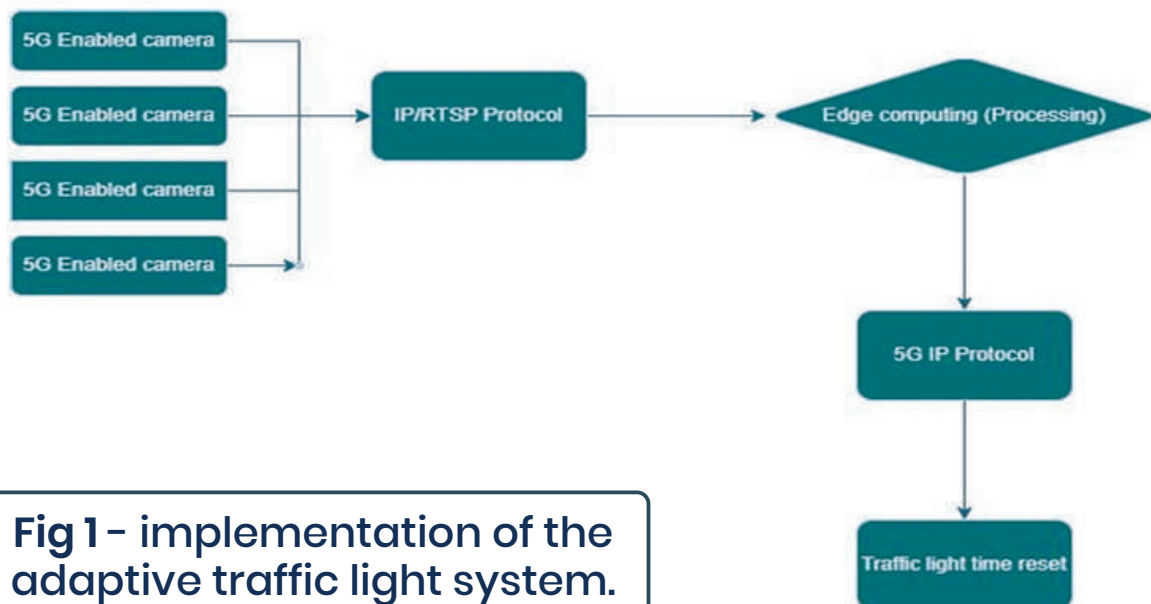


Fig 1 - implementation of the adaptive traffic light system.

Conclusion

This project was demonstrated during the final rounds of Innovation Hackathon with 5G-enabled traffic management use case, integrating edge computing and real-time video analytics to create an adaptive and intelligent signal control system. By dynamically adjusting traffic light durations based on live vehicle density, the system aimed to improve urban traffic efficiency while reducing congestion and emissions.

Visual-SLAM for Collaborative UAV Applications in Army Surveillance Using 5G

Team Members

Mr. Pranav M, Mr. Kanwardeep Singh Gahlot,
Ms. Neha Choudhary



Institute

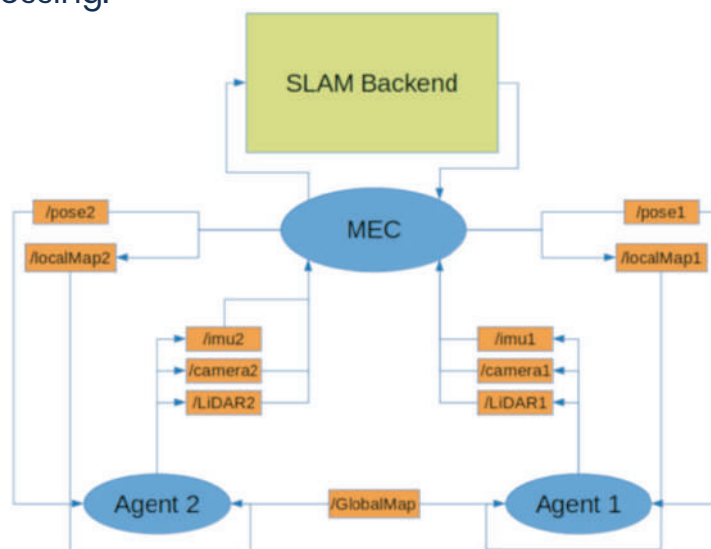
Birla Institute of Technology and Science,
Pilani

Problem Statement

Traditional SLAM (Simultaneous Localization and Mapping) relies mainly on LiDAR and Inertial Measurement Unit (IMU) for mapping and localization, but visual-SLAM (VSLAM) offers a lighter, more cost-effective option using cameras. When fused with LiDAR and IMU data, VSLAM can provide strong performance in dynamic environments, making it ideal for UAVs where weight and power are limited. With 5G integration, UAVs gain high-bandwidth, low-latency communication to share mapping data in real time.

Solution/ Architecture

The primary objective of this project is to design and implement a 5G-assisted VSLAM framework tailored for collaborative UAV missions in critical applications such as army surveillance and autonomous delivery systems. The proposed system aims to significantly enhance the capabilities of UAVs operating in outdoor environments by utilizing high-speed 5G connectivity for improved situational awareness, data sharing, and low-latency communication. A 5G-enabled MEC framework further supports collaborative SLAM among multiple UAVs, while combining SLAM with integrated sensing and communication (ISAC) allows navigation and perception to be enhanced through edge computing and reduced onboard processing.



Conclusion

The project involved the integration of Visual-SLAM with 5G for UAV-based surveillance applications. By utilizing the high-speed, low-latency communication capabilities of 5G networks, this project aimed to develop a reliable VSLAM system that ensures accurate and real-time navigation for UAVs in complex surveillance environments. The system will significantly enhance the effectiveness of UAVs in critical tasks such as border security, surveillance of strategic areas, and monitoring in disaster zones.

Real-Time Open Source Face Recognition on CPU Edge Server

Team Leader

Mr. A Sivaramakrishnan



Institute

Indian Institute of Science, Bangalore

Problem Statement

5G Architecture provides a very power EDGE compute component which the devices can leverage to facilitate a low latency and highly available application infrastructure framework. This project envisaged the extensive usage of the EDGE compute framework to build AI recognition models based on CPU with the use case of facial recognition that can be used in enterprise and industrial framework providing the required value enhancement to the private 5G setup for devices like camera and mobile applications.

Solution/ Architecture

To provide affordable, private face recognition for India's last-mile 5G edge infrastructure. It is designed for enterprise and industrial applications, enabling devices like cameras and mobile applications to use facial recognition for scenarios such as attendance, security, and safety. It utilizes Niral's EDGE compute solution deployed in 100 5G Labs in India to establish an enterprise and industrial application framework for facial recognition with CPU-based recognition model to ensure affordability and efficiency. It Offers an open-source, CPU-efficient, privacy-centric, and extensible solution with REST APIs and UI dashboards. It is 100% open-source pipeline with reproducible builds.

Real-Time Open Source Face Recognition on CPU Edge Server

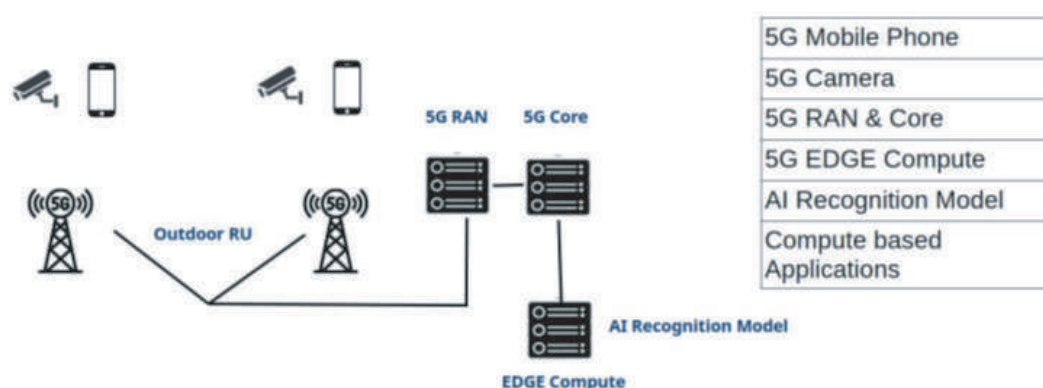


Fig: Architecture of the project

Conclusion

This project was demonstrated during final evaluation of 5G innovation Hackathon at National Communications Academy-Technology, Gahziabad. It a scalable, privacy-centric, and cost-effective facial recognition solution tailored for India's 5G edge infrastructure. It is fully open-source and optimized for CPU-based deployment. The solution ensures strong data privacy by performing all biometric processing locally on the edge server, without requiring cloud storage. It also has significant educational value, providing hands-on learning opportunities for students working with AI and 5G technologies.

Proposal No : HAC-2025-1817

A Framework for an Autonomous Drone-Based Network Using Digital Twin and AI-Driven Optimization for Disaster Recovery and Infrastructure Management

Team Members

Mr. Arun Kushwaha, Mr. Utkarsh Maurya,
Mr. Ananay Kaushal, Mr. Nitin Saini, Mr. Rahul Prasad

Institute

National Institute of Technology
Hamirpur (H.P.)



