विज्ञान और प्रौद्योगिकी विभाग
Department of
SCIENCE & TECHNOLOGY

NM-ICPS

IHFC

iitdelhi

I-HUB FOUNDATION FOR COBOTICS

R&D GRAND PROJECTS COMPENDIUM 2025

SCAN TO VISIT
OUR WEBSITE

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We acknowledge our Principal Investigators (PIs) for providing the R&D content and product images featured in this compendium.

About IHFC

I-Hub Foundation for Cobotics (IHFC) at IIT Delhi was established as a Technology Innovation Hub (TIH) in March 2020 under the National Mission on Interdisciplinary Cyber-Physical Systems (NM-ICPS), DST, Govt. of India. As a Section 8 company IHFC brings together 3 major pillars: Academia, Government and Industry. IHFC has 4 mandates under its 4 verticals. The mandates are Research & Development, Entrepreneurship and Startups, Education, Research and Upskilling and International Collaboration in the following verticals:

:: Industry X.0
:: Defence
:: Medical
:: Agriculture

IHFC's vision and mission revolve around translating cutting-edge research into state-of-the-art technology products and services in the field of collaborative robotics (cobotics). We aim to foster innovation, promote entrepreneurship, and drive socio-economic impact through the deployment of advanced technologies.

What Do We Do?

Propel innovation across India by serving as a dynamic launchpad for R&D for product development and commercialization.

Incubate and accelerate startups, guiding them towards developing products and solutions that contribute to the vision of an Atmanirbhar Bharat.

Torch bearers for developing a unique STEM driven curriculum across different educational boards and provide essential skills and training empowering youth in STEM in area of Robotics and Cobotics.

Foster international collaborations across the world to drive forward the future of Innovation in India.

Developing state of the art infrastructure such as Drone Technology Park (DTP), Medical Cobotics Centre (MCC) and Co-Innovation Centres (CiCs) for R&D and development of indigenised products and solutions for India.

12
Joint Projects with The National Science Foundation, USA (2022-23)

8
Startups and Industry associated

100+
Faculty

7 Patents
(Filed/Granted)

28+
Institutes

150+
Publications

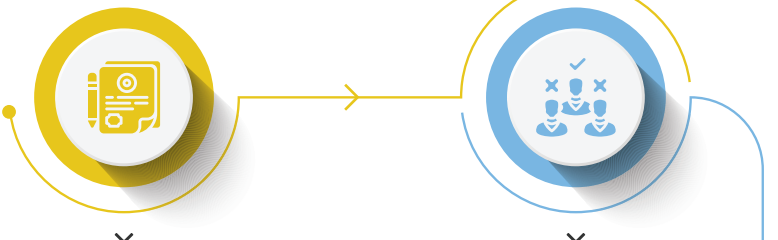
50+
HRD

This Compendium features 31 R&D Projects with Technology Readiness Level (TRL) 3-4 and above.

*IHFC consolidates multiple approved independent proposals in similar domains into unified Grand Projects, fostering collaboration over isolated efforts. This strategic approach has resulted in nine Grand Projects, built on shared expertise and collective strength, to deliver greater impact and scalable, cutting-edge solutions.

IHFC's R&D Project Lifecycle

The journey of each grand project at IHFC follows a rigorous and structured process to ensure technical excellence, strategic alignment, and real-world impact:



Launch of Call for Proposals: Invitations are announced for high-impact, innovation-driven technologies, translational research products, or prototypes aimed at commercialization — preferably those at TRL ≥ 4 in deep tech areas such as AI, Machine Learning, Robotics, IoT, Sensors, Communications, and related domains.

Initial Shortlisting of the Proposals: Proposals are first reviewed and shortlisted by IHFC's internal Members Committee based on relevance, technical readiness, and commercial potential. This is followed by an internal evaluation, including a presentation by the applicant.

Expert Evaluation: Shortlisted proposals are then evaluated in detail by domain experts including technical reviewers and commercial advisors.

Formalization through MoU: Upon approval, a Memorandum of Understanding (MoU) is signed with the project team or partner institution.

Review by Board of Directors: Proposals recommended by the experts are further reviewed and approved by IHFC's Board of Directors.

