ACTION TAKEN REPORTS

Name of the Host Institute: Indian Institute of Technology, Bombay

Name of the TIH: Technology Innovation Hub for IoT & IoE

Technology Vertical: Technologies for IoT & IoE

Recommendation of TIPS Workshop	**Action Taken**
Whether the representative of AS & FA, DST (not below the rank of Deputy Secretary) has been included as special invitee to HGB	Email has been sent to AS & FA, DST for the representation in HGB. Mr Manoj Kumar, Director, Integrated Finance Division joined the 4th HGB meeting on 19th Dec 2022.

Update on problems taken-up by line ministries

	Problem Area/details	**Name of line ministries /States Govt /PSUs/ industries**	**Collaborating TIH**	**Collaborating Partner other than TIH**	**Projects undertaken**	**Technology/product developed (Current status)**	**Any other update**
Other direct Initiatives	IoT solution for underwater pipeline inspection	HPCL and Indian Oil		Centre of Excellence Oil, Gas and Energy	Design and development of IoT solution for underwater pipeline inspection	The project is sanctioned, and the project work started. Field testing plan for underwater IoT platform jointly developed with IOCL and HPCL on March 23	
Other direct Initiatives	Design Studies for Control Systems	Directorate of Naval Design (DND), Indian Navy		IIT Bombay	Design input studies for autonomy & control systems of XLUUV	The proposal has been submitted. Commercial negotiation completed, waiting for project award.	
Other direct Initiatives	IoT application in Agriculture project	Indian Council of Agricultural Research (ICAR) – Directorate of Onion & Garlic Research (DOGR)		General Aeronautics, Proximal Soilsens Technologies Pvt. Ltd.,	Effective and Efficient Agriculture Project	MOU is signed. Controlled experiments testing and dataset creation at ICAR Pune in progress.	

Other direct Initiatives	Agriculture Project	National Bank for Agriculture and Rural Development (NABARD)		Centre for Climate Studies	Climate Smart Agricultural Water Management	The project proposal submitted as a consortium from IIT Bombay for the feedback from NABARD.	
Other direct Initiatives	IoT solution for Steel Melting Plant	SAIL (Steel Authority India Ltd)			Steel ladle tracking and management system in Steel Melting Shops (SMSs). of Steel Plants	Project is sanctioned under Industrial problems for CHANAKYA Fellowship and work in progress	
Other direct Initiatives	Govt. of India, Ministry of Communications	Department of Telecom		National Telecommunication Institute (NTIPRIT)	Expert Committee for Skill Development and Education & Awareness in IoT/M2M domain	The Committee is formed for developing courses in the area of IoT and M2M for skill development, re skilling, upskilling	
Other direct Initiatives	IoT Repository	National Security Council Secretariat			IoT Repository Project	Project formulation completed. Proposals received via Call for Proposal and projects will be jointly reviewed and monitored.	
W.r.t. problem statement shared by MO on 20.07.2021	Jal Jeevan Mission	Ministry of Jal Shakti, Department of Drinking Water and Sanitation			Smart regulation of 24 × 7 gravity water supply systems in hilly state	No inputs received from the ministry even after several follow ups	