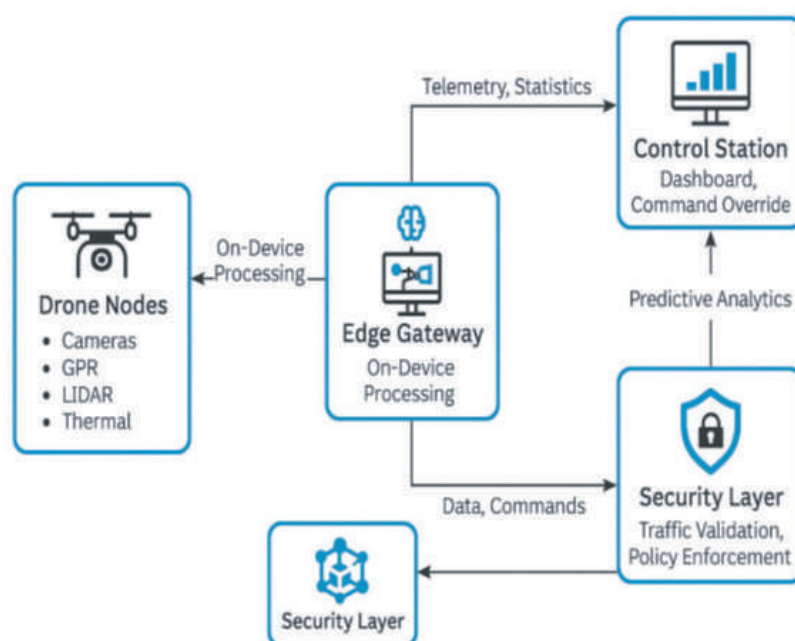
Problem Statement

Natural and man-made disasters—like landslides, earthquakes, floods, and building collapses—often result in tragic loss of life, primarily because of delayed victim detection and inefficient emergency response coordination. Existing response systems rely heavily on manual fieldwork and disconnected operations, which lead to delays in rescue efforts.

Solution/ Architecture

This system integrates AI-driven multi-sensor fusion, combining thermal imaging, LiDAR, and GPR for real-time disaster response using autonomous UAVs. It utilizes a decentralized coordination protocol with 5G/6G networks for ultra-reliable, low-latency communication, enabling dynamic mission reconfiguration. Edge-based machine learning pipelines, powered by devices like the Jetson Nano, process data locally, reducing cloud dependency and bandwidth usage. A real-time, physics-aware Digital Twin model simulates the disaster environment for predictive optimization. Secure operations are ensured through Zero Trust principles, IDS, and encrypted communication, providing remote, reliable control and ensuring the integrity of mission-critical data and operations.

Fig1: System Architecture



Conclusion

This project was demonstrated during final evaluation of 5G innovation Hackathon at National Communications Academy-Technology, Ghaziabad. This project tried to establishes a cutting-edge framework that integrates 5G connectivity, Digital Twin technology, and AI-driven autonomous drones to transform disaster response and infrastructure management.

Autonomous Drone For Virtual Intelligent Care Assistance

Team Members

Mr. Nikhil, Mr. Buxi, Mr. Vishal, Mr. Mohit
Mr. Maroof



Institute

Delhi Technological University

Problem Statement

ADVICA (Autonomous Drone for Virtual Intelligent Care Assistance) is an innovative drone-based system designed to transform emergency response in India. It integrates autonomous drones, AI voice assistance, and virtual ICU capabilities to provide real-time medical support, monitor patient vitals, and aid rescue operations—especially in remote or high-risk areas. Featuring GPS-based navigation, advanced obstacle avoidance, and live video streaming,

Solution/ Architecture

- It ensure rapid and autonomous drone deployment to emergency locations using GPS-based navigation.
- Provide an onboard Virtual ICU kit for vital monitoring (heart rate, SpO₂, temperature, respiratory rate).
- Enable live surveillance and real-time video feed to support remote medical decision-making.
- Offer multilingual AI voice assistance for patient guidance and psychological support.
- Improve safety with intelligent obstacle avoidance in complex environments.
- Enhance emergency operations in disaster zones, smart cities, and remote regions with internet/5G support.



Conclusion

Project ADVICA was demonstrated during final evaluation of 5G innovation Hackathon at National Communications Academy-Technology, Gahziabad highlighted the integration of autonomous drones, AI, and medical monitoring to support emergency care in remote and high-risk areas. It enhances response speed, reduces human involvement in dangerous situations, and improves access to life-saving support.

Proposal No : HAC-2025-1536

Crash Prevention through Vehicle-to-Everything (V2X) Communication using 5G Technology

Team Members

Mr.Yash Bhargava, Mr. Manan Jain,
Ms. Aditi Sharma, Ms. Simrat Kaur



Institute

Thapar Institute of Engineering and Technology,
Patiala

Problem Statement

Road safety remains a major concern as autonomous and connected vehicles evolve. Traditional systems using LiDAR, cameras, and radar operate independently, leaving vehicles unaware of hidden hazards beyond sensor range, such as accidents behind blind curves or roadblocks ahead. Current GPS-based platforms like Google Maps send alerts using satellite data and crowdsourced updates, but this information often arrives with delays of several seconds to minutes.

Solution/ Architecture

- To design and implement a 5G-enabled accident prevention system using real-time obstacle detection, braking, and remote monitoring.
- To implement a basic 5G-powered Vehicle-to-Everything (V2X) communication framework, enabling the vehicle to exchange safety-related information with nearby vehicles (V2V), infrastructure elements like traffic signals (V2I), and network/cloud services (V2N).
- To demonstrate the capabilities of 5G in enabling ultra-low-latency, reliable communication between the vehicle and an external dashboard, supporting real-time monitoring, control commands, and emergency interventions



Conclusion

The 5G-enabled V2X accident prevention system demonstrated during final evaluation of 5G innovation Hackathon at National Communications Academy-Technology, Gahziabad showed that how real-time communication and autonomous sensing can significantly improve road safety. By integrating ultrasonic detection, automatic braking, and remote monitoring, the prototype effectively prevents collisions and enhances situational awareness beyond sensor range.

Proposal No : HAC-2025-1582

AgriFlysense: A 5G-Enabled Cost effective SWIPT Drone-Assisted Sensor Node for Smart Agriculture Monitoring

Team Members

Mr. Vikas Kumar, Mr. Malav
Dr. Ashwani Sharma



Institute

Indian Institute of Technology Ropar

Problem Statement

This project, titled “A Framework for an Autonomous Drone-Based Network Using Digital Twin and AI-Driven Optimization for Disaster Recovery and Infrastructure Management,” proposes an advanced drone system that integrates Digital Twin technology and AI-based decision-making. The framework aims to transform disaster response and infrastructure monitoring through a coordinated fleet of autonomous drones equipped with multi-modal sensors such as thermal imaging, LiDAR, and ground-penetrating radar (GPR). These drones perform real-time detection of affected individuals and structural conditions while operating over reliable, ultra-low-latency 5G/6G communication networks. The Digital Twin continuously simulates and optimizes missions, overcoming the limitations of manual and disconnected drone-based operations.

Solution/ Architecture

- ▶ To design a miniaturized, dual-band drone-mounted antenna enabling Simultaneous Wireless Information and Power Transfer (SWIPT) for sustainable, long-duration drone-assisted operations.
- ▶ To develop compact, polarization-insensitive, microwave-powered, battery-free sensor nodes capable of harvesting energy via Wireless Power Transfer (WPT) and transmitting environment data (e.g., temperature, humidity) using 5G-based wireless communication.
- ▶ To implement and demonstrate the complete AgriFlySense system in a realistic agricultural environment, validating its reliability for continuous monitoring and field-scale deployment.

Conclusion

The project was demonstrated during final evaluation of 5G innovation Hackathon at National Communications Academy-Technology, Gahziabad, offers a comprehensive and scalable solution to the challenges of post-disaster response and infrastructure management. By integrating AI, multi-modal sensing, 5G communication, and Digital Twin technology, the proposed framework provides a robust alternative to current manual and disconnected systems. It addresses critical gaps by enabling real-time mission optimization, secure remote operation, and coordinated drone behavior.

A 5G-Enabled Smart Farming Assistant

Team Members

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Mr. Subhradeep Mandal, Dr.(Mrs.) Dalia Nandi



Institute
IIIT, Kalyani

Problem Statement

Krishibandhu, meaning “Friend of the Farmer,” is an AI and IoT-powered smart agriculture assistant that uses 5G connectivity and cloud computing to modernize farming. It collects real-time soil and environmental data through IoT sensors and uses drone or mobile images to assess crop health. The information is processed in the cloud using LSTM (Long Short-Term Memory) machine learning models to predict soil moisture, plant health, and weather conditions.

