National Mission on Interdisciplinary Cyber-Physical Systems (NM-ICPS)
Ministry of Science & Technology, Department of Science & Technology, Government of India

TIH
iHub Drishti

IHUB DRISHTI FOUNDATION

Technology Innovation Hub (TIH), focused on building cyber-physical systems for computer vision, AR and VR, is a Section-8, Not-for-profit Organization promoted by and at the Indian Institute of Technology Jodhpur under an NM-ICPS of the Government of India

https://ihub-drishti.ai/

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VISION

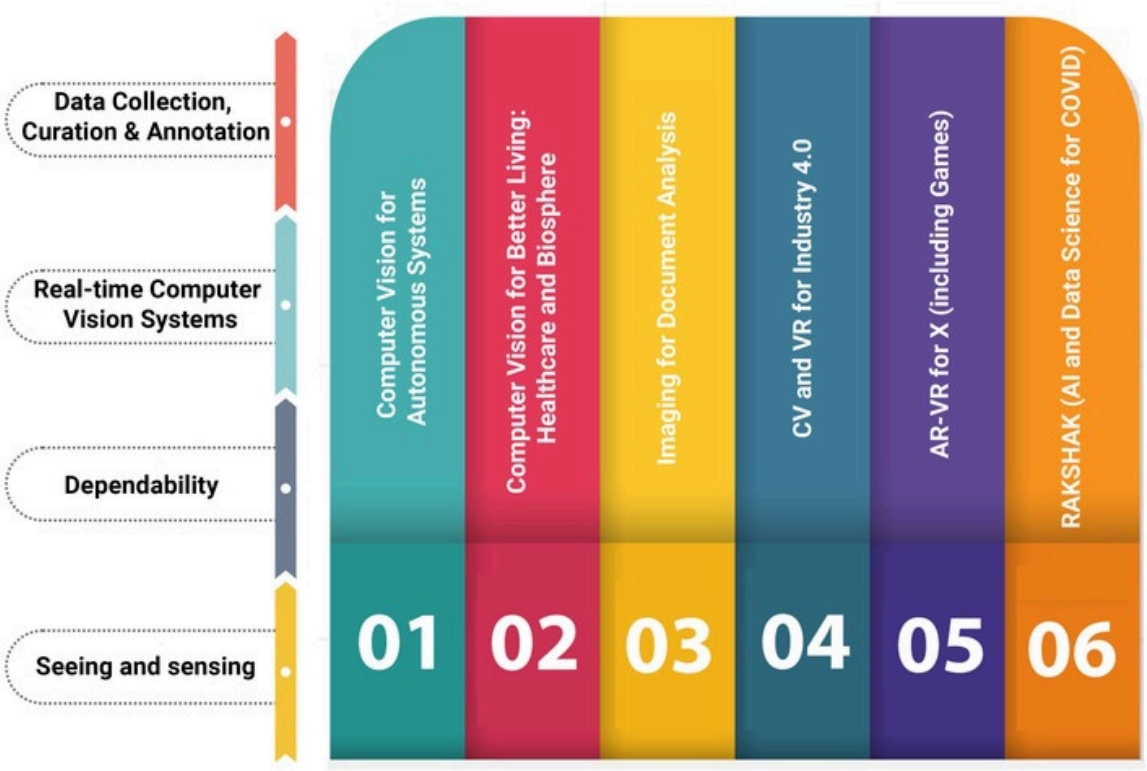
MISSION

The TIH on Computer Vision and Augmented and Virtual Reality (CV and ARVR), named as iHub Drishti, will:
(i) focus on advancing the research outcomes in core problems related to CV and, ARVR,
(ii) augment imaging with additional (multimodal) sources of input such as haptics, language, and IoT to advance state-of-the-art in the domain areas,
(iii) create technology solutions for socially relevant and industry-facing problems,
(iv) support and nurture start-up ecosystems,
(v) stimulate skilling and reskilling educational programs, and
(vi) to advise governments for appropriate policy-related matters in the domain of CV and ARVR.

The proposed TIH will focus on the core research areas of
(i) Seeing and Sensing,
(ii) Dependability,
(iii) Real-time Computer Vision Systems, and
(iv) Data Collection, Curation and Annotation for developing technologies in the following applications areas:

- Computer Vision for Autonomous Systems
- Computer Vision for Better Living: Healthcare and Biosphere
- Imaging for Document Analysis
- CV and VR for Industry 4.0
- Dependable AR-VR for X