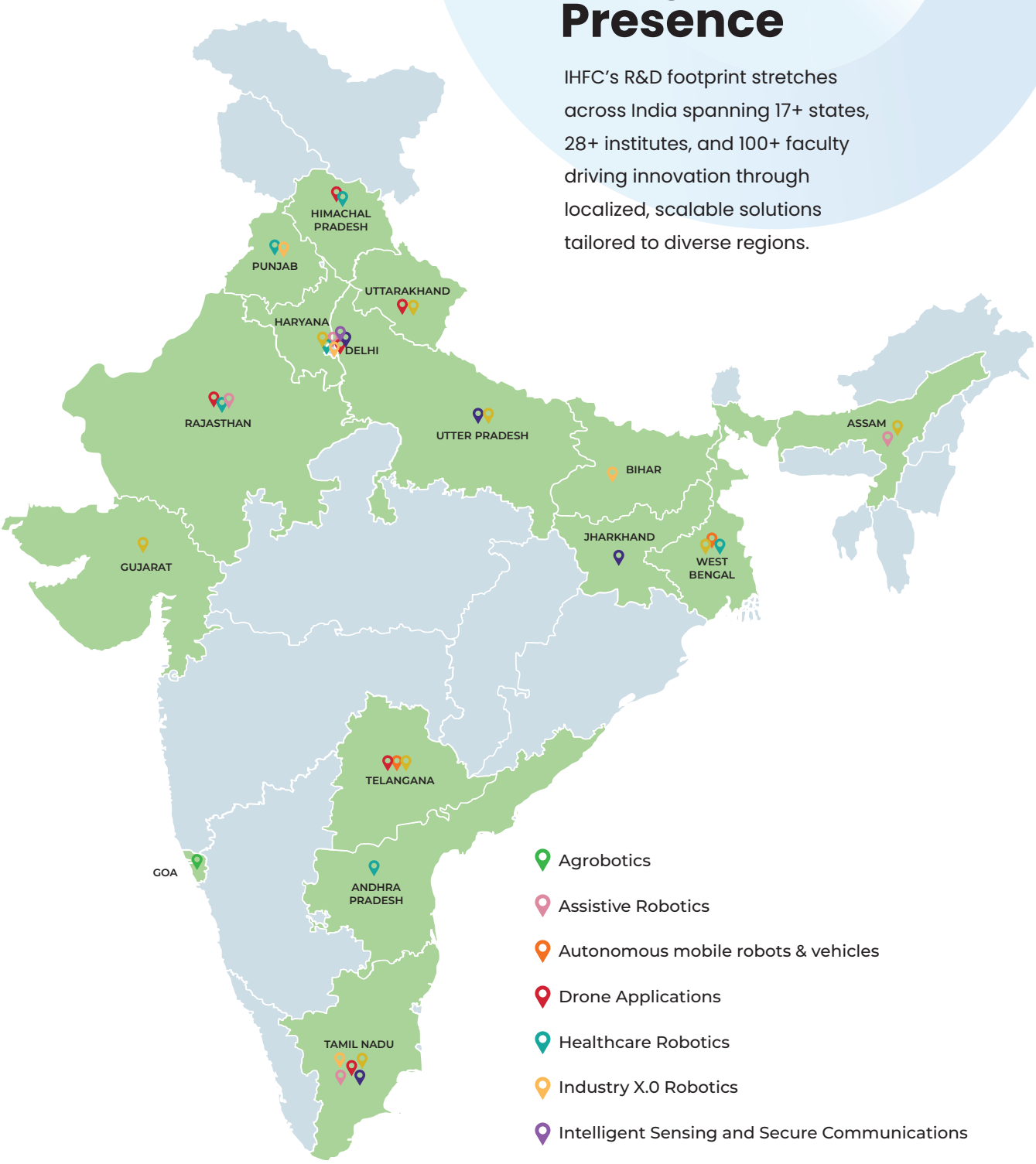
Funding Allocation: Approved projects receive financial support in accordance with defined milestones and deliverables.

Project Execution and Monitoring: Ongoing progress is closely monitored to ensure timely delivery, technical rigor, and milestone achievement.

Commercialization and Industry Engagement: Projects are supported through industry connects and strategic partnerships to facilitate real-world deployment and commercialization.

Geographical Presence

IHFC's R&D footprint stretches across India spanning 17+ states, 28+ institutes, and 100+ faculty driving innovation through localized, scalable solutions tailored to diverse regions.



- Agrobotics
- Assistive Robotics
- Autonomous mobile robots & vehicles
- Drone Applications
- Healthcare Robotics
- Industry X.0 Robotics
- Intelligent Sensing and Secure Communications
- Nanorobotics
- Rehabilitation Robotics

Assistive Robotics

EMG CoNtrolled PRosthetIC Hand: ENRICH

ENRICH is a smart, affordable prosthetic hand that helps upper limb amputees do basic tasks more easily, making life more independent and comfortable.

Problem Addressed

- India reports around 54 lakhs amputees, and 23,500 new amputees every year.
- Challenges are technical issues with prosthetic hand, cost vis-a-vis socio-economic background of users.

About the Technology

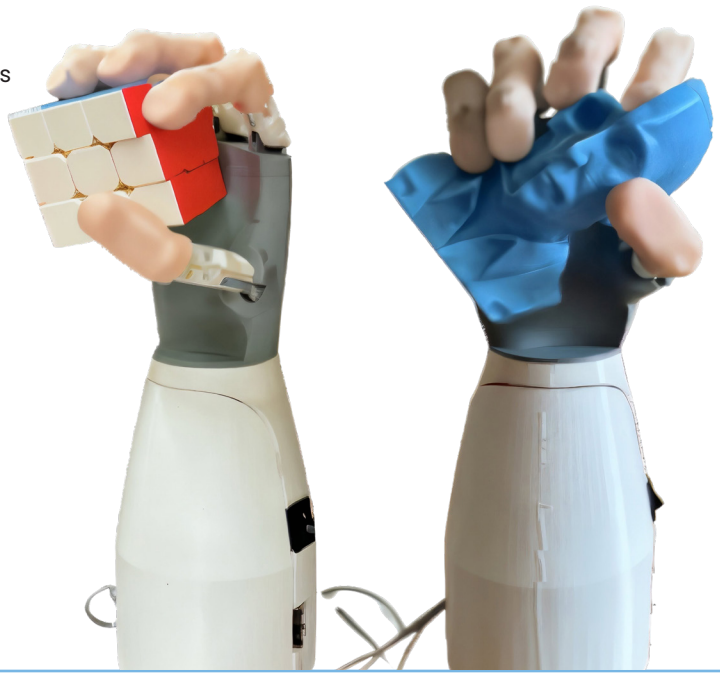
- ENRICH is designed mimicking the functionality and controllability of human hand.
- The real-time EMG based controller enables ENRICH to perform grasping operations in 250.80 ± 1.1 milliseconds, comparable to the time required by human hands i.e., 300 milliseconds.
- Fastest prosthetic hand satisfying human hand neuromuscular constraint
- Multiarticulate hand mimicking human hand
- Single channel EMG controlled prosthetic with less learning time
- Anthropomorphic and ergonomic design with powerful grasp
- Lightweight
- Adjustable sockets

Specifications

- Grasping time: 250.80±1.1 milliseconds
- Size: Length = 178 mm, width =82 mm,
- Height: 28 mm
- Weight: 450 gram
- EMG channel: 01
- Running time: 08 Hours
- Charging time: 03 Hours
- Battery: 7.4 V. 1000 mAh Lithium-Polymer Battery
- Degrees of Freedom: 14

Application Areas & Use cases

- Restoration of grasping operations for upper limb amputee



PI Name: Prof. Nayan M. Kakoty

Institute: Tezpur University

Technology Readiness Level (TRL): 7

Intellectual Property: PA No: 524691

Autonomous Robot Navigation Using Learning Based Technology

AI agents that learn to move naturally and respectfully around people by adapting in real time- ensuring smooth, socially aware navigation in dynamic spaces

Problem Addressed

- End to end navigation in dynamic and static environment using learning based technology.
- Study of multiple behaviour of humans collision avoidance
- Improved the directivity of the agent using learning based technology.
- Self-imitating ability to human by robot.