Solution/ Architecture

- To provide farmers with real-time and accurate weather forecasts using IoT data and LSTM-based prediction models for better irrigation and crop management decisions.
- To enable early detection of crop diseases using AI-based analysis of images captured via mobile phones or drones, and notify farmers instantly with recommended actions.
- To monitor soil moisture continuously through IoT sensors and support smart irrigation—either by advising farmers or automatically controlling water flow.
- To ensure accessibility and user-friendliness by delivering alerts and guidance in multiple local languages, making the system inclusive for rural communities.
- To deploy a low-cost, scalable solution using affordable hardware and cloud-enabled 5G connectivity, suitable for small and marginal farmers across diverse regions.

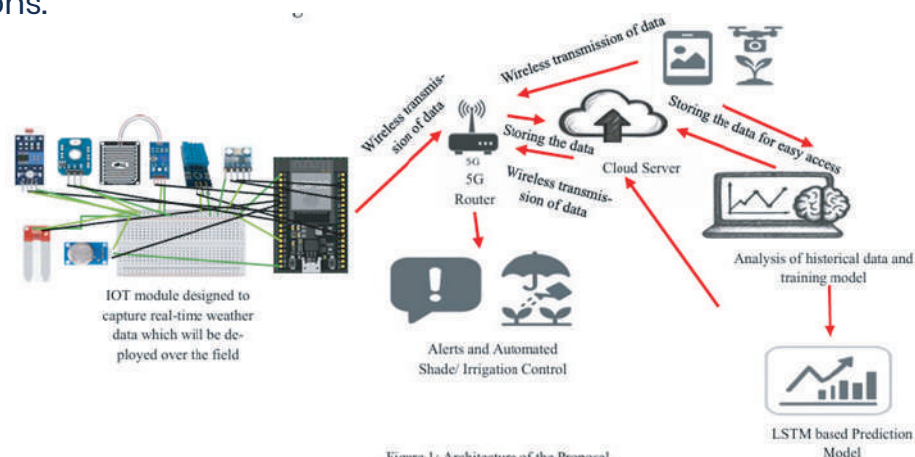


Figure 1: Architecture of the Proposal.

Conclusion

The project Krishibandhu was demonstrated during final evaluation of 5G innovation Hackathon at National Communications Academy-Technology, Gahziabad. The project demonstrated a step toward transforming Indian agriculture by combining cutting-edge technologies like 5G, AI, IoT, and cloud computing to support real time, data-driven farming. Developed and tested using the 5G lab infrastructure at IIIT Kalyani, this smart farming tried to addresses the core challenges faced by farmers—unpredictable weather, delayed disease detection, water mismanagement, and lack of accessible expert guidance.

Proposal No : HAC-2025-1856

Empowering 5G and Beyond: Intelligent RIS-Assisted Multi-User Communication with Passive Sensing and Machine Learning

Team Leader

Mr. Ankit Kumar Pal



Institute

Indraprastha Institute of Information, Delhi

Problem Statement

This project demonstrated a next-generation communication solution for Non-Terrestrial Network (NTN) applications. It features a fixed transmitter (TX) and a RIS positioned at the center of a semicircle, with stationary users arranged along the arc. Passive sensing by Near-Field Radio Frequency (NRF) modules at the RIS estimates users' azimuth locations through ML, followed by dynamic beam steering at the RIS using Field-Programmable Gate Array (FPGA)-programmed 1-bit Space-Time Coding (STC).

Solution/ Architecture

The proposed system architecture is designed around a highly controlled and replicable environment to facilitate precise testing and validation:

- ▶ A fixed TX is deployed at a predefined, known location to ensure a stable source of RF signals throughout experiments.
- ▶ A RIS, integrated with PIN diode control, is strategically positioned at the origin of a semicircle. This setup ensures that the RIS can dynamically manipulate the wireless environment by reflecting signals toward desired directions.
- ▶ Stationary RXs are distributed along the arc of the semicircle. These receivers are located at unknown azimuth angles (**denoted as θ_1 , θ_2 , etc.**), simulating realistic scenarios where the exact positions of users are not known beforehand.

This architecture provides a controlled yet challenging setup, where the RIS must intelligently adapt and steer signals toward multiple users based on real-time sensing and machine learning inference.

Conclusion

This project was demonstrated during final evaluation of 5G innovation Hackathon at National Communications Academy-Technology, Gahziabad. It is a future-ready, energy-efficient wireless communication framework designed for Non-Terrestrial Networks (NTN), drones, and airborne systems by integrating Reconfigurable Intelligent Surfaces (RIS), passive RF sensing, and machine learning. It enables real-time DoA estimation without active feedback, dynamic beam steering through FPGA-controlled 1-bit STC, and simultaneous multi-user communication using harmonic multiplexing, all while maintaining scalability through low-cost hardware.

Other finalists of 5g innovation hackathon 2025

Evaluated at Indian Institute of Science, Bangalore		
S. No.	Proposal/ Project Description	Institute
01	CoPercept-AMR: Farm Guard: 5G-AI-Blockchain Enabled Post-Harvest Crop Resilience System (HAC-2025-0379)	GITAM Institute of Technology and Management Deemed to be University/VVIT University Guntur.
02	Multi-Sensor PRS/SRS Fusion for Precise Positioning of UE Using AI 5G Drones as Virtual gNB in NTN (HAC-2025-0600)	SASTRA Deemed University
03	HoloScout: An IoT-Powered, ML-Driven Stealth Recon Drone for Urban Intelligence Gathering Team Members : Yash Parkhi (HAC-2025-0644)	Symbiosis Institute of Technology, Pune
04	RIS-Assisted 5G ISAC System for Passive Intrusion Detection in Industrial Perimeter Security (HAC-2025-1065)	Visvesvaraya National Institute of Technology, Nagpur
05	CoPercept-AMR: Quantum Metamaterial-Based Reconfigurable Surface for Quantum Communication (HAC-2025-1617)	M S Ramaiah Institute of Technology
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08	NeuroLink Rover: A 5G-Enabled Brain-Computer Interface for Remote Rover Control in Critical Operations (HAC-2025-0727)	Sardar Vallabhbhai National Institute of Technology, Surat
09	NeuroCareNet: A 5G-Powered Federated AI Network for Early Detection of Brain Disorders (HAC-2025-0818)	DEPARTMENT OF ELECTRONICS, CUSAT
10	IntelliResQ: 5G-Based Smart Traffic and Emergency Response System for Disasters (HAC-2025-819)	Department Of Electronics, CUSAT
11	5G-Enabled Multi-Sensor Rod System for Real-Time Slope Stability Monitoring in Open-Cast Coal Mines (HAC-2025-1069)	Visvesvaraya National Institute of Technology, Nagpur
12	HydroTerRa: Automated 5G Drone and Digital Twin Platform for Scalable Soil Moisture Monitoring (HAC-2025-1079)	College Of Engineering Guindy, Anna University
13	CoPercept-AMR: 5G-Enabled Drone-Based Damage Assessment and Remote Monitoring of Radio Towers (HAC-2025-1100)	Indian Institute of Technology Gandhinagar
14	Enhancing Public Transportation for the Visually Impaired Integrated with 5G (HAC-2025-1127)	BMS College of Engineering, Bengaluru
15	CoPercept-AMR: A Next-Generation Localization Framework for Autonomous Mobile Robots in 5G-Enabled Smart Environments (HAC-2025-1169)	Indian Institute of Information Technology Dharwad
16	5G-Enabled River Water Level Forecasting for Bridge Safety and Flood Mitigation (HAC-2025-1648)	Sri Sivasubramaniya Nadar College of Engineering
17	KASHYAP: AI-Driven 5G-Enabled Autonomous Seed Sowing Machine for Smart Farming (HAC-2025-1671)	Maulana Azad National Institute of Technology, Bhopal
18	5G-Enabled Mobile Gait Analysis: Advancing Real-Time Biomechanical Monitoring (HAC-2025-1695)	School of Computer and Information Sciences, University of Hyderabad, Telangana
19	LOG INSIGHT: AI-Powered Real-Time Log Search Analytics and Backhaul Monitoring System for Telecom Infrastructure (HAC-2025-1881)	MBM University, Jodhpur

CoPercept-AMR : Farm Guard: 5G-AI-Blockchain Enabled Post-Harvest Crop Resilience System

Team Members

Rebba Chandra Sekhar,
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Institute

GITAM Institute of Technology and Management
Deemed to be University

Problem Statement

Predict hyperlocal weather threats (<1km) using edge AI and trigger real-time crop protection. Empower farmers with AI-based price forecasting and blockchain-backed MSP compliance. Digitize and optimize cold storage using 5G-IoT for real-time availability and spoilage alerts.