SCIENTIFIC HORIZONTALS AND APPLICATION VERTICALS

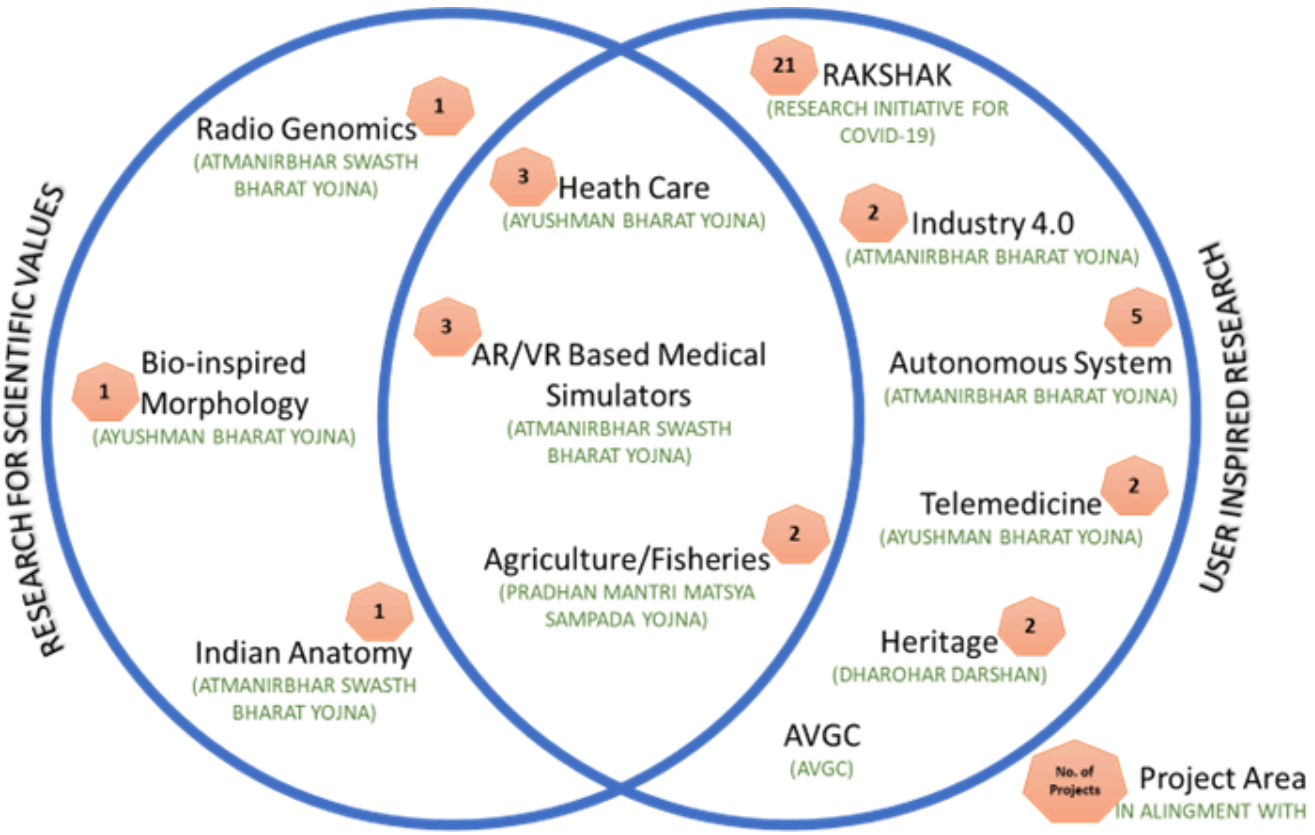


The TIH envisions creating an ecosystem in and around the thematic areas and building collaborations with other TIHs to foster the overall growth and development of CPS technologies. The facility would include a mix of office and laboratory spaces with state-of-the-art infrastructure facilities that will cater to the collaborating institutions. The TIH will also build a network of researchers and developers, both externally hired and from the student body, such that in the next 5 years, iHub Drishti will become the main hub of technologies related to computer vision, virtual and augmented reality in the entire country.

This will pave the way for building durable solutions to national needs in the area of defence and security, healthcare, education, and many other applications such as disaster management, transportation, mining, and handling hazardous environments.

iHub Drishti, a Section 8 company, is hosted on the premises of IIT Jodhpur. The hub, steered by the Hub Governing Board and the Director of the TIH, will host teams of faculty members, research scholars, developers and scientists who will work towards developing the technologies. Further, four different kinds of partners are identified:
(i) research collaborators from national and international institutions,
(ii) domain expert partner institutions,
(iii) hub and spoke model (mentor-mentee) based partner institutions, and
(iv) research labs and industry, including startups.

RESEARCH PORTFOLIO AT A GLANCE



KEY RESEARCH INTIATIVES

COMPUTER VISION BASED SOLUTIONS FOR HEALTHCARE

AI-Based Risk Stratification Referral models using eye images in a public health setting

The aim of the study is to develop an AI-based risk stratification model based on interior and exterior retinal images for early diagnosis, make referral decisions, and develop an eye image repository for further research leading to advancement of precision medicine.

Evaluation and development of Machine Learning (ML) models for the automated detection, localisation and characterisation of traumatic rib fractures on CT scans

The key goals of our project are to generate a high-quality expert reviewed annotated dataset of thoracic CT scans, use it to evaluate existing ML models, develop our novel model to detect, localise & characterise rib fractures, and subsequently generate a structured text report similar to a radiologist's.

COMPUTER VISION BASED SOLUTIONS FOR BIOSPHERE

Video Analytics for Wildlife Monitoring and Conservation

The goal is to create an annotated dataset along with a baseline approach and metrics for event understanding in very long videos in the context of wildlife monitoring and conservation. It will enable the non-invasive monitoring of wildlife, which can give environmental researchers insights into the impact of habitat loss, urban development, and climate change on wildlife and ecology.

COMPUTER VISION BASED SOLUTIONS FOR INDUSTRY 4.0

Vision System for Integrating Mass Manufacturing Line of Bearing Rollers

The vision-based inspection system can accurately measure and sort parts faster to improve productivity. In addition, the vision-based system can facilitate 100% inspection requirements of manufactured components, ensuring conformance to specifications and customer satisfaction. The present research aims to develop a vision-based inspection system for quality control of tapered rollers used in bearings produced by the centerless grinding operation.

COMPUTER VISION BASED SOLUTIONS FOR AUTONOMOUS SYSTEMS

- **TrustMe: Explainable Adversarial Attack Detection and Mitigation for Object Recognition Algorithms**

- **This project addresses the challenge of adversarial attacks for deep learning algorithms for object recognition algorithms. To ensure the dependability of a machine learning algorithm for a given task, it is essential to ensure that the input data is not attacked. This project aims to design and develop attack estimation and mitigation algorithms for object recognition in aerial and satellite data.**

AR-VR APPLICATIONS

Digital Museum

Five Rajasthan Government museums in Alwar, Chittorgarh, Baran, Bundi, and Bharatpur in Rajasthan are digitized and uploaded to the Rajasthan Government server. The key features are-

- **Augmented with 360-degree Interactive**
- **3D models of the museum artefacts**
- **Pre-defined tours take you through a guided experience with enhanced imagery & descriptions, easy-to-navigate controls.**
- **These Digital Museums are a step towards the future of digitizing India's rich heritage.**

Haptics-Based Medical Simulators for Palpation and Tele Diagnosis

The palpation training simulator will have two main components

1. Custom Haptic Device
2. Immersive Environment

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TIH iHub Drishti

WINTER SCHOOL

The Department of Computer Science and Engineering, IIT Jodhpur of Computer Science and Engineering, in association with TIH iHub Drishti at Indian Institute of Technology Jodhpur, organized "Winter School 2022 (in-person)" - a bouquet of two schools:

a) "Algorithms for Graphs and Games": December 05-11, 2022

b) "Responsible AI": December 11-15, 2022, and

c) A joint poster presentation session: December 11, 2022

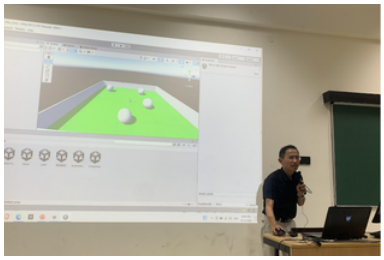
The school is intended for graduate students working or who want to work in Algorithms and related areas and for motivated undergraduate students who are enthusiastic about these areas. People from the industry looking for exposure or those working or planning to work in this area also attended the winter school.

M.TECH AR-VR IMMERSION

Executive M.Tech ARVR (2022) students attended a week-long immersion programme. Since the programme is for working professionals, all interaction was virtual. The immersion week gave students a zest for the classroom.

AR VR WORKSHOP

HOLOWORLD and Unity hosted a two-day workshop. Dr Thotreingam Kasar, Chief Research Officer, led a session where each participant created animation assets. The workshop had M.Tech ARVR students, PhD students from IIT Jodhpur, and working professionals from Cognizant, ADA-DRDO, CloudSpectra, and others.