About the Technology

This work develops socially aware navigation for AI agents using Expert Session-based Co-teaching to Reinforcement Learning (ESC-RL), blending human guidance with reinforcement learning for dynamic obstacle avoidance and social etiquette. Generative Adversarial Imitation Learning (GAIL) enhances adaptability by iteratively learning from human interventions, enabling efficient, real-world navigation without reliance on static datasets or rigid behavior models. Technology highlights include:

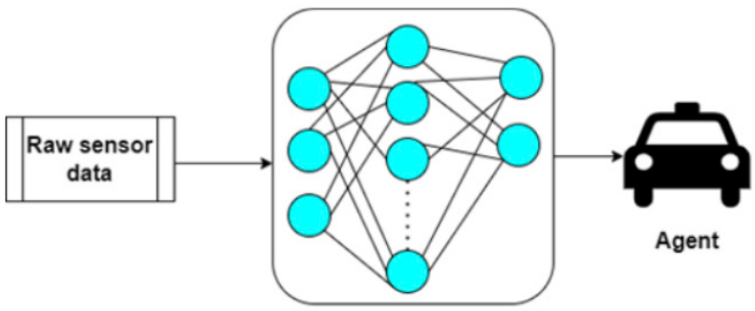
- Supervised learning.
- Reinforcement learning.
- Generative Adversarial Imitation Learning.
- Heuristic property of path planning.

Specifications

- Technology Name: Autonomous mobile robot
- Purpose/Function: Navigate dynamic environments safely and efficiently
- Key Features:
  - Dynamic obstacle avoidance
  - Reactive navigation
  - Social behavior
- Technical Details: Sensors: LiDAR . ROS-based
- Target Environment: Public spaces like airports, malls, hospitals and warehouse
- Input: Raw LiDAR Data
- Output: Velocity

Application Areas & Use Cases

- Autonomous navigation in structured(ware house) environment.
- Social navigation in unstructured environment (Public places).



PI Name: Prof. GC Nandi

Institute: IIIT Allahabad

Technology Readiness Level (TRL): 4

Intellectual Property: PA No. 202311009245

Intelligent Grasping for Warehouse Cobotics

A smart robot that uses regular or depth images to spot and grasp objects on a table with precision-guiding each pick with accuracy for smooth, hassle-free handling.

Problem Addressed

The project tackles three key challenges: intelligent robotic grasping using model-free reinforcement learning, autonomous coordination of multiple mobile robots, and seamless human-robot interaction. These advancements aim to enhance cobot efficiency in dynamic environments like warehouses and healthcare.

About the Technology

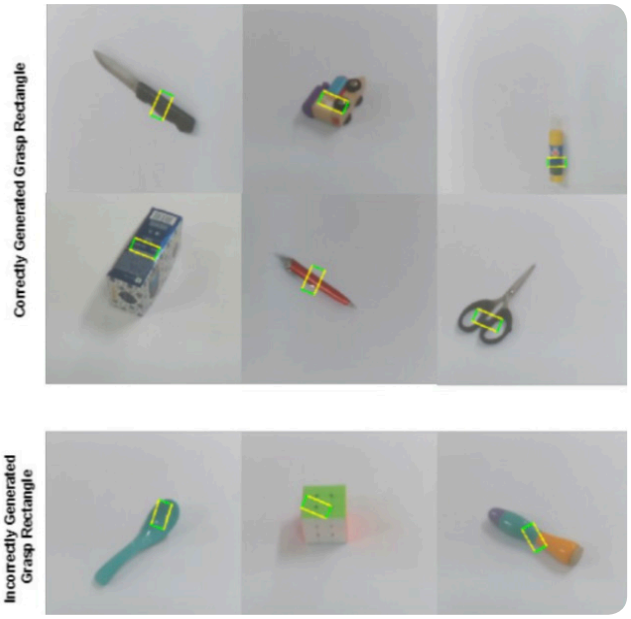
- It takes an RGBD image in one model and RGB image in another model of an object as input that is centrally placed on the tabletop with a white background and captures top view of the object.
- With our tool, in both the models a grasp rectangle is generated as an output, with parameters (x, y, and Θ), where (x, y) is the center of the rectangle and Θ is the orientation of the grasping rectangle. These parameters can be further utilized as an input to any robot system for executing robotic grasping through existing inverse kinematics and trajectory planning methods.
- Both CNN and deep Generative models have been used for model development.
- Both RGBD & RGB images have been used as inputs for grasp generations.
- Works for seen and unseen objects

Specifications

- Input: RGBD & RGB images
- Output: Grasp rectangle with parameters (x, y and Θ)
- Models used for our design: VQ-VAE & Pix2Pix GAN
- Approach: Generative Based

Application Areas & Use Cases

- Warehouse
- Asistive Robotics



PI Name: Prof. GC Nandi

Institute: IIIT Allahabad

Technology Readiness Level (TRL): 4

Intellectual Property: PA No. 202311009245

Autonomous, High-reach, Omnidirectional Mobile Robot

A smart warehouse robot that autonomously finds, picks, and carries items—speeding up operations, cutting costs, and simplifying inventory management.

Problem Addressed

The burgeoning e-commerce sector has put warehouse managers under increased pressure to reduce costs without compromising efficiency. The major expenses are those related to receiving, storing, choosing, and sending. A significant portion of these operating expenses are related to item selection, pick & place, and transportation.

About the Technology

- The invention under consideration aims to maximise the efficiency of item searching, item-picking and items movement in warehouses.
- The autonomous mobile robot and system are designed to reduce total warehouse automation expenses by streamlining operations.
- Autonomous omnidirectional wheel system can navigate on warehouse environment based on map,
- Onboard light weight (Total manipulator weight 12Kg) wired driven telescopic manipulator having maximum payload capacity 3Kg (Weight to Payload ratio 4) by means of Jaw Gripper
- Camera based (QR code reading) object searching from the rack up to a height of 1.93m.