Solution/ Architecture

Stage	Tech Stack	5G Use Case
Weather Protection	IoT sensors + TinyML	5G D2M multicast alerts
Price Optimization	LSTM AI + Ethereum blockchain	5G URLLC for price APIs
Smart Storage	LoRaWAN sensors + GIS mapping	5G mMTC for IoT density

Societal & Industrial Impact

Quantified Benefits

Metric	Impact	Source
Loss Reduction	30-40% (₹45,600 cr/year)	NABARD 2023
Farmer Income	22% higher profits	NITI Aayog 2024
Cold Storage Efficiency	35% lower spoilage	NCCD 2023

Stakeholder Benefits

- **Farmers** : MSP transparency, reduced spoilage.
- **Government** : Supports Digital Agriculture Mission 2025.
- **Startups** : Open APIs for weather and pricing data.

Conclusion

Farm Guard delivers a scalable, secure, and intelligent post-harvest solution using 5G, AI, and blockchain. By addressing weather risk, price exploitation, and storage inefficiencies, it empowers farmers, supports national agri-tech goals, and creates a resilient agricultural supply chain. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Multi-Sensor PRS/SRS Fusion for Precise Positioning of UE Using AI 5G Drones as Virtual gNB in NTN

Team Members

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Institute

SASTRA Deemed University

Problem Statement

This project proposes an AI-powered system for precise localization and trajectory prediction of UAVs in GPS-denied environments using 5G Positioning Reference Signals (PRS), Sounding Reference Signals (SRS), and sensor fusion. By deploying drones as virtual gNBs within Non-Terrestrial Networks (NTN), the system enhances mission-critical operations such as search and rescue, disaster response, and military coordination. A Multilayer Perceptron (MLP) model is trained on features like Time of Arrival (ToA), Angle of Arrival (AoA), RSSI, and interference levels to predict UAV position and movement in real time.

Solution /Architecture

Fuse PRS/SRS, path loss, and CSI data to extract key localization features. Train an MLP model using ToA, AoA, RSSI, and interference metrics. Deploy the trained model on SDR hardware for real-time UAV localization. Predict UAV trajectory using AI models for dynamic mission planning. Enable virtual gNB functionality in drones for enhanced communication in disaster zones.

Societal & Industrial Impact

- ▶ **Disaster Relief:** Enables rapid localization and communication in earthquake and landslide zones (e.g., Myanmar, Wayanad).
- ▶ **Military Operations:** Tracks troop positions and supports secure communication via drone-based gNBs.
- ▶ **Public Safety:** Captures aerial imagery and facilitates contact between victims and rescuers.
- ▶ **Infrastructure Resilience:** Replaces damaged gNBs with AI drones for uninterrupted service.

Conclusion

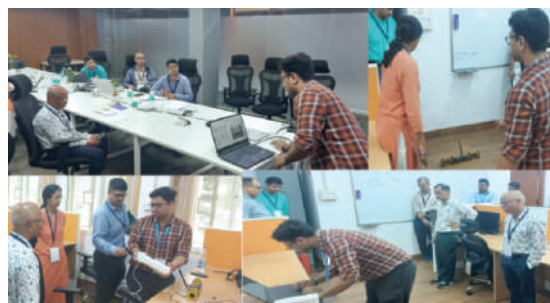
This project demonstrates a robust AI-driven framework for UAV localization and trajectory prediction using 5G PRS/SRS and SDR-based sensor fusion. By transforming drones into virtual gNBs, it ensures resilient communication and precise positioning in critical environments. The system's scalability, real-time performance, and societal relevance position it as a key enabler for future NTN deployments in 5G and beyond.

Proposal No : HAC-2025-0644

HoloScout: An IoT-Powered, ML-Driven Stealth Recon Drone for Urban Intelligence Gathering

Team Leader

Yash Parkhi



Institute

Symbiosis Institute of Technology, Pune

Problem Statement

Reconnaissance in high-risk urban and underground environments presents challenges such as limited visibility, complex layouts, and safety hazards for human personnel. HoloScout is a ground-based drone system designed to address these issues using advanced technologies like Simultaneous Localization and Mapping (SLAM), visual odometry, and AI-driven detection. It enables safe, efficient, and intelligent surveillance in confined spaces, supporting defense, disaster response, and industrial inspection missions.

Solution/ Architecture

Hardware Components

- ▶ Four Mecanum wheels for omnidirectional movement.
- ▶ Camera module connected to Raspberry Pi for visual data capture.
- ▶ ESP32 microcontroller for movement control and sensor processing.
- ▶ MPU6050 IMU for motion tracking and stability.
- ▶ Optional ToF sensors for obstacle detection.
- ▶ Power system using Samsung INR21700 cells with boost and buck converters.

Software Architecture

- ▶ OpenCV for image processing and feature extraction.
- ▶ SLAM algorithms (GMapping/Cartographer) under ROS for mapping and localization.
- ▶ AI models (TensorFlow/PyTorch) for face and object detection.
- ▶ Remote interface for live video, map visualization, and drone control.
- ▶ Database for storing images, maps, and positional data.

Communication Protocols

The system leverages 5G for high-speed, low-latency data transmission. Key protocols include:

- ▶ MQTT: Efficient telemetry data exchange.
- ▶ WebSocket: Real-time control communication.
- ▶ WebRTC: Secure peer-to-peer video streaming.

Conclusion

HoloScout sets a new standard for urban reconnaissance by merging SLAM, AI, and IoT into a compact, intelligent drone system. Its ability to navigate complex indoor environments and deliver actionable intelligence makes it a valuable tool for defense, disaster response, and industrial applications. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-1065

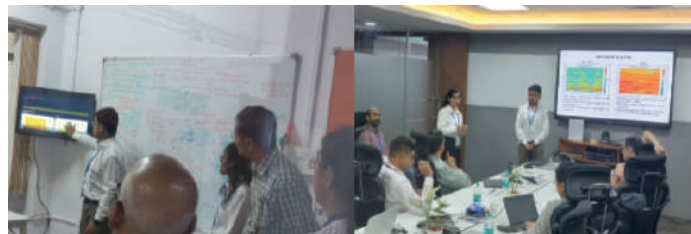
RIS-Assisted 5G ISAC System for Passive Intrusion Detection in Industrial Perimeter Security

Team Members

Dr. Prabhat Kumar Sharma, Akshat Kumar Sinha

Institute

Visvesvaraya National Institute of Technology, Nagpur



Problem Statement

Design and validate a RIS-assisted 5G ISAC system for passive intrusion detection. Use RIS to steer and enhance 5G signal reflections in NLOS zones. Extract Channel State Information (CSI) and Doppler features for motion detection. Train AI models to classify motion types using signal variations. Integrate with VNIT's MEC server for real-time alerting and visualization

Solution/ Architecture

Component	Functionality
RIS Panels	Programmable phase control for beam steering and zone scanning
Passive Receiver	Captures CSI and CIR from reflected 5G signals
MEC Server	Hosts AI models for motion classification and alert generation
Operator Dashboard	Displays intrusion zones and triggers alerts via SMS/email
VNIT 5G Lab	Provides standalone 5G network, gNB, and testing tools

Methodology

- **RIS Integration:** VNIT's RIS panels steer beams across test zones for enhanced signal return
- **Signal Processing:** Passive receivers extract CSI and CIR; detect anomalies via Doppler shifts and time-of-flight changes
- **AI Classification:** Models trained to distinguish human, vehicle, and ambient motion patterns
- **Visualization:** Real-time dashboard displays intrusion zones; alerts sent via multiple channels
- **Validation:** Simulated industrial perimeter (~100 sqm) with mobile targets; test runs measure accuracy, latency, and false alarms

Conclusion

The RIS-assisted 5G ISAC proposal by VNIT Nagpur represents a breakthrough in industrial perimeter security. By repurposing 5G infrastructure for passive sensing and integrating RIS technology, the system delivers non-invasive, real-time intrusion detection in environments where traditional surveillance fails. It aligns with national goals in smart infrastructure and strategic security, and lays the foundation for future 6G networks that unify communication, sensing, and control. With strong validation and scalable design, this solution positions VNIT as a leader in RIS-ISAC innovation for industrial safety. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-1617

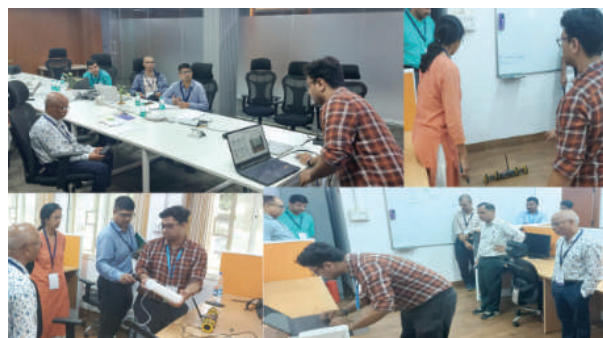
CoPercept-AMR: Quantum Metamaterial-Based Reconfigurable Surface for Quantum Communication

Team Leader

Swetha Amit

Institute

M S Ramaiah Institute of Technology



Problem Statement

This project proposes a Quantum Metamaterial (QMM)-based Reconfigurable Intelligent Surface (RIS) for secure quantum communication in the Terahertz (THz) spectrum. The RIS integrates Vanadium Dioxide (VO_2) as a phase-change material, a Sapphire substrate, and a Niobium (Nb) superconducting ground plane. By leveraging temperature-induced phase transitions and quantum coherence effects, the surface dynamically switches between absorption and reflection modes at 5.5 THz. This enables adaptive wavefront control, quantum key distribution (QKD), and interference suppression—critical for 6G and quantum-secure networks.