HUB AND SPOKE

IISER Bhopal, FLAME University Pune, Delhi Technical University, Delhi Technological University and NSUT Delhi have joined iHub Drishti under the Hub and Spoke paradigm. The fundamental objective of the Hub-Spoke model is to codify the intent to collaborate on events and network facilitation to explore the potential for CPS for CV and ARVR, as well as associated innovation and partnerships between the Hub and Spoke. With training in CPS for CV and ARVR and new-age technologies, this model encourages the growth of entrepreneurship and the startup ecosystem. They are additionally evaluating the potential to find high-quality CPS for CV and ARVR-related patents, projects, and articles created by students and professors of Spoke and translating them into actual goods by Hub. Building long-term strategic relationships on activating the overall innovation ecosystem by cultivating HRD and skill development through fellowship-based UG/PG, PhD, Post-Doctoral, and short-term faculty training, as well as establishing and strengthening international collaborative research for cross-fertilization of ideas, can address societal needs.

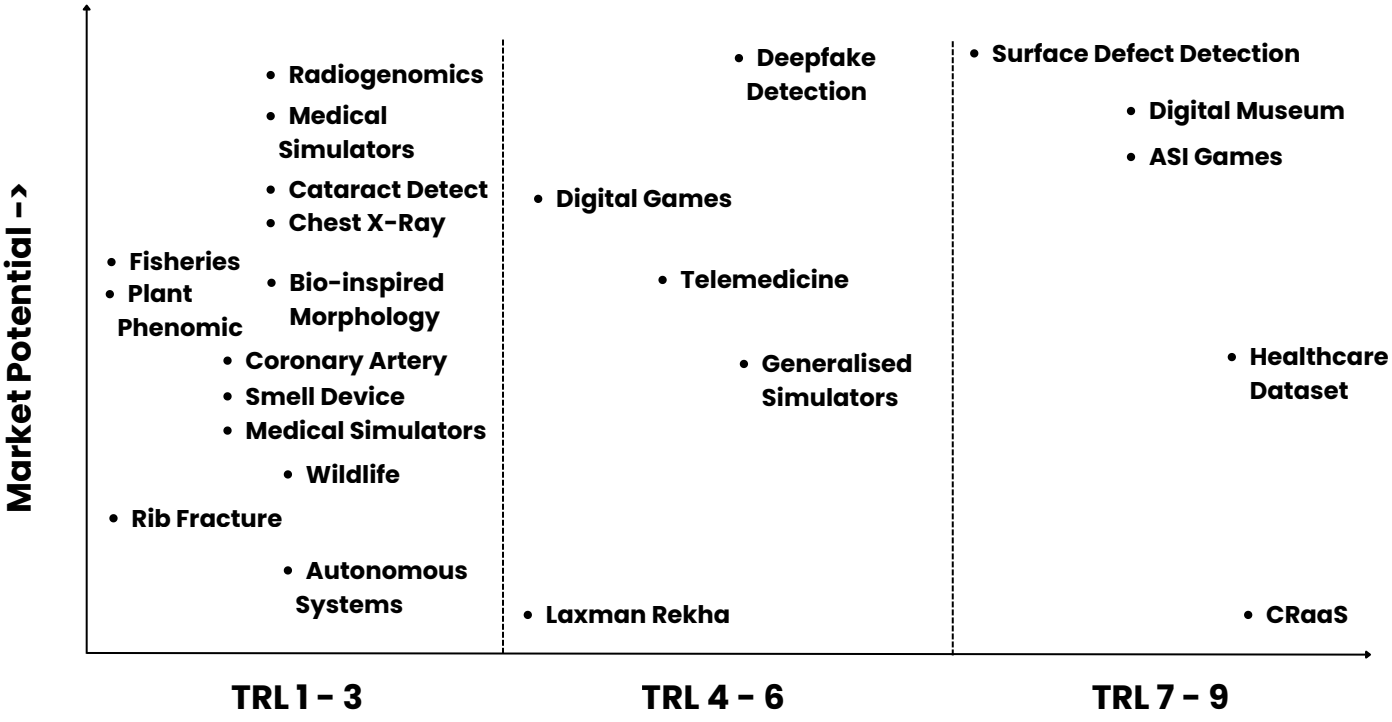
Delhi Technological University

IISER Bhopal

Flame University, Pune

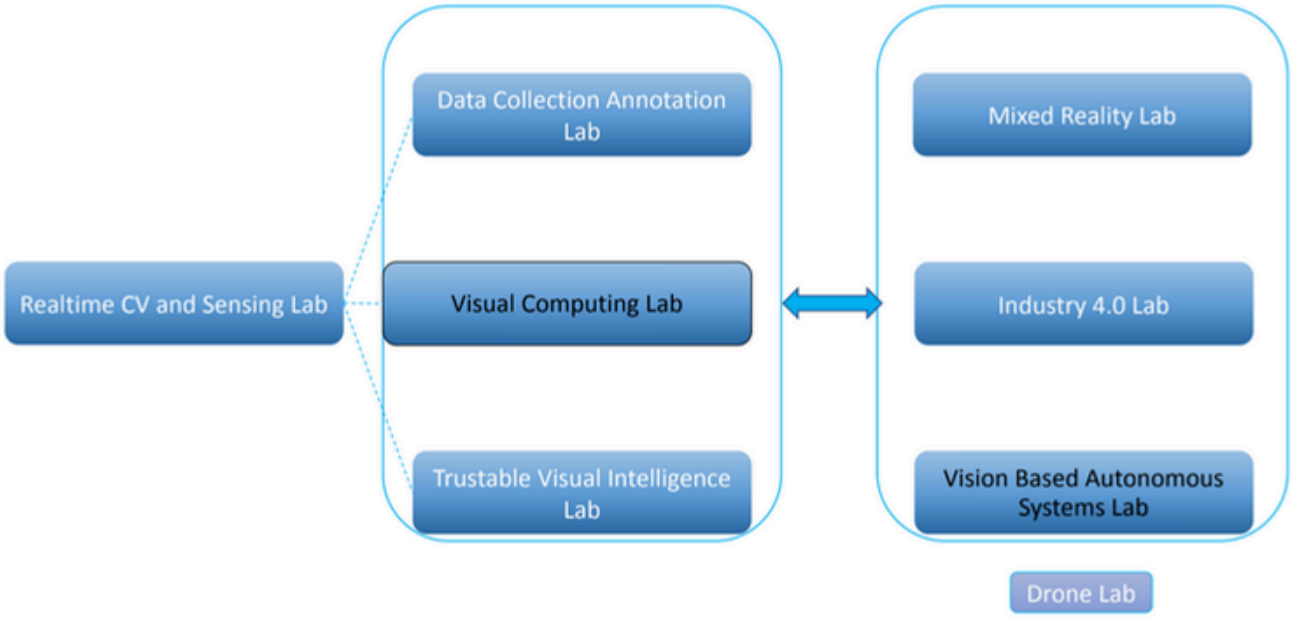
NSUT Delhi

TECHNOLOGY CAPABILITY



BIRD'S EYE VIEW OF TIH ACTIVITY

LAB INFRASTRUCTURE



iHub Drishti has successfully installed and commissioned NVIDIA Omniverse - a real-time platform for collaboration across 3D applications and assets. The NVIDIA virtual GPU solution enables IT to virtualize and share a data centre GPU across multiple virtual machines or VMs. With the RTX GPU at the backend, vGPU-enabled Virtual Machines can run Omniverse sessions without compromising performance.