Specifications

- Omnidirectional four-wheel robot
- Multistage telescopic mast with a jaw gripper mouted over a turret
- Camera for barcode reading as well as job identification followed by pose of job
- Camera and/or LIDAR for environment mapping
- Bump switch to protect the vehicle
- On-board navigational sensors and actuators e.g. motor, encoder, brake, INS, compass
- On-board power pack for the endurance 4-5hrs
- Mechanism for self-alignment of jobs on the AMR

Application Areas & Use Cases

- Wirehouse application
- Hospital

PI Name: Dr. Ranjit Ray

Institute: CSIR-CMERI, Durgapur

Technology Readiness Level (TRL): 3-4

Drone Based Aerial Manipulator

A drone-based system that automates pollination, reducing human risk and labor while boosting crop yields and supporting sustainable farming.

Problem Addressed

Drone pollination tackles critical agricultural challenges like labor shortages and declining bee populations, providing a sustainable and efficient alternative to traditional pollination methods.

About the Technology

- Drone pollination utilizes precision drones equipped with novel bristle designs to capture and release pollen effectively, ensuring targeted and efficient pollination.
- This technology is adaptable and easily integrates into existing agricultural practices
- Adaptive spraying adjusts to speed and wind conditions for optimal coverage.
- Novel bristle design ensures precise pollen delivery and maximum efficiency.

Specifications

- Flight Time: 30 mins
- Payload: 10 Kg

Application Areas & Use Cases

Drone pollination is ideal for large-scale agriculture, particularly in crops like paddy. It improves crop yields, reduces reliance on manual labor, and supports sustainable farming practices, paving the way for resilient agricultural systems.

PI Name: Dr. Spandan Roy

Institute: IIIT, Hyderabad

Technology Readiness Level (TRL): 7

Autonomous AI Agriculture Drone

An AI-powered agriculture drone that autonomously navigates orchards and fields, enabling precise, large-scale farming without manual effort.

Problem Addressed

The project addresses inefficiencies in traditional agricultural practices by eliminating manual scouting and enabling quick, large-area coverage. It automates repetitive tasks like spraying, watering, and disease monitoring within orchards. The drone enhances precision and scalability by leveraging AI for plant health assessment and pest detection. It can also adapt to other domains, such as railway track and river monitoring.

About the Technology

- The AI Agriculture Drone autonomously navigates your fields using advanced AI algorithms, eliminating the need for manual scouting.
- The drone can identify plantation, and passage within orchards/trees and can traverse within the orchard with ease.
- This technology enables farmers automate repetitive task and cover larger areas.
- The drone can also, traverse tree lines and automate tasks such as spraying and watering along with aerial inspection for diseases on the fly.
- It can identify plant types and health status.
- It detects potential issues like pests.
- Covers large areas quickly and efficiently.

Specifications

- Quad drone 40 TOPS AI computation
- Autonomous flight without human intervention
- Easy manual to Auto mode switch
- Dual camera system for navigation and scouting
- FPV mode for human inspection
- Real time plant disease detection
- Adjustable flight height as per plantation

Application Areas & Use Cases

- This drone technology is trained over tree line, orchards and hence strong use cases are:
- Peach/Apple orchard scouting
- Tree line spraying
- Railway track inspection
- This technology can also be retrained for various other applications such as autonomous river monitoring, algal estimation, etc.

PI Name: Dr. Kaushal Kishore

Institute: CSIR CEERI Pilani

Technology Readiness Level (TRL): 5

Drone Based Disease Identification

AI-powered smart drones that spot plant diseases early-helping protect crops, boost yield, and prevent major losses before problems spread

Problem Addressed

In India, 15-20% of crop yield is lost annually due to plant diseases. These losses often go undetected until it's too late. The need for early, precise, and scalable disease identification in agriculture is critical to widespread crop damage and economic loss.

About the Technology

In India, it is reported that 15-20% of crops are lost due to diseases. This Technology solution addresses this problem. Using Drones with Contemporary AI/ML and Deep Learning technologies, we have arrived at a comprehensive solution that identifies diseases in plants in early stages, thereby preventing crop losses. Technology highlights include:

- Images of the Plant Disease dataset are taken, and the images are resized to a smaller size for better operation.
- The CNN is trained with images of the dataset along with their disease names and its intensity using TensorFlow and Keras.
- Now, after training, the CNN model can predict and report on disease affected in any plant images.

Specifications

- Drone based data collection
- Crop Health Monitoring
- Identification of Plant Diseases- On-slaught-Early Detection
- Application of AI/ML DL Technology
- Farmer Friendly Web app
- General Treatise of software to be applied for various diseases with in built diseases data base

Application Areas & Use Cases

The Product and the Technology have undergone extensive Field trials. We have also successfully captured diseases immediately after their on-slaught and ring-fenced them from spreading to other areas.

PI Name: Dr. M. K. Padmanabhan

Institute: Meiyur Technologies Pvt.Ltd

Technology Readiness Level (TRL): 5

Open Cast Minefield Surveillance Drone

Smart drones that autonomously monitor open-pit mines in real time-capturing detailed aerial data to boost safety, track conditions, and streamline mining operations.

Problem Addressed

The project aims to enhance surveillance and mapping in open-cast mines, making the process quicker and more accurate. Conventional methods are time-consuming, labor-intensive and expose person to hazardous conditions. The development of autonomous quadcopters enables efficient and quick data collection through automated flight planning. Data captured by UAVs is utilized for surveillance and volume estimation.