Solution/ Architecture

- ▶ **VO_2 Layer:** Acts as a tunable absorber or reflector based on temperature or THz excitation. Exhibits quantum superposition near phase boundaries.
- ▶ **Nb Ground Plane:** Superconducting below 9.2 K, enabling perfect reflection and minimal energy loss. Transitions to absorptive state under magnetic fields or THz-induced pair breaking.
- ▶ **Sapphire Substrate:** Provides ultra-low loss, thermal stability, and compatibility with quantum emitters and superconducting circuits.
- ▶ **Quantum Behaviour:**
 VO_2 and Nb exhibit superposition of electromagnetic states, allowing simultaneous absorption and reflection.
THz pulses trigger ultrafast transitions, enabling real-time reconfigurability without mechanical components.

Conclusion

This project pioneers the fusion of quantum metamaterials with reconfigurable intelligent surfaces for secure THz communication. By combining VO_2 's tunable phase-change behaviour with Nb's superconducting properties, it delivers a dynamic, low-loss, and quantum-coherent platform for next-generation networks. The proposed QMM-RIS sets a new benchmark for quantum-secure 6G infrastructure and cryptographic innovation. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

EdgeAI-Enabled Real-Time Fruit Harvester for Automated Smart Farms

Team Members

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Institute

GITAM Institute of Technology and Management Deemed to be University

Problem Statement

This project proposes a low-cost, high-accuracy fruit harvesting system powered by EdgeAI and 5G connectivity. Unlike traditional cloud-based solutions, the system performs real-time inference locally, minimizing latency and ensuring uninterrupted operation in remote farms. The harvester integrates vision sensors, AI-based fruit readiness detection, and a robotic arm for actuation. A novel model partitioning technique enables deployment of complex AI models across resource-constrained edge devices and edge servers, maintaining accuracy without relying on expensive hardware. The system is scalable, patentable, and designed to benefit small, medium, and large farms alike.

Solution/Architecture

Automate fruit harvesting using EdgeAI for real-time inference. Maintain high detection accuracy without cloud dependency. Reduce hardware cost via model partitioning across edge and edge server. Use 5G for low-latency communication between devices. Enable modular, scalable deployment across diverse farm types

Component	Functionality
Vision Sensor	Captures fruit images for analysis
Edge Device (e.g., Raspberry Pi)	Hosts partial AI model layers for initial inference
Edge Server (ES)	Completes model inference and sends harvesting instructions
5G Connectivity	Enables fast data transfer between edge and ES
Robotic Arm	Executes harvesting based on AI inference
Mobile Interface	Displays live feed and system status to farmer

Conclusion

This EdgeAI-powered fruit harvester offers a transformative solution for precision agriculture. By combining model partitioning, low-cost hardware, and 5G connectivity, it delivers real-time, accurate, and scalable automation for farms of all sizes. The system addresses key challenges in labor, cost, and latency while enabling future-ready smart farming. With strong potential for patenting, research publication, and commercial deployment, it positions itself as a pioneering innovation in agricultural robotics—bridging the gap between affordability and advanced automation. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore

Software-Defined Networking for Non-Terrestrial Networks: Optimizing Sub-6 GHz Connectivity

Team Members

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Problem Statement

This project proposes a dynamic, AI-enhanced Software-Defined Networking (SDN) framework for Non-Terrestrial Networks (NTN) operating in the Sub-6 GHz spectrum. As NTN infrastructure—comprising LEO satellites, UAVs, and HAPS—becomes integral to global connectivity, efficient spectrum utilization and interference mitigation are critical. The proposed system leverages SDN's centralized control, AI/ML-based predictive resource management, and real-time traffic rerouting to enhance spectral efficiency, network resilience, and seamless integration with terrestrial 5G/6G networks.

Solution/ Architecture

The architecture includes:

- ▶ **USRP (SDR Front-End)** : Acts as the RF interface for Sub-6 GHz transmission/reception across satellites, UAVs, and ground stations.
- ▶ **SDR Software (GNU Radio/MATLAB)** : Handles modulation, demodulation, channel estimation, and error correction.
- ▶ **Middleware Layer** : Bridges SDR and SDN, enabling real-time feedback for routing and spectrum optimization.
- ▶ **SDN Controller (ONOS/Ryu/OpenDaylight)** : Uses OpenFlow to dynamically manage traffic, allocate spectrum, and reroute data to avoid interference.
- ▶ **AI/ML Models** : Analyze historical and real-time data to predict demand, optimize bandwidth, and adapt to disruptions.
- ▶ **Edge Computing Nodes** : Perform local processing to reduce latency and support time-sensitive applications like IoT and V2X.
- ▶ **User Devices** : Connect via NTN for broadband, messaging, and sensor data in remote or underserved areas.
- ▶ **Feedback Loop** : Continuously adjusts network parameters based on signal quality and user demand.
- ▶ **NTN-Terrestrial Integration**: SDN enables seamless communication between NTN and 5G core networks.
- ▶ **Network Slicing**: Supports diverse applications (IoT, emergency response) with virtualized services.
- ▶ **Dynamic Spectrum Sharing**: Efficient use of Sub-6 GHz bands via AI-driven allocation. URLLC: Ensures low-latency, high-reliability links for mission-critical tasks.
- ▶ **mMTC**: Scales IoT connectivity in remote areas with energy-efficient NTN operations.

Conclusion

This project presents a scalable, intelligent framework for optimizing Sub-6 GHz NTN connectivity using SDN and AI. By addressing spectrum scarcity, interference, and resource allocation challenges, it lays the foundation for resilient, adaptive, and globally integrated NTN systems—crucial for the future of 6G, IoT, and ubiquitous broadband access. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

NeuroLink Rover: A 5G-Enabled Brain-Computer Interface for Remote Rover Control in Critical Operations

Team Members

Het Haresh bhai Bhutak, Nandan Patel, Vacha Buch, Varad Chaudhari , Ayush



Institute

Sardar Vallabhbhai National Institute of Technology, Surat

Problem Statement

Traditional robotic control systems rely on handheld devices and stable connectivity, which are often compromised in dynamic or obstructed environments. In contrast, BCI systems offer intuitive, distraction-free control by interpreting brainwave patterns. However, their deployment in field robotics has been limited due to latency, signal precision, and safety concerns.

NeuroLink Rover addresses these challenges by leveraging 5G's ultra-reliable low-latency communication (URLLC), high bandwidth, and edge computing capabilities. This enables robust, real-time transmission of EEG signals and sensor feedback, making thought-controlled robotics viable for critical operations.

Solution/ Architecture

The NeuroLink Rover system comprises several interconnected layers:

► EEG Acquisition Layer

Portable headsets like OpenBCI or Muse 2 capture multi-channel EEG signals, detecting patterns such as alpha, beta, theta, and gamma waves.

► Signal Processing and Classification

EEG data undergoes filtering, artifact removal, and feature extraction using tools like FFT and band-pass filters. Machine learning models—SVM, LDA, or CNNs—classify mental commands (e.g., blink for forward, concentration for turn).

► 5G Communication Layer

Commands are transmitted over 5G networks with <1 ms latency. Edge servers process data locally, reducing reliance on cloud infrastructure and ensuring responsiveness.

► Rover Control Layer

A Raspberry Pi-based control unit interprets commands and activates motors, sensors, and cameras. Feedback from onboard systems is sent back to the operator via 5G.

► Operator Feedback Display

Real-time visualization through AR headsets or dashboards allows the operator to monitor rover status and surroundings, creating a closed-loop control system.

Conclusion

NeuroLink Rover represents a transformative leap in human-machine interaction. By combining neuroscience, robotics, and 5G, it enables cognitive control of machines in real time—redefining remote operations in critical environments. This project lays the foundation for neuroadaptive systems that extend human capabilities while enhancing safety, precision, and accessibility. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-0818

NeuroCareNet: A 5G-Powered Federated AI Network for Early Detection of Brain Disorders

Team Members

Ms. Supriya M H, Tessy Ninan , Anil PY, Praveena K , Kripa felix



Institute

DEPARTMENT OF ELECTRONICS, CUSAT

Problem Statement

NeuroCareNet is a privacy-preserving, 5G-enabled federated AI platform designed to detect neurological disorders such as brain tumors, Alzheimer's, and Parkinson's at early stages. It integrates multimodal data—MRI/CT scans and voice recordings—processed locally at hospital edge nodes. Through secure federated learning, encrypted model updates are shared across institutions to collaboratively train diagnostic models without exposing patient data. The system supports real-time alerts, clinical dashboards, and national health data compliance, enabling scalable, equitable, and secure neuro diagnostics.