We have also installed the World's First AI System built on NVIDIA A100, NVIDIA DGX™ A100, which is the universal system for all AI workloads and offers unprecedented compute density, performance, and flexibility in the world's first five petaFLOPS AI system. It features NVIDIA A100 ensor Core GPU and thus will enable TIH to consolidate training, inference, and analytics into a unified, easy-to-deploy AI infrastructure.

NVIDIA OMNIVERSE AND DGX A100

Skill Development

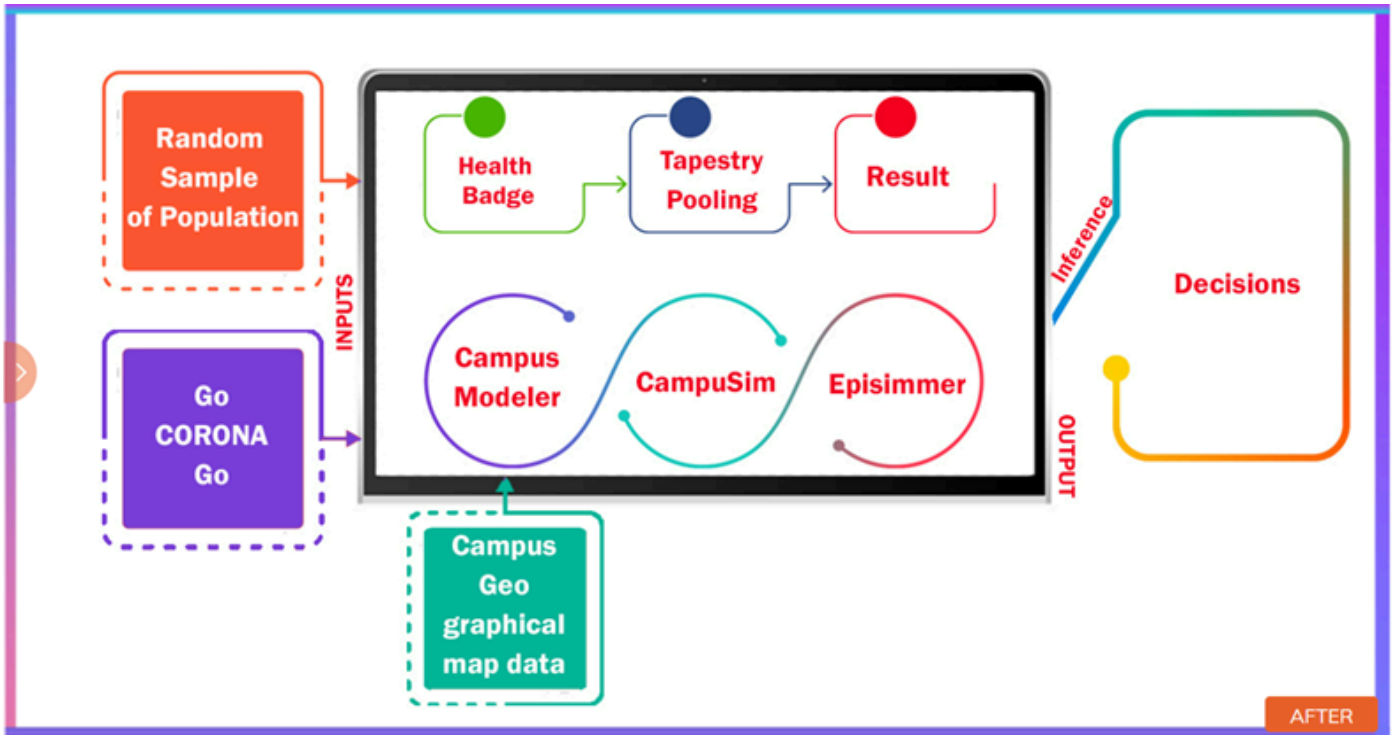
M.Tech in AR-VR for Working Professionals

TIH iHub Drishti Foundation, IIT Jodhpur, in collaboration with the School of AI and Data Science, IIT Jodhpur, conducts part-time M.Tech. in Augmented Reality and Virtual Reality (AR & VR) for working professionals. Augmented Reality and Virtual Reality has been emerging as core technology with a significant impact on productivity. To cater to the immediate requirement of a performing workforce trained in emerging AR & VR technologies, IIT Jodhpur & TIH iHub Drishti Foundation, IIT Jodhpur, offer a part-time M.Tech. Augmented Reality and Virtual Reality. It is designed to enable working professionals to pursue M.Tech in AR-VR Technologies as off-campus students with campus immersions at most 15 days per semester. The minimum duration of the programme is two academic years. Faculty members from different IITs and Industry experts conduct the programme. We have already completed the 1st academic year of our initial session 2022-24 batch.

PROJECT DETAILS

Campus Rakshak as a Service (CRaaS)

"Campus Rakshak" - a safety assurance solution for Academic Institutes to manage their campuses during the pandemic and transition smoothly from the online/hybrid mode to an entirely physical mode. This project aims to make the campus a safe place to work and live as it was in the pre-COVID era. Campus Rakshak as a Service (C-RaaS) acted as a decision support framework and assisted the campus administrators in making an informed decision during this critical transition period. The package includes components like a simulation engine, which will model the campus and provide precise predictions on the possible disease spread scenarios. Other tools provide a cost-effective, flexible screening strategy, privacy-preserving contact tracing, and a holistic health information management system. The DST Secretary inaugurated the product in October 2021. We have successfully piloted and commercially deployed C-RaaS at IIT Jodhpur and IIIT Hyderabad campuses. This platform integrates the following components: three complementary agent-based simulation models (Campus Sim (IISc), Campus Rakshak Modeller (IIT-KGP), EpiSimmer (IISc, RxCoVEA), "Tapestry" pooled testing (IIT-B) algorithms, contact tracing methods using the GoCoronaGo App (IISc), and a badging scheme-driven dashboard (HealthBadge.org) for monitoring safety on campuses.



