TIH Foundation for IoT and IoE (TIH-IoT), IIT Bombay is set up in the technology vertical-Internet of Things (IoT) & Internet of Everything (IoE).

**About TIH-IoT**

**VISION**

To become world’s premier IoT hub where ideas for system-level implementation are conceived, prototyped, tested and handed over to capable partners for commercialization and deployment in various industries.
Objectives

- Knowledge Development in the IoT and IoE areas
- Technology/product development
- Develop ecosystem to support commercialization of innovative solutions in collaboration with Government-Industry-Academia
- Human resource and skill development
- To develop collaboration models
- To contribute to industry standards for IoT
Grand Challenge

Grand problem:
**Interconnecting** land, air, water and biological systems for automating operation, monitoring and predictions.

Grand challenge

Self-healing, Recyclable or Re-usable IoT Devices => Accountability for health of devices and interconnections

Roadmap

**System of Interconnected Systems (SIS)**

- Modification of existing systems for interconnection or novel devices for interconnection
- **Interconnected** systems; Safety critical analysis; Testing and Validation Methods
- Interconnected heterogenous systems (land, ground, underwater, biological, manned/unmanned)

**Industry 5.0 & Society 5.0**

Human-in-loop interconnected system
Application Areas

Strategic investment in use-cases

- **Agriculture**
  - End-to-End solution
  - Irrigation
  - Disease monitoring

- **Smart Education**
  - Quality course delivery
  - Scalable and sustainable model

- **Healthcare**
  - Converting medical devices to IoT for telemedicine

- **Industrial IoT**
  - Industry driven problems
  - Manufacturing
  - Structural inspection

- **Security**
  - Challenging and innovative problems
  - Inter-connecting land-water-air

Current - Future
Collaboration Framework

- Academic Institutions & Other TIHs
- Satellite Centers, Spokes
- Faculty, Experts, Students

- Government, PSUs, R&D Organizations
- Issues of National Importance
- Inter Ministerial Problems

- Industries Using IoT/IoE Technologies
  - Security, Healthcare, Education
  - Industrial IoT, Agriculture

- Industries Developing IoT/IoE Technologies
  - Devices, Sensors, Actuator, Energy and Network
  - Control and Optimization AI & ML

- Industry Organizations & Groups
  - CII, FICCI, NASSCOM etc.
  - Focused Groups, CoEs
Academic & Industry Experts

Honeywell
THE POWER OF CONNECTE

NVIDIA

radix®

ModeliCon
INFOTECH

LARSEN & TOUBRO

Academia

Industry
Faculty affiliated with TIH-IoT

Prof. Anirban Guha
Design optimization
Robotics Ground robots

Prof. Arnab Maity
State estimation, navigation, control and guidance of drones, UTM

Prof. Arpita Sinha
Agro-robotics, Motion planning, Multi-agent Systems

Prof. Dipti Gupta
Sensors and Data Analysis, Nanomaterials based Sensors' fabrication

Prof. Gaurav Kasbekar
IoT Networking
Wireless networks
Network security

Prof. Hemendra Arya
Systems Engineering, Hardware-in-Loop Simulation, Aerial Vehicles, Agriculture

Prof. Leena Vachhani
(PIC, TIH-IoT) Embedded Control System

Prof. Maryam Shojaei
IoT Device Energy Management and Harvesting, Intelligent Electronic Systems Design and Development

Prof. Rajabu V.
Signal processing, Edge ML, Video analytics
Technology Roadmap and Milestones

T1: Grand Challenge Competitions
- Q1: 2023-2024
  - Stationary and Self-Driven IoT Devices
  - Multimodal sensor fusion

T2: Core Technologies
- Q2: 2022-2023
  - Smart Actuator System
  - Secured and trustworthy edge computing

T3: Test Bed Verification and Validation
- Q3: 2024-2025

T4: Application Oriented Technologies
- Q4: 2024-2025

T5: Technologies for New CPS Areas
- Q4: 2025-2026
Priority Area: Core Technologies

- Self-powered IoT devices
- Low cost or energy harvesting wireless communication and system design
- Secure and privacy-preserving IoT communications
- Shared and open software stack for secured communication (heterogeneous communication protocols)
- Mechanisms for physical safety
- Implementation/testbed/deployment of aerial computing
- TinyML systems and application

- Sensors & sensor networks
- Low power & Energy constrained
- Communication Protocols & Security
- Data Analytics & Machine Learning
- Real-time Control, Planning & Estimation

Stationary & self-driven IoT devices
Multimodal sensor fusion
Secured and trustworthy edge computing
Smart Actuator interface

Edge computing (challenging data integrity problems)
Priority Area: Agriculture

Integrated and Multi-Disciplinary Approach using IoT technology

Soil Conditioning
- When?
- Where?
- How much?

Auto Spreading
- Disease identification

Pre-harvest Monitoring
- Time to harvest
- Yield Prediction

Data Analytics
- Smart storage for Agri Products

Water Management
- Information Dissemination

Plant Nutrition Management
- Data Analytics

Crop Yield Analysis
- Smart Storage

Soil preparation and profiling
- When?
- Which?
- How much?

Economical
- Dynamic
- Scalable
- Adaptable
- Replicable
- Crop Independent
# Effective and Efficient Agriculture - Project Map

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### Block Diagram showing the Interfaces of different projects

- **B1. Sensors and systems**
  - Field data
  - Mosaic of field images in form of RGB, multispectral, hyperspectral etc
  - Location for pesticide/fertilizer application, spray irrigation etc

- **B2. Networking and Communication**
  - Field data
  - (for P1, P2, P3)

- **B3a. Imaging Drones**
  - (for P2, P3, P4)
  - (for P1, P2, P3)

- **B4. System Modeling and Data Analytics**
  - Field data
  - (for P1, P2, P3, P4)

- **B6. Mechanization and Automation**
  - (for P5)

- **B7. Smart Systems**
  - (for P6)

### Additional Notes

- The table and diagram illustrate the integration of various technologies and their applications in effective and efficient agriculture.
- The project map indicates the flow of data and technology interfaces among different projects.
- B1, B2, and B3a are core technologies that interact with various aspects of agriculture.
- B4 and B6 focus on data analytics and mechanization, respectively.
- B5 and B7 provide additional functionalities for data visualization and smart systems.
Priority Area: Smart Education

Technologies

- Low cost device for installing learning material
- AI based Assessment, Query Solving and Feedback
- Light weight course delivery modules
- Video bots for Educational Course Content Delivery
- Education in Vernacular Languages
- Learning modules using games

Multimedia repository

Learning material
Research material
Priority Area: Other Projects

Agriculture
- IoT Enabled, Self-Calibrating and Self-Healing Sensor System for In-situ Agriculture Applications

Healthcare
- 2D TMD Based Biomedical Sensor for Smart Health Monitoring via IoT
- HEMT-based Sensors for IoT-enabled Water Quality Analysis
- Automation of Wheelchair
- EMG Signal Controlled Wheelchair
- Enabling Geriatric Exercising for Senior Population in Remote Areas

SMART education
- Indian Sign Language Recognition – Empowering Hearing & Speech Specially Abled Community

Industrial IoT
- Design and Analysis of Non-Orthogonal Multiple Access Technique for IoT Devices
- Structural Health Monitoring of Bridges using Mobile IoT Robot
Keywords:

Current Research Areas
- Agriculture
- Health
- Autonomous Vehicles / UAVs
- Smart Education

Current Applications/Platforms
- AI / ML
- Edge Computing
- Next-G Communication
- Controls
- Sensors / Actuators / IoT
- Embedded Systems
“...to make lives simpler”

Thanks!

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