Solution/ Architecture

Enable early detection of brain disorders using multimodal AI (imaging + voice). Preserve patient privacy via federated learning and secure aggregation. Deploy edge AI inference at hospitals for real-time diagnostics. Use 5G for fast model synchronization and alert delivery. Integrate with EHR and telemedicine platforms for clinical usability. Support scalable deployment across rural and urban hospitals.

Component	Functionality
Edge Node	Local preprocessing, AI inference, FL client (Docker/Kubernetes)
Aggregation Server	FL orchestration (Flower/FLARE), secure aggregation (HE/SMPC)
Clinical Dashboard	Risk scores, imaging overlays, voice biomarker tracking, EHR integration
5G Connectivity	eMBB for model sync, URLLC for alerts, slicing for QoS isolation

Conclusion

The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore

Proposal No : HAC-2025-819

IntelliResQ: 5G-Based Smart Traffic and Emergency Response System for Disasters

Team Members

Ms. Supriya M H and team



Institute

Department Of Electronics, CUSAT

Problem Statement

Deploy edge AI-enabled smart traffic nodes for adaptive signal control and incident detection. Detect emergency vehicle sirens and trigger green wave pre-emption. Disseminate disaster alerts via BLE/LoRa mesh to reach last-mile users. Enable vehicle-to-network (V2N) communication for rerouting and incident reporting. Use 5G slices for low-latency control, high-bandwidth video, and massive IoT connectivity. Support authorities with centralized dashboards and predictive analytics.

Solution/ Architecture

Component	Functionality
Smart Traffic Nodes	Edge AI for vehicle detection, adaptive signal control, 5G URLLC for command execution
Audio Detection Units	Siren recognition via CNNs, direction estimation, alert transmission via 5G/LoRa
Disaster Mesh Nodes	BLE/LoRa/Wi-Fi mesh for local alert propagation, solar-powered, gossip protocol
Vehicle OBUs / App	BLE alert reception, rerouting guidance, incident reporting via phone sensors
Central Control System	Cloud/MEC backend for data aggregation, traffic simulation, alert orchestration

Conclusion

The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-1069

5G-Enabled Multi-Sensor Rod System for Real-Time Slope Stability Monitoring in Open-Cast Coal Mines

Team Members

Prabhat Kumar Sharma, Akshat Kumar Sinha, Swayam Kamble, Vishal Kumar , Harsh Rathod



Institute

Visvesvaraya National Institute of Technology, Nagpur

Problem Statement

India's open-cast coal mines face frequent slope failures, leading to fatalities and operational losses. This proposal from VNIT Nagpur introduces "Omni-Rods"—rugged, sensor-embedded rods deployed into dump slopes and benches to monitor geotechnical conditions in real time. Using VNIT's private 5G infrastructure, these rods transmit high-frequency data to edge servers, where AI models detect early signs of instability and trigger alerts. The system merges geotechnical instrumentation, 5G connectivity, and AI analytics to create a scalable, predictive safety solution for smart mining.

Solution/ Architecture

Develop a multi-sensor rod prototype for slope stability monitoring. Integrate 5G IoT modules for ultra-low latency data transmission. Build AI models to predict slope failures using fused sensor data. Create a real-time dashboard for alerts and risk visualization. Validate the system up to TRL 6 using VNIT's 5G lab infrastructure

Component	Functionality
Omni-Rod	Embedded sensors: accelerometers, gyroscopes, piezometers, pressure sensors, thermocouples, LVDTs
Microcontroller	Collects sensor data and transmits via 5G
5G Gateway	Connects rods to VNIT's 5G Core and MEC servers
Edge Server	Performs anomaly detection and prioritizes alerts
Cloud Dashboard	Visualizes risk levels and sends SMS/email notifications

Conclusion

The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-1079

HydroTerRa: Automated 5G Drone and Digital Twin Platform for Scalable Soil Moisture Monitoring

Team Members

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Institute

College Of Engineering Guindy, Anna University

Problem Statement

HydroTerRa is a fully automated 5G-enabled drone system designed to revolutionize soil moisture monitoring across agricultural landscapes. By integrating FMCW radar, edge computing, and digital twin visualization, the platform delivers real-time, actionable irrigation insights with minimal farmer intervention. The system addresses water scarcity, labor inefficiencies, and crop yield variability—offering a scalable solution for precision agriculture.

Solution/Architecture

Deploy autonomous drones with FMCW radar for soil moisture scanning. Enable real-time data transmission via 5G and edge processing. Visualize moisture data through a digital twin interface. Reduce water usage by 25% and increase crop yields by 15–20%. Operate without manual scheduling or sensor deployment.. Create rural employment and bridge the digital divide.

Feature	Role	Impact
eMBB	High-speed radar data transfer	Seamless real-time transmission
URLLC	Low-latency alerts	Immediate irrigation adjustments
Edge Computing	Local processing	Reduced cloud dependency
Network Slicing	Prioritized data flow	Reliable performance in rural zones
mMTC	IoT scalability	Multi-drone, multi-sensor support

Conclusion

HydroTerRa offers a transformative leap in precision agriculture by automating soil moisture monitoring and irrigation planning. With its 5G backbone, radar-based sensing, and digital twin interface, the system empowers farmers to make data-driven decisions while conserving water and boosting yields. It's a scalable, inclusive, and future-ready solution for sustainable farming. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-1100

Copercept – AMR 5G-Enabled Drone-Based Damage Assessment and Remote Monitoring of Radio Towers

Team Leader

Chandrabhan Patel

Institute

Indian Institute of Technology
Gandhinagar



Problem Statement

This project, developed by a team from IIT Gandhinagar, introduces a cutting-edge prototype that integrates drone technology, 5G connectivity, and advanced computer vision (CV) to automate the assessment of structural damage to radio towers—especially during disasters like floods and earthquakes. The system enables real-time remote monitoring and expert diagnosis, significantly reducing inspection time, labor costs, and communication downtime in critical scenarios.

Solution/ Architecture

The architecture is modular and layered, comprising:

- ▶ **Drone Subsystem**
Equipped with optical, multispectral, and optional thermal or LiDAR sensors, drones capture real-time imagery and transmit it via 5G.
- ▶ **5G Connectivity Hub**
Ensures seamless, high-speed communication between drones, edge processors, and cloud servers.
- ▶ **Edge Processing**
Performs initial data decoding, compression, and lightweight CV inference for quick anomaly detection.
- ▶ **Cloud Processing**
Conducts deep analysis using advanced CV models (e.g., U-Net, Mask R-CNN) and aggregates historical data for trend analysis.
- ▶ **Data Storage & Dashboard**
A robust database stores imagery, metadata, and analytical results, which are visualized through an interactive dashboard for expert review.
- ▶ **Expert Remote Monitoring**
Real-time alerts and diagnostic tools allow experts to assess tower conditions and guide remediation efforts remotely.

Conclusion

This prototype demonstrates a transformative approach to infrastructure monitoring, combining drones, 5G, and AI to deliver rapid, accurate, and scalable damage assessment. It addresses critical gaps in current inspection methods and sets a strong foundation for future research, commercialization, and deployment in disaster-prone regions. The system exemplifies how technology can enhance resilience, reduce costs, and protect vital communication infrastructure. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Enhancing Public Transportation for the Visually Impaired Integrated with 5G



Team Members

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Institute

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Bengaluru

Problem Statement

This project from BMS College of Engineering addresses the challenges faced by visually impaired individuals in navigating public transportation. The team has developed a low-cost, intelligent IoT system using ESP32 microcontrollers and GPS modules to provide real-time audio prompts for bus identification. Communication between sender (on the bus) and receiver (at the bus stop) modules is achieved via ESP-NOW protocol. To overcome range limitations and improve scalability, the system is being enhanced with Over-the-Air (OTA) firmware updates and 5G connectivity using the SIM8200 module—enabling real-time GPS data transmission and centralized management across urban and rural deployments.

Solution/Architecture

- **Sender Module:** ESP8266 + NEO6M GPS transmits bus location.
- **Receiver Module:** ESP8266 + VS1053 MP3 shield on Arduino UNO plays audio alerts.
- **Protocol:** ESP-NOW enables low-latency communication within 15–20 meters.
- **Challenges:** Limited range, battery dependency, and lack of remote monitoring.

Societal & Industrial Impact

Societal Benefits

- Reliable transit access for visually impaired individuals
- Real-time GPS tracking in rural and disaster-prone areas
- Sustainable, low-power architecture reduces e-waste
- Promotes inclusive smart infrastructure

Industrial Applications

- Logistics and fleet tracking
- Smart agriculture and remote monitoring
- Manufacturing and oil & gas automation
- Unmanned systems in hazardous environments.