Computer Vision and AR VR based solutions for Heritage preservation

Digitisation of Five Museums of Rajasthan

"Five Rajasthan Government museums at Alwar, Chittorgarh, Baran, Bundi, and Bharatpur in Rajasthan are digitized and uploaded to the Rajasthan Government server. The key features are:

1. Augmented with 360-degree Interactive
2. 3D models of the museum artefacts
3. Pre-defined tours take you through a guided experience with enhanced imagery & descriptions and easy-to-navigate controls.
4. These Digital Museums are a step towards the future of digitizing India's rich heritage.

Gamification of Vadnagar ASI site

The project involves the creation of a 2D side-scrolling single-player platformer game for the ASI excavation site at Vadnagar, Gujarat. The game's concept is to tell stories about the rich heritage of the Vadnagar site. Three levels of the game have been developed. As a user plays the game, the intent is to help the user improve their analytical thinking and problem visualization capabilities alongside critical thinking. This is achieved using innovative game puzzle designing that will appeal to the average Indian youth and keep them engaged. Simultaneously the artefacts and history of the Vadnagar site are showcased in an interactive way where a player can seamlessly learn about both through in-game mechanics.

US-India Collaborative Research

The U.S. plans to join six of India's Technology Innovation Hubs to support at least 25 joint research projects in 2022 in areas such as artificial intelligence and data science to advance progress in applications such as agriculture, health and climate. The U.S. National Science Foundation and the Department of Science and Technology of India will deepen this cooperation through the new U.S.-India Initiative on Critical and Emerging Technology. iHub Drishti, TIH at IIT Jodhpur, is among the six hubs where the joint Indo-US collaborative projects are being launched. All the projects were launched in a joint NSF-DST workshop on August 8, 2022. The details of the three collaborative projects of TIH IIT Jodhpur are-

Graph-Based Statistical Analysis of ENTIRE Scenes by Combining Multi-Sensor, Multi-Perspective Video Streams

Led by Prof. Saket Anand of IIIT Delhi and Prof.Anuj Srivastava of Florida State University (FSU), this project aims to analyze video streams from Autonomous Ground Vehicles (AGVs) using graph-based methodologies. Graphs provide an abstraction of capture scene geometry, and the statistic techniques that involve graphs are more resilient to noise/interference. The ultimate goal is to use the learnings in the development of self-driving vehicles through road-action modelling.

Generalizing Robot Perception for Indoor and Outdoor Scenarios by Combining Spatial and Semantic Reasoning

Led by Prof. PB Sujit of IISER Bhopal and Prof. Karthik Dantu of the University Buffalo (UB), this project aims to combine simultaneous location and mapping (SLAM) and semantic reasoning for application in infrastructure and agricultural inspection. The analytical techniques are expected to be generalized to both indoor and outdoor scenes.

Video Analytics for Wildlife Monitoring and Conservation

Led by Prof. Richa Singh of IIT Jodhpur and Prof. Sudeep Sarkar of the University of Southern Florida (USF), along with Prof. Saket Anand (IIIT Delhi) and Prof. Mayank Vatsa (IIT Jodhpur), this project aims to understand events in long videos related to wildlife monitoring and conservation. For the first time in Computer Vision, a video dataset of wildlife birds is being built. The videos show migratory birds shot over extended periods in different weather and illumination conditions. The non-invasive monitoring of wildlife can aid research on the environment and ecology.

In addition to the technical objectives, these collaborations also allow leveraging of international datasets and expertise; facilitate the setting of scientific standards, foster participation in scientific and technical organizations; and enhance international cooperation through exchanges and co-development initiatives. TIH facilitates collaboration between Indian researchers (working in Computer Vision, Virtual Reality, and Augmented Reality) and NSF funded researchers in the US.

Computer Vision based solutions for Healthcare

Capturing Dynamics of Cellular Behavior using Biosphere tunable Soft Hydrogel: Development of a Bio-imaging based ML Model to Decipher Cell fate & Morphology

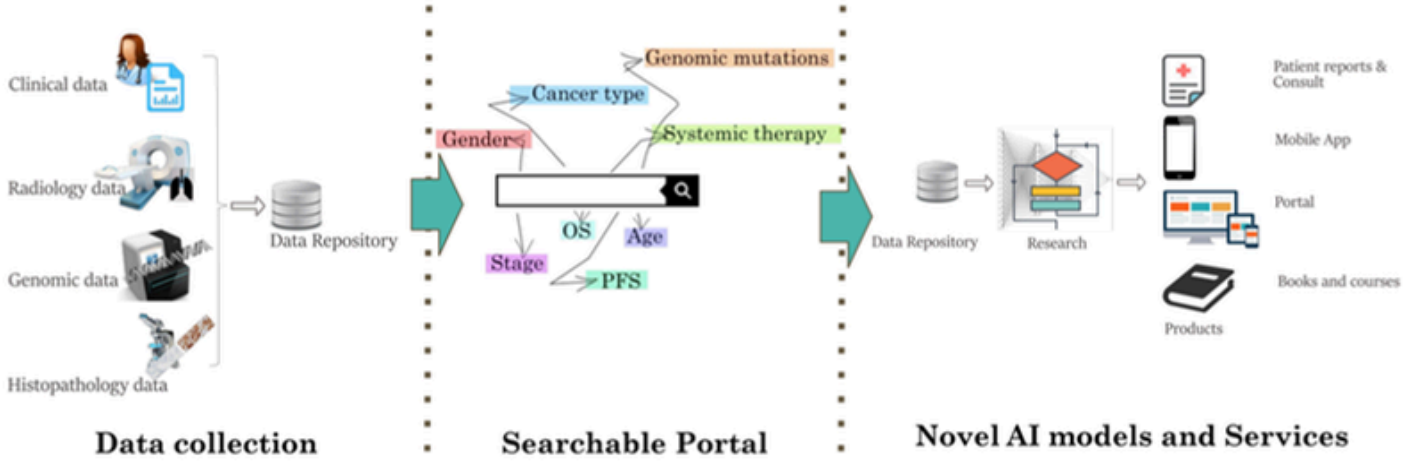
Cell morphology has been identified as a potential index of cell's response to biomaterials.

1. Cell morphology reflects the integrative effect of many distinct processes and signalling pathways across different scales and may be a valuable descriptor of cell behaviours in differentiation, function or dysfunction, migration and cancer progression.
2. Hydrogels, in many ways, have quite similar properties that are desirable for studying cell behaviour, migration proliferation and transdifferentiation. Their biocompatibility, mechanical strength and behaviour towards cells can be hugely altered by the incorporation of cell adhesive epitopes or by changing hydrogel crosslinking density.
3. Combining various metrics and machine learning, it is possible to identify significant differences in cell behaviour upon changing the chemical as well as physical properties of biomaterials.
4. To assess cell morphology with cell-material interactions, we are planning to develop a shape phenotyping framework based on support-vector machines which in future can be implemented in tissue engineering and also to diagnose metastatic cancer.