Inter Hub Collaboration and Spokes-Spike details							
S.No.	**Name of the Hub/Spoke/Spike**	**Inter Hub /Spoke/Spike**	**Place**	**List of Projects undertaken (if any)**	**Research Area (if any)**	**Progress / Outcome**	**Remarks (If Any)**
1	IIT Ropar TIH Awadh	Inter Hub	Ropar/Mumbai		Agro IoT	Participated In the roundtable on Technologies for IoT and IoE in Agriculture with various stakeholders to discuss future prospects in the Agriculture Sector and identify the areas where IoT-based solutions can be deployed to solve the problems of the end-user.	Area of collaboration identified
2	TIH, IIT Indore	Inter Hub	Indore/Mumbai		Agro IoT	Participated In the roundtable on Technologies for IoT and IoE in Agriculture with various stakeholders to discuss future prospects in the Agriculture Sector and identify the areas where IoT-based solutions can be deployed to solve the problems of the end-user.	Area of collaboration under discussion
3	COE-OGE, HPCL and Indian Oil	Spoke	Mumbai	IoT solution for underwater pipeline inspection	Industrial IoT	Field testing plan for underwater IoT platform jointly developed with IOCL and HPCL on March 23	
4	ICAR DOGR	Spoke	Pune	Effective and Efficient Agriculture	Agro IoT	Controlled experiments testing at ICAR Pune in progress.	
5	Centre for Climate Studies (IIT Bombay) & NABARD	Spoke	Satara	Climate Smart Agricultural Water Management	Agro IoT	Field-testing plans at two villages in Satara district	
6	National Science Foundation, USA	Spoke	University of Pittsburgh	Machine Learning-based Crop Disease Detection on the Edge	Agro IoT	• 6 -40 pots of healthy & infected eggplant and tomato in ICAR Goa • Measurement devices are set up. • RGB and IR images, soil temperature and moisture, Ambient temperature and humidity, soil EC, Leaf temperature	
7	National Science Foundation, USA	Spoke	The Ohio State University	Computational Learning through Context Adaptation for Effective & Efficient Agriculture	Agro IoT	Pest classification using ML models with existing (plant village) dataset demonstrated (Indian team)	

						Model/dataset proposed for defoliation in soybeans (US team) has been shared, to consider learning for use with Onions Plan to use UAV system developed by US team in Indian Onion fields by Jan 2023	
8	National Science Foundation, USA	Spoke	Pennsylvania State University	Enabling Energy and Safety-Awareness in Autonomous Robotics for Smart Agriculture	Agro IoT	Design of robotic device completed, Fabrication in progress Mech state estimation eqns developed; validation in progress Battery state estimation; Localization and path planning algorithms in Progress	
9	National Science Foundation, USA	Spoke	University of Texas	Coordinated UAVs for Efficient Agricultural Spraying Operations	Agro IoT	• Obtaining the spray requirement function $\phi(x, y)$ using field data • Modeling the spray distribution $\psi(r, h)$ at different altitudes • Algorithm development for the generation of coordinated trajectories	
10	National Science Foundation, USA	Spoke	Georgia Institute of Technology	Rapid Node Cardinality Estimation in IoT using Reinforcement Learning	Agro IoT	Extensive survey of the research literature Propose to use of knowledge distillation techniques	
11	National Science Foundation, USA	Spoke	Stanford University	Modelling Energy Behaviour In Education Buildings Using IoT And Sensing Technology	Sensors/ Actuators / IoT	Final stages of sensor procurement. Paper titled 'Investigating interactions between Indoor Environmental Quality (IEQ) and energy consumption in Tropical buildings' is ready for submission.	
12	National Science Foundation, USA	Spoke	University of Colorado, Boulder	Design & Development of Microservice-based Fog-Enabled Infra for Smart Agriculture	Agro IoT	• Demonstrated how a fog node can connect and/or communicate with multiple end nodes. • 13Used single channel (it can communicate with one end node at a time) LoRa antenna at fog node.	
13	National Science Foundation, USA	Spoke	University of California, Berkeley	Explaining Decision-Making in (Semi-) Autonomous Vehicles	Autonomous Vehicles / UAVs	Extending Synplicate algorithm (SYNPLICATE+): • Identified strategy for a practically useful infinite class of interpretations with finite VC dimension	