About the Technology

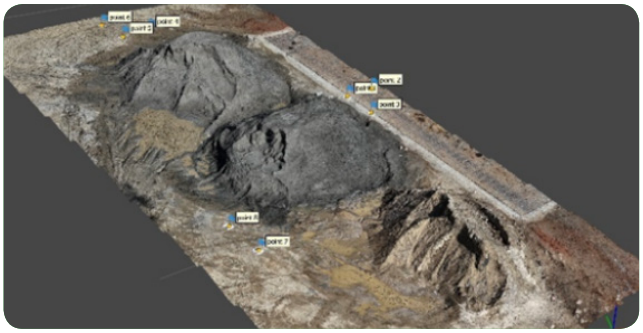
- The aim of the project is to develop intelligent autonomous Unmanned Aerial Vehicles (UAVs) for surveillance, management, and hazard assessment in open-cast mines.
- The UAVs are used to collect data such as aerial photographs and videos, which are used to determine stockpile and dump volumes, mapping, slope stability assessment, land reclamation, and environmental assessment.
- Efficiency: The technology cut survey time tenfold, reduced costs, and minimize manual labour.
- Precision: Improve accuracy, resource management and environmental reclamation.
- Indigenous Innovation: Locally developed quadcopters support Make in India.
- Advanced Method: Novel approach validated for stockpile volume estimation

Specifications

- Payload Capacities: 1.8 kg, 1 kg, 0.9 kg
- Flight Time: Approx 30 Minutes
- Payload types: Mapping camera
- Hardware Redundancy: Dual GNSS, Dual communication protocol and dual battery.
- Control: Autonomous and Manual
- Failsafe: Connection Loss, GPS Loss and Low battery return to home

Application Areas & Use Cases

- Open-cast minefield mapping and survey.
- Stockpile and dump volume estimation.
- Hazards assessments such as slope stability analysis and harmful gases
- Environmental monitoring and land reclamation.



PI Name: Dr. P M Pathak

Institute: IIT Roorkee

Technology Readiness Level (TRL): 4

Distributed Adaptive Coverage Control of Drone Networks

Intelligent software that lets a team of drones work together to cover farms autonomously—adapting in real time to soil conditions for faster, smarter, and low-maintenance field monitoring.

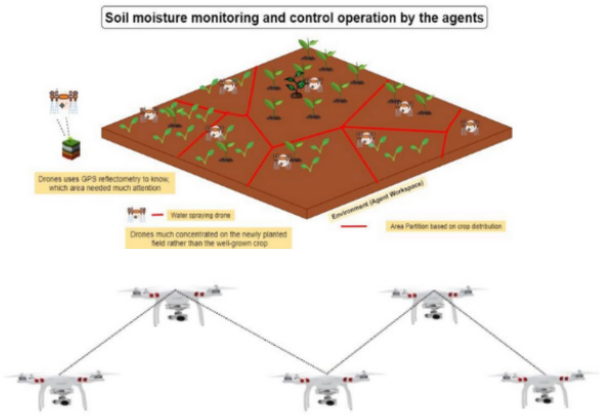
Problem Addressed

The project tackles the challenge of coordinating multiple drones to effectively perform coverage tasks such as soil moisture monitoring when the environment's sensory information is unknown and dynamically changing. Existing centralized or pre-programmed solutions are inefficient in such scenarios, and this project seeks to create adaptive, distributed algorithms that allow drones to self-organize and operate autonomously in uncertain environments.

About the Technology

The proposed system develops a distributed adaptive coverage control algorithm for a fleet of UAVs, enabling them to autonomously distribute themselves based on real-time sensory data (e.g., soil moisture). Each drone learns environmental information and collaborates locally with neighboring drones to optimize area coverage, using minimal prior knowledge and limited communication, allowing scalable and robust operation in practical field condition. Other technology highlights include:

- Real-time distributed control using adaptive algorithms.
- Minimal data richness required for convergence and performance.
- UAVs use local communication to achieve optimal spatial distribution.
- Soil moisture sensing and action using GNSS reflectometry and coordinated sprinkling.
- Indoor and outdoor validation with experimental drone platforms and thermal sensors.



Specifications

- Drone hardware: Custom drones with GNSS/thermal sensors
- Control: Distributed adaptive control algorithms with local estimation
- Infrastructure: OptiTrack motion capture system for indoor tests, field experiments for outdoor validation
- Hardware setup: 10 Crazyflie drones, 3 custom drones, GPU server, V100-equipped laptop

Application Areas & Use Cases

Applications include precision agriculture (e.g., automated irrigation and pest control), disaster relief (e.g., fire detection and mitigation), surveillance, environmental monitoring, and wildlife management. The technology is especially valuable where large-scale autonomous coverage is required with minimal human intervention.

PI Name: Dr. Shubhendu Bhasin

Institute: IIT Delhi

Technology Readiness Level (TRL): 3-4

Healthcare Robotics

Automated Orthopaedic Recon Plate Bending Machine

A CNC-based machine that automates bending of orthopaedic plates for precise fit, making surgeries faster, easier for surgeons, and better for patient recovery.

Problem Addressed

Existing practice in orthopaedic surgery uses hand tools for manual bending, holding and contouring of reconstruction plates at the time of performing operative procedure on the patient.

The recon plate bending consumes operative procedure time, and the bending using hand tools is not perfect to match fracture bone profile specially in complex fractures such as Acetabular fractures.

About the Technology

This fully automated technology reduces operative time by pre-bending plates on a CNC platform, eliminating the need for manual bending during surgery.

- Pre-bent plates eliminate the surgeon's time and effort required to bend plates manually during surgery.
- Ensures higher accuracy of the plate profile.
- Reduces the skill required for plate bending.

Specifications

- Addressable Recon Plate Size: 80 - 150 mm
- Type of plates: SS304 and Titanium
- Number of axes: 4
- Machine footprint: 600 mm x 600 mm
- Machine weight: 100 kg
- Type: Table top
- Control: CNC based

Application Areas & Use Cases

- The growing orthopaedic implant market in India enhances surgical efficiency, allowing surgeons to treat more patients and meet rising healthcare demands.
- Local innovations in implants can reduce costs, improve accessibility, and support economic growth in the medical device sector.