Radiogenomics Hub and Services

We propose to develop a radio genomics dataset from cohorts distributed over multiple hospitals of different types of cancers. The dataset will comprise images of different modalities like Computed Tomography (CT), MRI, Diffusion-weighted MRI, Positron Emission Tomography (PET)/CT images, and FDG-PET. Semantic annotations of the tumours as observed on the medical images using a controlled vocabulary by radiologists and segmentation maps of tumours in the Imaging data. This data will be paired with results of tumour gene mutation analyses, gene expression microarrays, RNA sequencing data (as available), and clinical data (including personal information and histopathology data), including survival outcomes. In the Indian context availability of radio genomics data will be limited. In this project, we shall explore various facets of learning with small data sets, including variants of few-shot learning techniques.

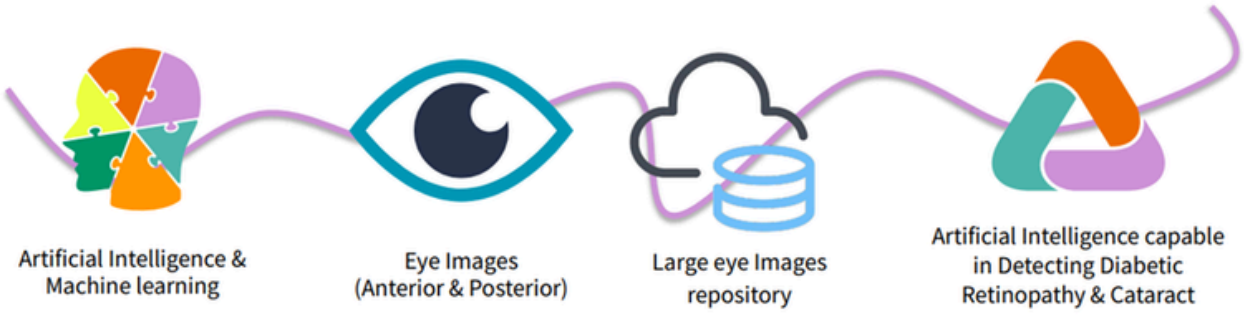
Concerted efforts will be made to provide a thorough understanding of the relationship between dataset sizes, possible confounders, and the performance of outcome prediction. Consequently, large-scale multi-centre prospective studies will be done to generate machine learning-based models.



AI based risk stratification referral models, using eye images in a public health setting

Cataract is an important cause of visual impairment worldwide, and cataract surgery is the commonest elective surgical intervention. There have been coordinated national efforts to address this challenge. As a result, though the prevalence of cataract blindness is projected to decrease, the absolute number of cataract-blind persons increased from 7.75 million in 2001 to 8.25 million in 2020 due to a substantial increase in the population above 50 years in India over this period. These numbers reflect the significantly increased demand for healthcare services.

Along with cataracts, Diabetic retinopathy (DR) is one of the most commonest complications of diabetes mellitus (DM), and its prevalence is increasing across states in India, and currently, it varies from 18% to 34%. Treatment interventions at the early stages of cataracts and DR can reduce the burden of blindness by up to 90%. A key intervention would be annual screening and early detection for DR by expert human grading of retinal images, which in the context of increasing population and limited numbers of trained graders, is extremely challenging.



The study aims to develop an AI-based risk stratification model based on Anterior and Posterior eye images for early diagnosis of Diabetic Retinopathy and Cataracts to make referral decisions and create an eye image repository for further research leading to the advancement of Artificial Intelligence in Diagnosis and medicine.

Study the miRNA profile of patients with coronary artery disease and to correlate this with atherosclerotic plaque burden by intra vascular ultrasound

- Identification of putative miRNA for CAD
- Designing non-invasive techniques for the diagnosis of CAD using machine learning (ML).
- Establishing a relationship between plaque burden in IVUS and miRNA using ML
- Establishing a relationship between findings in CCTA and IVUS using ML techniques
- Automated analysis of atherosclerotic plaque burden from IVUS using ML.

Evaluation and development of Machine Learning (ML) models for the automated detection, localisation and characterisation of traumatic rib fractures on CT scans

The objective is to development of ML models which use the spatiotemporal relationship of ribs while sequentially processing the complete CT scan for fracture characterization.

The Key features will be:

- A novel ML model to take advantage of the spatiotemporal relationship of rib fractures.
- A model for automatically generating structured text reports.
- Random clinical trial results of the developed model.
- An annotated and expert-reviewed dataset.
- Evaluation results of existing Deep Learning architectures using created dataset.

AR VR Based Medical Simulators

Haptics-based Medical Simulators for Abdomen Palpation and Pulse Behaviour

In this project, we intend to build a haptic-based medical simulator for abdomen palpation and pulse rate analysis. The proposed simulator will enable medical practitioners to perceive the sense of hardness and softness of the human abdomen while palpating with the help of a force feedback interface. The simulator will also enable doctors to perceive the pulse of a human being with the help of a customized actuator attached to the haptic interface. Once trained on this simulator, the medical practitioners may determine whether there are issues with the abdomen, like enlargement of the liver and pulse behaviour.

Haptics-Based Medical Simulators for Palpation and Tele Diagnosis

The palpation training simulator will have two main components

1. Custom Haptic Device and
2. Immersive Environment

Custom Haptic Device: A six-degree-of-freedom (DOF) haptic device for interfacing with simulated organs will be built. It will have a three-dimensional location and rotation sensing, as well as force rendering capability. The haptic device will provide the user with tactile and force feedback.

Immersive Environment: Another component of the simulator is the virtual world where the various organs will be simulated, and different properties of them will be rendered. The 3D virtual environment (VE) can be rendered either in a 2D display or in an immersive head-mounted display (HMD). Both the haptic device and VE will be rendered in real-time.

Computer Vision based solutions for Biosphere

Computer Vision based monitoring of fishes in marine cage farming

Intensification of coastal and offshore cage farming of fishes is being assigned greater priority for the growth of marine fish production. Close monitoring of the status of fishes stocked in cages as to their development, biomass increment and health are essential management decision inputs. Currently, this is being done through physical means involving high risk to persons managing the cages.

The process often results in stress to fishes, injury and infections, resulting in mortalities. Many times it becomes impossible due to inclement weather conditions. Hence, if we can develop/ design vision-based systems to capture images/ videos of the stocked fishes and real-time analysis of these to derive targeted information (size, growth, biomass, health status, and disease symptoms), would reduce onsite involvement of human beings, minimize stress to stocked fishes and economize the farming operations, besides real-time information gathering.

The project aims to develop protocols for image acquisition, analysis and converting it to information that managers can use for decision making.