						• Investigating aggregation techniques for sets of Pareto-optimal interpretations • Investigating techniques for ranking features from small-sized Pareto-optimal interpretations	
14	ICAR – NRCG (National Research Centre for Grapes)	Spoke	Pune	Automated monitoring and advisory system for intelligent viticulture	Agro IoT	A prototype of a vineyard-suitable autonomous vehicle mounted grape and plant image capturing system which will allow biotic and abiotic stress indicators to be manually identified.	Collaborative project proposal between TIH IoT and NRCG under review.
15	Society for Innovation and Entrepreneurship (SINE), IIT Bombay	Spoke	Mumbai	Collaborate for executing entrepreneurship development programs.	IoT & IoE	Launched 2 programs in support with SINE: Start-ups and Spin-off program and Seed Support program.	
16	Deshpande Start-ups, Hubli	Spoke	Hubli	Using each other's expertise, interest, infrastructure availability, and mandate to collaborate with an aim towards promoting the entrepreneurial ecosystem.	IoT & IoE	Conducted a Roundtable Discussion on "Technologies for IoT and IoE in Agriculture" with the support of Deshpande Start-ups.	
17	IIT Dharwad and Aveti Learning, Bhubaneswar, Odisha (Educational Content Translation to Tribal Language)	Spike	Dharwad and Odisha	Educational Content Translation to Tribal Language	Smart Education	• Understanding the existing framework of educational content creation in ODIA • Mapping the same to KUI language educational content creation by identifying different modules to be implemented for semi-automatic process of translation from ODIA to KUI language • Text data creation in ODIA and KUI language has been started ● Speech data collection in KUI language has been started	

						• Proposed framework for ODIA to KUI translation is finalized	
18	IIITDM Kancheepuram, Chennai and IITRAM, Ahmedabad	Spike	Chennai and Ahmedabad	Development of Energy Efficient Wireless Sensor Network and Communication Platform for Precision Agriculture	Agro IoT	Literature Survey of existing communication Platforms Development of data aggregation algorithm at fog computing layer Paper Submitted – LoRa-based Fog Computing Enabled Data Compression for Smart Agriculture System	
19	Wisemindz Ventures Private Ltd.	Spike	Nagpur	Technology modules using games	Smart Education	• Games developed for Maths, Science and English targeting tier 2 & 3 Indian cities. • 2. Games developed for Level 1 (Class 1 & 2) Level 2 (Class 3 to 5) and Level 3(Class 6 to 8).	
20	Birla Institute of Technology and Science, Pilani	Spike	Pilani	LoRa-WSN-based IoT Communication Platform for Precision Agriculture	Agro IoT	Detailed project plan with details on identified candidate algorithms for routing, data collection, synchronization Ordering and procuring 5 LoRa WSN nodes and other sensors Ordering and procuring the ambient weather station	
21	Ayur AI	Spike	Chennai	AYUR-CoVCARE - Smartphone-based Comprehensive Digital monitoring of Ayurveda COVID care using Deep Pulse Analytics and AI-based Recommendation Engine for Therapeutics	Healthcare	AYUR-CoVCARE, developed by Ayur-AI, is a first of its kind application that enables smart phone based comprehensive diagnosis and Ayurveda based management of COVID. It is an integrative and data-driven Ayurveda COVID care app for effective COVID and long COVID treatment and monitoring and an AI-based recommendation engine for effective management. The application digitizes the entire Ayurveda care for COVID treatment.	
22	G.H. Raisoni Institute of Engineering and Technology, Wagholi, Pune	Spike	Pune	Smart health monitoring system for detection of covid related symptoms	Healthcare	SHMS (Smart health monitoring system) is IoT based solution that provides an integrated approach towards resolving this problem by automatically monitoring the vitals of an individual daily and recording	

						it for future reference which can be used for large number of peoples. The system has been developed and under the testing and validation phase.	
23	IIT Bombay	Spike	Mumbai	AI Assisted Grading in SAFE (Smart Authenticated Fast Examinations)	Smart Education	Identification of hand-written numbers/text in scanned answer-sheets is done. Part-A: identification of roll num, name from scanned answer sheet, integration ongoing Part-B: identification of question and answer regions Part-C: detection of keywords; initial trials done, core work pending	