PI Name: Prof. Sunil Jha

Institute: IIT Delhi

Technology Readiness Level (TRL): 7

Intellectual Property: Patent No. 495561

Healthcare Robotics

Hand-held Device for Bone Properties Assessment

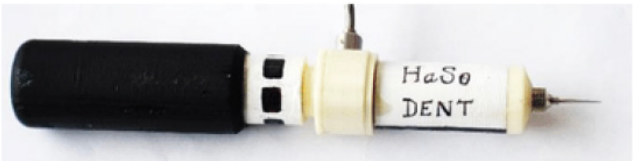
A portable, radiation-free device that measures bone strength and flexibility with a gentle tap, offering safe, on-site assessment for labs and clinics.

Problem Addressed

To design a hand-held portable medical device for in-vitro assessment of mechanical properties of bone. These mechanical properties of bone are very useful in medical applications as well as for research community. Current methods X-Ray, DEXA, CT, X-Ray scan are not precise and DEXA scans are expensive and time consuming and cause radiological exposure to body.

About the Technology

- An impact-trigger mechanism play relationship for load-displacement in minimally deformed bone material, and mathematical modeling for properties calculation used are like the indentation method for viscoelastic material as bone is.
- Conventionally there is no portable device available for measurement of mechanical properties of bone in- vitro, and other conditions.
- A hand-held lightweight portable indenter.
- Minimally invasive measurement device.
- Measurement areas below millimeter scale.
- Direct implementation to subjected areas.
- More accurate than DEXA bone quality score as direct measurements of mechanical properties.
- Less skilled professionals can operate easily.

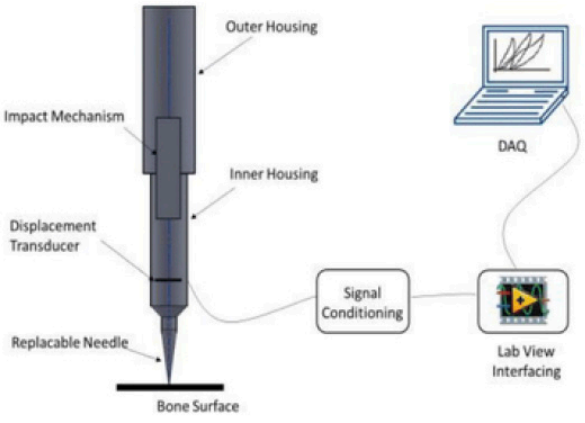


Specifications

- Material: Plastic
- Penetration depth: µm
- Accuracy: ~.1 N
- Parameters: Modulus, Hardness; MPa
- Sample area < 5mm
- Dimensions: D - 40mm, L- 1 50 mm
- Weight < 100 gm

Application Areas & Use Cases

- Measurements of Bone quality parameters; modulus, hardness, stiffness.
- Portable indenter instruments for in-vitro and other conditions.
- Helpful to less skilled personal usage.
- For Clinicians, Doctors, Orthopedicians, Engineers, Scientists and Researchers.



PI Name: Prof. Navin Kumar

Institute: IIT Ropar

Technology Readiness Level (TRL): 4

Intellectual Property: PA No.: 201911007207

Healthcare Robotics

Smart Robotic Nursing Assistant

A smart platform that trains robots to learn and safely perform everyday nursing tasks by watching humans—seamlessly working alongside staff in busy hospital settings.

Problem Addressed

Hospitals face increasing demands, particularly during pandemic-like crises, requiring innovative solutions to alleviate the burden on healthcare workers. Current systems lack the adaptability and efficiency needed to learn and execute diverse tasks dynamically. To address this, we developed a novel learning framework enabling mobile robot manipulators (robotic nursing assistants) to learn tasks from video demonstrations and execute them interactively.

About the Technology

- This technology creates and critically evaluates a general-purpose architecture for learning different routine tasks that can assist nurses in the hospitals.
- Represent the human (nurse) demonstrations in a scalable and alternate relational space, that will allow us to transfer the task to heterogeneous robots robustly.
- Exploit offline computation to achieve fast, robust and collision-free motion planning in a dynamically changing environment.
- Software that will allow us to learn, and transfer these skills across various robotic platforms, minimizing the platform-specific setup
- Robot is able to learn new task and execute them as per given input command.
- Integrated multi-modal input command system that accepts voice commands, gesture recognition, and touch screen based input.
- Autonomous navigation in dynamic environment (eg. obstacle avoidance).

Specifications

- Weight and Battery life: 30-35 kg, typically 2 hrs.
- Mobility System: Wheels for movement, Camera System: High-definition RGB cameras for visual monitoring and LiDAR for navigation and obstacle detection.
- Manipulation Capabilities: Single robotic arm (7-DoF) with 2-finger gripper.
- Navigation and Mobility: Indoor autonomous. navigation, anti-collision technology, and adjustable speed.
- Lift Capability by Robotic Arm: Maximum 5Kg.
- Communication and User Interface: Touchscreen displays for manual controls, Voice interaction via microphones and speakers.

Application Areas & Use Cases

- Application areas: hospitals and clinics, elderly care facilities, home-based care, rehabilitation centres, tele-medicine and remote monitoring, pandemic crisis such as COVID-19 and infection control.
- Use cases: patient monitoring and data collection, Medication Management, Emotional Support and Companionship, Assistance in Rehabilitation Therapy, emergency response with the mobile platform for tele-medicine consultations.