Computer Vision for Plant Phenomics and Smart Agriculture

The major aim of the project is to identify and quantify plant traits and donors for tolerance to water and nutrient deficit stress conditions under controlled environment and field conditions for smart agriculture using different imaging sensors and computer vision and scale of some of the successful techniques for large-scale precision agriculture. To address this aim, the following objectives are proposed:

- To identify and quantify plant architecture-related traits (leaf area, counting of leaves, tillers, automated detection of phenology, detection of flowering and ear/panicle), biomass, and yield in rice and wheat through different sensors using computer vision.
- To diagnose and quantify drought and temperature stress response using imaging sensors.
- To diagnose and quantify nitrogen, zinc, and iron deficiencies in rice and wheat using sensors and computer vision.
- To diagnose symptoms of a combination of biotic and abiotic stresses prevailing in natural field conditions using computer vision-based image analysis.

Computer Vision based solutions for Autonomous Systems

TrustMe: Explainable Adversarial Attack Detection and Mitigation for Object Recognition Algorithms

This project aims at addressing the challenge of adversarial attacks for deep learning algorithms for object recognition algorithms. In order to ensure dependability of a machine learning algorithm for a given task, is important to ensure that the input data is not attacked. This project aims at designing and developing attack estimation and mitigation algorithms for object recognition in aerial data and satellite data.

Real-Time 3D Scene reconstruction and localization of Autonomous ground vehicles in unknown environment

Typically, the defense application areas are unknown and unstructured. For example, rapidly changing surface structure and the presence of mirage in the desert areas and unknown, cold, occlusions, highly variable environment in the mountains, cluttered and unknown forests with occlusions due to trees. The problem of 3D reconstruction of such environments and detecting, recognizing, tracking the 3D objects present in such environments is a fundamental problem for situational awareness and effective defense applications. However, this problem is a challenging problem to solve in combat zones due to the reasons mentioned above. Furthermore, defense applications require such tasks to be solved in almost real-time to perform critical operations rationally. Under this project, we would like to solve the following two problems: almost real-time 3D reconstruction of dynamic and unstructured environments and localization of the autonomous ground vehicle in the reconstructed 3D model.

Human in loop Control for semi- Autonomous system under presence of sensing and actuation delay

In this project, aim is to develop a control framework for HIL control systems, where human decision will be involved in the feedback-loop consisting of a robotic system and controller. Humans will make decisions based on admissible control inputs generated by HIL controller, and multimodal feedback feedback. The proposed controller will allow humans to act as decision makers or a supervisor, when necessary.

Visual Intelligence Generation from Wide Area Sensing

The main objective of this project is to provide more accurate visual information for the purpose of surveillance and enhancing situational awareness. It aims to develop an automated system capable of providing emergent and combined Intelligence, Surveillance and Reconnaissance (ISR) information. The main utility of this project is mitigation of limitations of single camera by using multiple cameras (overlapping field of view) to:

- Improve object detection across two or more views (eg. small objects, dynamic illumination etc.)
- Improve estimates of trajectory moving objects (tackle occlusion in a better way via the use of multiple view)
- Improve overall situational awareness.

Seeing through partial occlusion

Occlusion is one of the main limiting factors of sensing in various critical applications. Foliage can be one of such an occluding medium. This can be very crucial in the identification of the signs in case of surveillance of any region to identify the hidden signs under foliage. In this project, we aim to develop a real-time system to facilitate the identification of the hidden objects/signs especially human made in the presence of partial occluding such as Foliage, Mesh. We plan to utilize the IR sensing along with the Light Field based approach to identify and reconstruct the object in such a scenario. Such a setup requires a low cost framework which is robust against the errors arising due to the misalignment of the setup for real-life applications usages. The power of AI can be utilized to further refine the reconstruction by utilizing the Deep Learning based framework to further reduce the errors.

Computer Vision based solutions for Industry 4.0

Vision System for Integration with Mass manufacturing Line of Bearing Rollers

The vision-based inspection system can accurately measure and sort parts at higher speeds to improve productivity. In addition, the vision based system can facilitate 100% inspection requirements of manufactured components, ensuring conformance to specifications and customer satisfaction. The present research aims to develop a vision- based inspection system for quality control of tapered rollers used in bearings produced by the centerless grinding operation.

Remedial Action, Knowledge Skimming and Holistic Analysis of COVID-19 (Rakshak)

Development of Advanced Machine Learning Tools for Multi-modal Image Assisted Diagnostics of Infectious Respiratory Diseases

The web-based diagnosis tool was designed, where we can just upload the CXR images and can apply different preprocessing techniques along with the different preprocessing technique there is also an option to choose the class imbalance handler and the deep classifier of your choice and finally gets the final prediction on the final result page. Along with the prediction of the class to which that CXR image belongs to Class activation map is also shown which describes why the classifier reaches the particular decision.

Establishment of AI based Platform to monitor and identify smell, taste and key covid-19 therapeutic hotspots

- Device development for recording smell and generating scores/questionnaires based on data collection from different age group individuals.
- Development of AI platform that triages COVID-19 asymptomatic suspects based on the defined parameters - anosmia and ageusia.

Radiology Data Projects for SARS nCov-2

This project had the following accomplishments:

- Created expert annotations on publicly available Chest X-Ray data of patients with and without COVID-19 disease
- Collected COVID-19 Chest X-Ray data from sites across India
- Deployed a platform for community-based expert annotation for Chest X-Ray data
- Deployed a platform for comparison of AI models and data download about COVID-19 on Chest X-Ray data

Long-term outcome of infants born to COVID-19 positive mothers: A Prospective Cohort Study for your kind perusal

This project aims to Study the perinatal transmission of CoronaVirus Disease-19 (COVID-19) from COVID-I9 positive mother to her infant and its impact on the long-term outcome of these infants.

Telemedicine for Homecare

iMediX has been installed in a server at IIT Jodhpur and a mobile app for a patient has been developed with a chat interface. For the chat interface a set of APIs are developed by IIT, Kharagpur and the mobile-compatible chat interface for the role of a patient has been developed by IIT, Jodhpur. The integration also takes care of facilitating video conferencing between a doctor and a patient by connecting to publicly accessible web application Jitsi Meet. The system has been tested successfully in the laboratory environment.

Smart Health Solution for Rapid Mass Screening using Integrated Telemedicine

Developed a small, low-cost, vital measurement device and integrated it with a smartphone app and a web portal for collection, storage, and observation of the data by authorized individuals. A low-cost acoustic stethoscope was also digitized and integrated with the applications which allowed noise cancellation to be applied to the recorded stethoscope audio.

Coswara –speech and sound based diagnostic tools for COVID-19

Since the outbreak of COVID-19, an increasing number of studies have suggested that the disease triggers the SARS-CoV-2 virus to replicate and migrate down the respiratory tract to the epithelial cells in the lungs. Hence, it becomes interesting to understand if there are detectable signatures of COVID-19 in the sound samples such as breathing, cough, and speech, originating from the respiratory system. To explore this, we pursued an exploratory study consisting of respiratory sound sample dataset creation, and acoustic analysis of the data using signal processing and machine learning approaches.