Conclusion

This project delivers a resilient, scalable, and inclusive IoT solution for public transportation accessibility. By integrating OTA updates, 5G connectivity, and power-aware logic, it creates a dynamic network of ESP32 nodes coordinated by a central gateway. The system is ready for real-world deployment and aligns with national goals for smart, inclusive infrastructure. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Copercept – AMR Next-Generation Localization Framework for Autonomous Mobile Robots in 5G-Enabled Smart Environments

Team Members

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Institute

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Problem Statement

AMRs operating in dynamic environments like factories, warehouses, and smart cities face significant challenges in localization due to GPS unavailability, sensor occlusions, and scalability issues in multi-agent settings. Traditional methods often fail to deliver consistent performance under these conditions. CoPercept-AMR proposes a solution by leveraging cooperative perception—sharing sensor data among robots and infrastructure—to create a redundant and resilient localization system. This requires ultra-reliable low-latency communication (URLLC), high bandwidth, and distributed fusion techniques, all enabled by 5G.

Solution/ Architecture

The CoPercept-AMR architecture is modular and layered, comprising

- ▶ **Perception & Sensing Layer** : AMRs and infrastructure units (e.g., RSUs, drones) are equipped with sensors like LiDAR, cameras, IMUs, and GPS. These capture spatial features and motion vectors, forming the raw input for localization.
- ▶ **Communication Layer (5G V2X)** : Real-time data exchange occurs via V2V (robot-to-robot), V2I (robot-to-infrastructure), and V2N (robot-to-network) links. 5G NR sidelink and gNB-assisted interfaces ensure deterministic, low-latency communication.
- ▶ **Cooperative Perception & Fusion Layer** : Shared data is fused using Bayesian filters, Graph SLAM, and deep learning models. Temporal and spatial alignment techniques resolve occlusions, allowing AMRs to perceive beyond their line of sight.
- ▶ **Localization & Mapping Layer** : The system estimates robot positions, corrects GPS drift, and maintains global map consistency through cooperative SLAM.
- ▶ **Edge Intelligence Layer** : Lightweight AI models run on edge nodes to perform sensor fusion, anomaly detection, and task prioritization. Federated learning enhances privacy by avoiding raw data transmission.
- ▶ **Visualization & Monitoring Layer** : A central dashboard provides live tracking, signal overlays, and alerts. AR/XR tools and drones support visualization for testing and demonstrations.

Conclusion

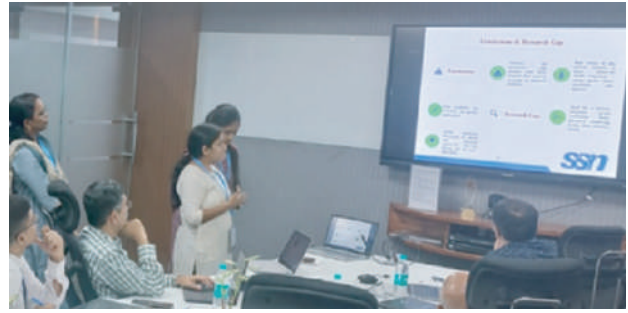
CoPercept-AMR represents a leap forward in autonomous robot localization, combining cutting-edge technologies to overcome longstanding challenges. Its fusion of cooperative perception, 5G connectivity, and edge intelligence sets the stage for safer, smarter, and more scalable robotic systems in the era of Industry 4.0 and smart cities. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-1648

5G-Enabled River Water Level Forecasting for Bridge Safety and Flood Mitigation

Team Members

P Sangeetha, Kaythry P, Pranitha V S, Srinivasan V,
Ninu Praseetha N.S, Negha R, Vishaal S



Institute

Sri Sivasubramaniya Nadar College
of Engineering

Problem Statement

This project from Sri Sivasubramaniya Nadar College of Engineering proposes a 5G-enabled real-time river monitoring system to enhance bridge safety and flood preparedness. By integrating smart sensors, edge AI, and cloud analytics, the system delivers predictive water level insights and early alerts to authorities. It addresses infrastructure vulnerability, climate-induced flood risks, and delayed emergency response—offering a scalable solution for disaster mitigation.

Solution/ Architecture

Sensor Layer

- Ultrasonic/radar sensors monitor water levels.
- Rainfall and atmospheric sensors capture environmental data.
- Metadata (GPS, timestamp) enriches each reading.

Communication Layer

- 5G routers transmit data instantly.
- Dual-path routing: edge for immediate analysis, cloud for long-term storage.
- Network slicing ensures priority for emergency data.

Edge Computing Layer

- AI/ML models detect anomalies and predict flood onset.
- Alerts triggered locally for rapid response.
- Reduces cloud dependency during severe weather.

Cloud Platform

- Stores historical data and supports regional flood modeling.
- Correlates sensor data with weather forecasts and dam releases.
- Provides dashboards for planners and emergency teams.

Alert System

- Sends notifications via SMS, mobile apps, and public sirens.
- Enables proactive bridge closures and evacuations.

Conclusion

This 5G-enabled river monitoring system offers a transformative approach to flood mitigation and bridge safety. By combining smart sensing, edge AI, and cloud analytics, it delivers timely, predictive insights that empower authorities to act before disaster strikes. Scalable, resilient, and SDG-aligned, it's a future-ready solution for climate-resilient infrastructure. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-1671

Kashyap AI-Driven 5G-Enabled Autonomous Seed Sowing Machine for Smart Farming

Team Members

Akshat Agarwal and members

Institute

Maulana Azad National Institute of Technology,
Bhopal



Problem Statement

KASHYAP is an autonomous seed sowing robot designed to modernize Indian agriculture through precision farming and real-time connectivity. Developed by students at Maulana Azad National Institute of Technology, Bhopal, the rover integrates AI-based decision-making, environmental sensing, and 5G communication to automate seed placement, monitor field conditions, and transmit live data to farmers. It reduces labor dependency, improves sowing accuracy, and enables remote farm management—especially in rural areas with limited infrastructure.

Solution/ Architecture

Component	Functionality
Raspberry Pi 4	Central controller for sensors, motors, and AI logic
Sensors	Soil moisture (FC-28), temperature/humidity (DHT22), IMU (MPU6050), GPS (NEO-6M), ultrasonic for seed count and obstacle detection
Seed Mechanism	Triple-layer shutter system for singulation, blade for trenching, soil cover plate
Mobility	Conveyor belt-based tracked system for all-terrain navigation
5G Module	Quectel RM500Q for real-time data transfer and remote control
Farmer App	Live video feed, remote commands, field monitoring dashboard

Conclusion

- System initialization calibrates sensors and sets sowing parameters
- 5G enables bi-directional communication and scalability across multiple rovers
- Sensor data guides AI model to calculate sowing depth and spacing
- Triple-shutter system dispenses one seed per cycle, verified by ultrasonic sensor
- Soil covering plate ensures optimal germination conditions
- GPS-based field mapping and grid generation automate sowing routes

The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-1695

5G – Enabled Mobile GAIT Analysis Advancing Real-Time Biomechanical Monitoring

Team Leader

Mohd Irfan (Research Scholar)



Institute

School of Computer and Information Sciences,
University of Hyderabad, Telangana

Problem Statement

Gait analysis is a vital tool in healthcare and sports science for assessing human locomotion and detecting mobility disorders. Traditional systems rely on expensive, marker-based setups in controlled environments, limiting accessibility and scalability. This proposal introduces a mobile application that leverages 5G infrastructure and edge computing to deliver real-time, clinical-grade gait analysis using only a smartphone camera—eliminating the need for specialized hardware and democratizing access to biomechanical monitoring.

Solution/Architecture

Hardware & Network

- ▶ Smartphone camera captures video frames.
- ▶ 5G-enabled transmission to Multi-access Edge Computing (MEC) servers.
- ▶ Real-time feedback via dashboards over ultra-low latency 5G links.

Software Pipeline

- ▶ MediaPipe BlazePose for 2D joint keypoint detection.
- ▶ Edge-based anonymization (face removal) and pose data generation.
- ▶ AI models for gait parameter estimation and anomaly detection.
- ▶ Local storage of results for post-analysis.

Conclusion

- ▶ **Healthcare** : Remote monitoring for 1,000+ patients annually.
- ▶ **Sports** : Injury risk reduction through real-time feedback.
- ▶ **Commercialization** : Freemium app for consumers; subscription model for clinics and teams.

The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-1881

Log Insight AI-Powered Real-Time Log Search Analytics and Backhaul Monitoring System for Telecom Infrastructure

Team Members

Narendra Kumar Tripathi
Vaibhav Sikka and teamSekhar



Institute

MBM University, Jodhpur

Problem Statement

Log Insight is a centralized, scalable log analytics platform designed to deliver real-time visibility, anomaly detection, and predictive diagnostics across telecom infrastructure. Built on the Elastic Stack (ELK), ScyllaDB, and integrated machine learning, the system ingests high-volume logs from routers, firewalls, switches, and cloud-native workloads. It enables full-text search, intelligent correlation, and live dashboards for operational monitoring. By automating root cause analysis and backhaul latency tracking, Log Insight enhances network resilience, security, and compliance—supporting both 5G and legacy systems.