PI Name: Prof. Laxmidhar Behera

Institute: IIT Mandi

Technology Readiness Level (TRL): 4

Tele-dentistry Robotics System

A telepresence dentistry robot helps dentist examine and guide procedures remotely with lifelike precision—offering real-time, expert care even from afar

Problem Addressed

Stable teleoperation of 6 DoF robot with the help of a haptic device for the development of a tele-dentistry system

About the Technology

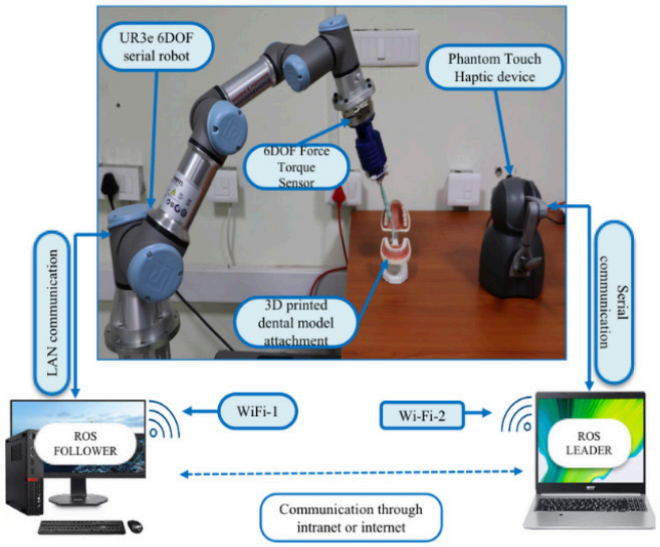
- The UR3e cobot, integrated with a Schunk Gamma F/T sensor, is teleoperated using a Touch Magic haptic device with the help of positon force bilateral controller.
- Successfully tested a stable experimental testbed for controlling a remote robot using a haptic interface over different network conditions
- Implemented Husernet communication protocol for teleoperation
- Time Delay Passivity Approach for stability of the setup
- Perceptual deaband approach for haptic data compression

Specifications

- Robot: UR3e
- Haptic Device: Geo-Magic Touch from 3D systems
- FIT Sensor: Schunk Gamma F/T Sensor
- Controller: Master-Slave Bilateral Controller, TDPA for stability
- Communication Protocol: Husernet

Application Areas & Use Cases

- Tele-dentistry system facilitates early diagnosis of dental diseases of remote patients.
  - To assess the hardness of teeth and severity of pain by tapping with the help of an attachment mounted on the robot.
  - To assess the softness of tissues/gum by pressing them with the help of an attachment mounted on the robot.
- The developed setup may be utilized for any teleoperation task where human presence is restricted.



PI Name: Dr. Amit Bhardwaj

Institute: IIT Jodhpur

Technology Readiness Level (TRL): 4

Healthcare Robotics

Calf Stimulation Foot Drop Exercise Device

A low-cost, portable calf stimulator that helps regain ankle movement with foot drop—making daily physiotherapy easier, consistent, and more accessible.

Problem Addressed

Foot drop is a neurological and muscular condition that affects the ability to lift the foot towards the individual's body and away from the ground causing difficulty while walking. This is often caused by muscular disorders, nerve injuries, or neurological condition's like stroke or multiple sclerosis. Physiotherapy for foot drop involves repetitive exercises with the help of a therapist that may not be affordable or consistently accessible for everyone. This project aims to provide a portable and cost-effective device that provides ankle movement to achieve recovery through repetitive motion and muscle activation.

About the Technology

- The device developed is an Arduino-based rehabilitation system. It consists of a DC gear motor controlled via a motor driver, push buttons, and an LCD interface.
- The system delivers dorsiflexion/plantarflexion to the foot using a linkage mechanism. This movement is helpful for retraining muscles and nerves.
- Multiple operating modes such as continuous, manual, and preset modes with adjustable parameters like speed, angle and cycles.
- Intuitive wired remote interface using buttons for easy parameter setting and the LCD screen displays current mode and settings selected.

Specification

- Arduino Uno (ATmega328P)
- 12V DC Gear Motor
- L298N Dual H-Bridge Driver
- 16x2 I2C LCD
- Push Buttons
- 3d printed PLA frame
- Wooden Base

Application Areas & Use Cases

- Rehabilitation centres for patients recovering from stroke or nerve injuries, or muscular disorders.
- Home-based physiotherapy for patients having mobility challenges, and rural and low-resource areas where access to full-time physiotherapists is limited.

PI Name: Dr. Ravi Kumar Mandava

Institute: IIIT Kurnool

Technology Readiness Level (TRL): 4

Healthcare Robotics

Brain Wave Controlled Wheelchair

A smart wheelchair that controls movement using brainwaves, touch, voice, or gestures-offering obstacle-free mobility, smart home control, and greater independence.

Problem Addressed

Mobility aids are essential, but most options are either basic or unaffordable. In India, only 10% of people have access to wheelchairs, and existing models lack flexibility. The proposed prototypes offers an affordable solution with multimodal controls (Brain control interface (BCD, touch, gesture, voice) and home automation integration. It provides customizable mobility, improving independence and quality of life for individuals with disabilities, while reducing reliance on caregivers.

About the Technology

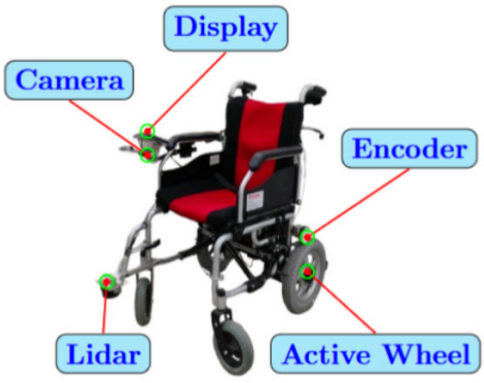
- The Brainwave-controlled wheelchair transforms a manual wheelchair into an autonomous system with AI-powered obstacle avoidance for smooth navigation.
- It offers customizable multimodal controls (BCI, touch, gesture, voice) to suit diverse user needs and integrates home automation for greater independence.
- This cost-effective smart wheelchair enhances accessibility and empowering users with improved mobility and autonomy.
- Autonomous navigation with advanced obstacle avoidance and safety features.
- Multimodal inputs: Brain-wave, touch, gesture, voice, and joystick, offering flexible control options.
- Affordable design: making the smart wheelchair accessible to a wider population.
- Integrates home automation, enabling control of household devices directly from the wheelchair.