Data Acquisition for AImedHUB: A Medical Data Bank Hosting & Data analytics Challenges framework

Indian-CT was constructed to provide chest CT scans of COVID-19 patients from India for building machine-learning models that can aid in analyzing lungs for the diagnosis of the disease. This dataset can also be used as a category while detecting other pulmonary diseases. To our knowledge, this is the only chest CT-scan dataset from the Indian population. Since all the images included in this dataset are from a single hospital and acquired using a single CT scanner, any confounding factors in the data are minimized.

Smart Health Solution for Rapid Mass Screening using Integrated Telemedicine

Development of low-cost, highly scalable, non-invasive solutions that allow rapid screening of vitals for COVID-19 by combining IoT devices with online telemedicine solutions. The developed IoT devices were envisioned to be used for collecting and monitoring vitals - such as temperature, pulse, saturation of peripheral oxygen (SpO2), mean blood pressure, heart sounds, and lung sounds - by the patient from a PHC or from their own homes. These parameters are very helpful for both, the screening for COVID-19 and the evaluation of the patient's heart health post COVID treatment. Such a solution was also expected to significantly improve existing remote healthcare solutions, such as tele-consultancy platforms, by enabling the automatic and secure transfer of the collected data to the authorized medical practitioner. Once the devices are standardized, any variability in the data could be compensated for by software. Thus, the solution can eliminate the errors in data collection caused by the use of different devices or verbal communication.

AI-driven screening of COVID-19 using chest X-ray images

This project accomplished the following:

- "Explainable solution" for detecting COVID-19 pneumonia in patients through chest radiographs.
- Development of COMiT-Net which performs the tasks of classification and segmentation simultaneously.

Social Distance Alert and Monitoring System using smartphone, IoT and AI

- Development of a wearable device prototype
- The device can manage crowds in post-COVID situations
- Can be effectively used in a controlled environment such as meetings, classrooms, or offices.

AI-driven estimation of covid-19 prognosis using multimodal data

The main objective of our study was to predict the type of infections in the lungs due to COVID-19 for subsequent days. To achieve this objective, we trained an infection severity level classifier to detect the infection type. We reached a model based on DenseNet, which gave us an AUC score of 0.85 over the test dataset. Following this, we trained a prognosis model using the longitudinal CXR images of the previous follow-ups to predict the infection level for the subsequent follow-up.

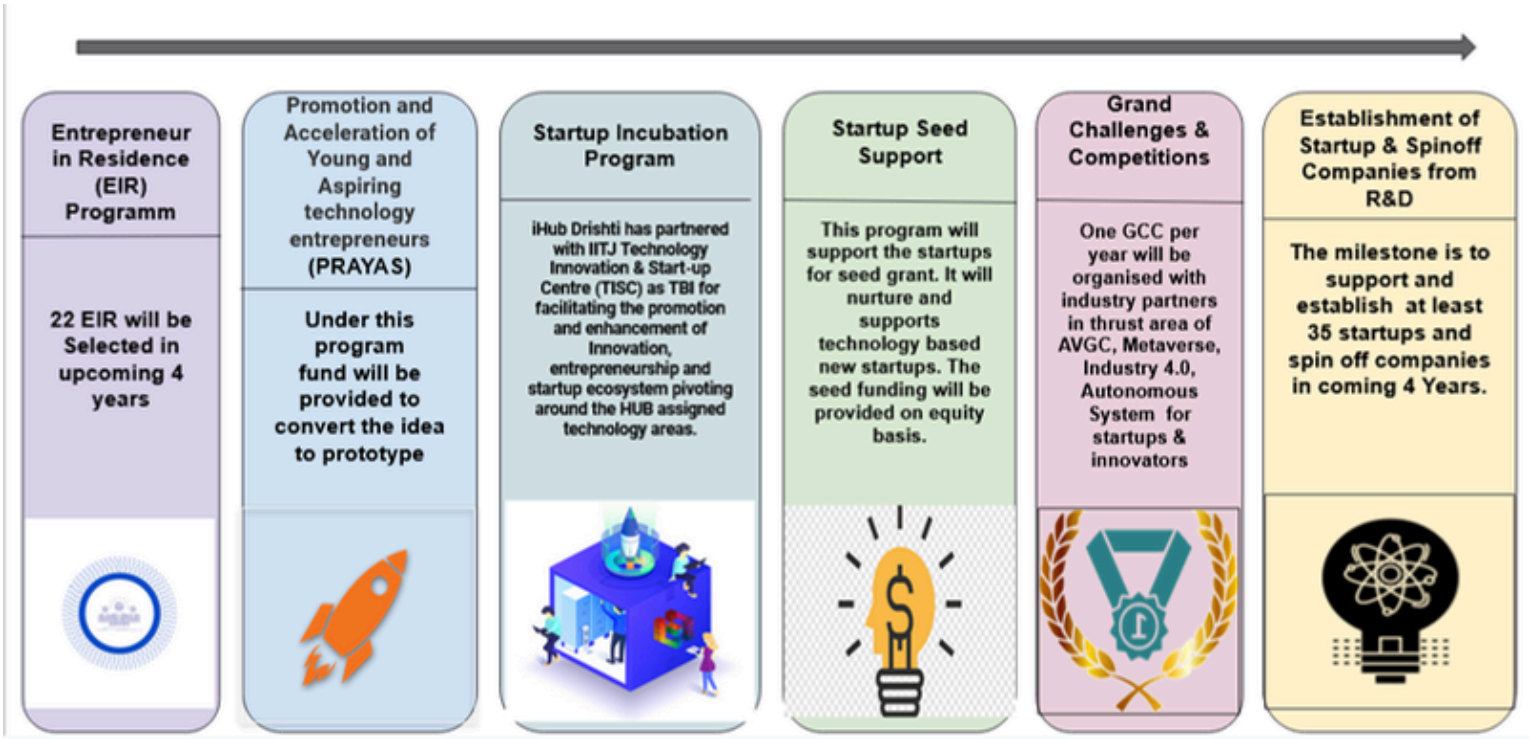
Autonomous Detection of Social Distancing and Hygienic etiquettes

- Development of algorithm for Pedestrian detection on surveillance video frames, marked with green boxes
- Detection of social distancing- pedestrians who are maintaining and not maintaining safe social distancing are marked with green and red respectively
- Detection of facemasks when multiple people are present and when the face is partially occluded.

Laxman Rekha: AI biometric driven home quarantine management application using mobile based continuous recognition and geofencing

- A developed android app is used to track the users under quarantine.
- A simple-to-use guard application for guard/security personnel to initiate users' quarantine by feeding their institute id and terminating it whenever it is required.
- Designed a holistic administrative Web-APP that can be used to view user information and is suitable for administrative purposes.

Startup Ecosystem



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SCAN FOR MORE INFORMATION

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