System Architecture

Component	Functionality
Data Sources	Routers, switches, firewalls, 5G core, OSS, VPNs, Kubernetes clusters
Ingestion Layer	Rsyslog, Filebeat, Metricbeat in HA mode
Processing Layer	Logstash with Grok parsers for normalization
Storage Layer	Elasticsearch (text search), ScyllaDB (structured event data)
Analytics Engine	ML models for anomaly scoring and pattern detection
UI Layer	Kibana dashboards with filters and visualizations
Alerting Engine	Rule-based and AI-based triggers for real-time alerts

Conclusion

Log Insight delivers a robust, AI-powered log analytics platform tailored for telecom infrastructure. By combining centralized ingestion, real-time search, and intelligent anomaly detection, it empowers operators to maintain resilient, secure, and compliant networks. With scalable architecture and 5G integration, the system is ready for deployment across government, enterprise, and telecom environments—setting a new standard for operational intelligence in the digital era. . The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Experience Sharing Sessions

DoT has initiated experience sharing sessions where the excellent labs share their engagement with stakeholders, other institutions, project development, paper publication, and IPR creation in the field of 5G use cases.

The experience sharing sessions will be a regular activity and will be a platform for capacity development, knowledge sharing, and collaboration between researchers and institutions to develop solutions for real world problems and take them for commercialisation.

The sessions also help DoT to understand challenges faced by institutions, support required to take the lab engagement at deeper level, and create schemes/projects to fill the gaps on people, processes, and resources.

S. No.	State/ UTs	No. of labs	Name of 5G Use Case labs
1	Andaman & Nicobar	0	0
2	Andhra Pradesh	5	1.IIIT- Design and Manufacturing Kurnool 2. Koneru Lakshmaiah Education Foundation 3. Vignans Foundation for Science Technology and Research 4. GITAM Institute of Technology and Management, Deemed to be University 5. IIT- Tirupati
3	Arunachal Pradesh	1	1.NIT Arunachal Pradesh
4	Assam	2	1.IIT- Guwahati 2.NIT- Silchar
5	Bihar	3	1.NIT- Patna 2. IIT- Patna 3. Dr Rajendra Prasad Central Agricultural University
6	Chandigarh	2	1.Punjab Engineering College Deemed to be University 2. University Institute of Engineering and Technology Punjab
7	Chhattisgarh	2	1. IIT Bhilai 2. NIT- Raipur
8	Delhi	4	1. Jamia Hamdard 2. Indraprastha Institute of Information Technology Delhi 3. Delhi Technological University 4. Indian Agricultural Research Institute
9	Goa	2	1. Birla Institute of Tech and Science, K. K. Birla Goa Campus 2. NIT- Goa
10	Gujarat	3	1. Sardar Vallabhbhai NIT- Surat 2. School of Cyber Security and Digital Forensics National Forensic Sciences University - Gandhinagar 3. IIT- Gandhinagar

11	Haryana	2	1. Central University of Haryana 2. National Power Training Institute
12	Himachal Pradesh	2	1. NIT- Hamirpur 2. IIT- Mandi
13	Jammu & Kashmir	2	1. Institute of Tech, Univ of Kashmir 2. IIT- Jammu
14	Jharkhand	3	1. Birla Institute of Tech, Mesra 2. IIT- Dhanbad 3. NIT- Jamshedpur
15	Karnataka	8	1. Siddaganga Institute of Tech 2. BMS College of Engineering 3. Indian Institute of Science 4. M. S Ramaiah Institute of Tech 5. NIT- Karnataka, Surathkal 6. IIIT- Dharwad 7. VTUS Centre for Post Graduate Studies ,Kalaburgi 8. Manipal Institute of Technology
16	Kerala	4	1. Department of Electronics, Cochin University of Science and Tech 2. NIT- Calicut 3. Indian Institute of Space science and Technology 4. IIT- Palakkad
17	Ladakh	0	0
18	Lakshadweep	0	0
19	Madhya Pradesh	4	1. PDPM IIIT-, Design and Manufacturing Jabalpur 2. IIT- Indore 3. Atal Bihari Vajpayee IIIT- and Management, Gwalior, Madhya Pradesh 4. Maulana Azad NIT-Bhopal

20	Maharashtra	7	1. Dr D Y Patil School of Science and Technology 2. Symbiosis Institute of Technology, Pune 3. VNIT Nagpur 4. Dr. Babasaheb Ambedkar Technological University, Lonere 5. COEP Technological University 6. Government College of Pharmacy Amravati 7. DKTEs Textile and Engineering Institute, Ichalkaranji
21	Manipur	2	1. NIT- Manipur 2. IIIT- Senapati, Manipur
22	Meghalaya	1	1.NIT- Meghalaya
23	Mizoram	1	1.NIT- Mizoram
24	Nagaland	2	1. NIT- Nagaland 2. Christian Institute of Health Sciences and Research
25	Odisha	4	1. IIT- Bhubaneswar 2. Kalinga Institute of Industrial Tech Deemed to be University 3. NIT- Rourkela 4. Siksha O Anusandhan Deemed to be University
26	Puducherry	2	1.NIT- Puducherry 2. Pondicherry University
27	Punjab	4	1. Dr B R Ambedkar NIT Jalandhar 2. Thapar Institute of Engineering and Technology 3. Guru Nanak Dev University, Amritsar 4. IIT- Ropar
28	Rajasthan	5	1.Banasthali Vidyapith 2.Birla Institute of Technology and Science Pilani 3. Malaviya NIT- Jaipur 4. IIT- Jodhpur 5. MBM University, Jodhpur

29	Sikkim	1	1. Sikkim Manipal Institute of Technology
30	Tamil Nadu	7	1. NIT- Tiruchirappalli 2. Vellore Institute of Technology 3. College of Engineering Guindy 4. SASTRA Deemed University 5. Sri Sivasubramaniya Nadar College of Engineering 6. Saveetha Institute of Medical and Technical Sciences 7. SRM Institute of Science and Technology
31	Telangana	3	1. IIIT Hyderabad 2. NIT- Warangal 3. University of Hyderabad
32	Tripura	1	1. Tripura Institute of Technology
33	Dadra and Nagar Haveli and Daman and Diu	0	0
34	Uttar Pradesh	6	1. Jaypee Institute of Information Technology, Noida 2. Motilal Nehru NIT- Allahabad 3. IIIT- Allahabad 4. Aligarh Muslim University 5. IIT- Kanpur 6. IIT- BHU
35	Uttarakhand	3	1. College of Technology, Govind Ballabh Pant University of Agriculture and Technology 2. THDC Institute of Hydropower Engineering and Technology 3. IIT- Roorkee
36	West Bengal	2	1. NIT- Durgapur 2. IIIT- Kalyani

Annexure-II

SN	Parameter	Target
1	No. of students utilised Lab for product testing/ applications	50 unique students / year
2	No. of faculty utilised the lab for mentoring/ development/ testing	10 unique faculty / year
3	No. of projects utilizing the Lab	10 projects / year
4	No. of start-up/ MSMEs engaged in the lab for testing/ product / use case development	5 Start up/ MSME / year
5	Engagement with Atal Tinkering Labs/ Schools/ colleges/ academic institutes (Workshops/ mentorship etc.)	5 institutes / year
6	No. of companies other than start-up/MSME/ Academic institutes engaged in the lab for testing/ product / use case development	5 companies or organisations / year
7	Inclusion of 5G related academic course utilizing the Lab in the curriculum	Completion of the course for 50 students
8	Contributions related to 5G and beyond in international journals or Standardization organizations such as ITU/3GPP/ISO/IEEE/ ORAN alliance etc	2 Contributions/ year
9	No. of product/ solutions/ use cases developed	2 products/ solutions/ use cases developed
10	No. of IP generated	2 IPs in a year
11	No. of developed products/use cases in the Lab commercialized / piloted/ deployed	1 Product per year

List of Institutions mentored by Qualcomm

1. National Institute of Technology Arunachal Pradesh
2. National Institute of Technology Silchar
3. Delhi Technological University
4. Indian Institute of Technology Mandi
5. M.S. Ramaiah Institute of Technology
6. Department of Electronics, Cochin University of Science and Technology
7. National Institute of Technology Calicut
8. PDPM Indian Institute of Information Technology, Design and Manufacturing Jabalpur
9. DPU, Dr. D. Y. Patil School of Science and Technology
10. COEP Technological University
11. Indian Institute of Information Technology, Senapati
12. National Institute of Technology Meghalaya
13. National Institute of Technology Mizoram
14. National Institute of Technology Nagaland
15. National Institute of Technology Rourkela
16. Thapar Institute of Engineering and Technology
17. Malaviya National Institute of Technology Jaipur
18. Vellore Institute of Technology
19. Jaypee Institute of Information Technology, Noida
20. THDC Institute of Hydropower Engineering and Technology