Specifications

- Product Dimensions and Maximum Payload: 108 x 68 x 93 cm; 100 kg
- Speed, Battery and Power: 0.5 m/sec, Lead Acid battery. 20AH Battery, 2-4 km per Charge
- Control Interface: Brain-Signal interface, Touch, Voice and gesture control
- Sensors for Navigation: Depth Cameras for visual monitoring and LiDAR for autonomous navigation and obstacle avoidances
- Brain Control Interface Headset: Dry electrode based headset and wireless model
- Communication and User Interface: Touchscreen displays for manual controls, Voice interaction via microphones and speakers
- Home automation : 4-device control at a time

Application Areas & Use Cases

- Assists stroke patients, Motor Neuron Disease (MND) patients, and the elderly.
- Enhances mobility and independence with home automation.
- Supports navigation in crowded spaces.
- Enables control of household devices for convenience.



PI Name: Prof. Laxmidhar Behera

Institute: IIT Mandi

Technology Readiness Level (TRL): 4

Intellectual Property: PA No. 202311000340

Healthcare Robotics

Embodied AI for Vision-Language based Navigation

A simulation platform that trains AI agents to understand and perform hospital tasks using natural language in 3D and text-based environments- boosting their reasoning and real-world readiness.

Problem Addressed

This project focuses on developing complementary simulation environments tailored for training embodied agents to perform hospital-based tasks. The environments cater to two specific domains:

- Vision-Language Navigation (VLN): Agents learn to navigate a simulated 3D hospital setting using natural language instructions. Here we address the challenge of training agents in visually rich environments
- Text-Based Tasks: Agents interact with a text-based representation of a hospital to perform language-driven reasoning and task execution. This enables language-centric reasoning in purely text-based scenario (TextWorld).

About the Technology

- VLN using Unity : Unity3D provides a development platform for a visually immersive hospital simulation environment. The build of the environment is referenced to a hospital setup and then the simulation using an agent is developed on a vision-language navigation framework.
- Text-based tasks using Text World : TextWorld offers a framework for simulating text-based hospital tasks, focusing on the agent's ability to reason and act based on textual descriptions.
- Simulation Scope:
  - First-person waypoints based navigation in the simulation environment.
  - Environment consists of corridors, wards, ICUs, operating rooms, etc.
  - Dynamic elements : medical equipments (few).
  - Textual descriptions of hospital rooms and objects.
  - Commands issued as text (e.g., "Pick up the thermometer from the cabinet").
- Agent Training:
  - Input : RGB or RGB-D visual data and natural language instructions using medical vocabulary.
  - Output : Navigation actions (move forward, turn left) or textual responses in reasoning.

Specifications

Unity Development Platform for VLN:

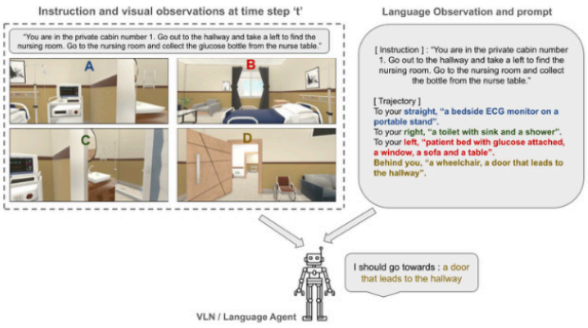
- Assets : high-quality 3D models of domain objects.
- Navigation Meshes Unity's built-in NavMesh for agent navigation.
- AI Frameworks : ML-Agents Toolkit for agent training, LLaVA models for VLM training.

TextWorld for Language- agents

- Similar to gym-like framework for development of text based games.
- Simulate observations in natural language descriptions and outputs actions in text.

Application Areas & Use Cases

- Healthcare Robotics: train robots to assist in navigation and reasoning in hospital environments
- AI Training for Assistive Systems: Develop intelligent systems for patient care and logistics.
- Cognitive Reasoning: Test language models for understanding and executing instructions.



PI Name: Prof. Pawan Goyal

Institute: IIT Kharagpur

Technology Readiness Level (TRL): 3-4

Smart Shopping Cart

A smart, self-driving shopping cart with a touch screen, theft protection, product suggestions, and detachable parts- designed to make shopping smoother, safer, and more convenient.

Problem Addressed

An automated system will allow users to shop conveniently without delays around billing counters and long queues. The system will allow users to check out anytime by paying the bill.

About the Technology

- Interactive GUI, hassle-free shopping experience, Anti-Shoplifting.
- Dynamically Movable Cart in real-time.
- Recommendations System enabled.
- Collision free.
- Detachable Units
- The prototype system provides an interactive GUI as a mobile application for the customer to keep track of the products in the cart. The application is real-time.
- The system automatically detects whether the product is added to the cart or removed using input from various sensors.
- The system generates an alarm if the user adds the product to the cart without scanning.

Specifications

- Barcode Scanner: To scan the product
- Jetson Nano: Computational Power
- Weight Sensor: To weigh the product
- LiDAR: Obstacle Avoidance
- Arduino Mega: Local Computation
- 3D Camera: Localization
- Mobile Platform: Move as per user

Application Areas & Use Cases

- Mobile SMART Shopping Carts in India enhance retail efficiency, reduce checkout times, and improve customer experience through advanced technology.

PI Name: Dr. Sachin Kansal

Institute: Thapar Institute of Engineering & Technology, Patiala

Technology Readiness Level (TRL): 4

Intellectual Property: PA No. 202311005807

BLDC Motors for UAVs

A cost-effective, 2kW BLDC motor made in India for UAVs, enabling reliable use in logistics, agriculture, industry, defense, and more-while reducing import reliance.

Problem Addressed

Dependence on Imported Morse Motors: Most UAV motors in India are imported, leading to high costs and supply chain vulnerabilities. This motor is entirely designed and developed in India, ensuring technological self-reliance and reducing dependency on foreign suppliers.

Unsuitability of Imported Motors for Indian Conditions: Imported motors often struggle to perform optimally in India's tropical climate. This indigenous motor is specifically designed to handle high temperatures, humidity, and diverse environmental conditions, ensuring reliable performance across the country.

Cost Inefficiency of Foreign Technologies: Imported motors are expensive, making UAV development costly. By leveraging a low-cost rectangular PM design, this indigenous motor provides an affordable yet high-performance alternative tailored for the Indian UAV market.

Lack of Locally Adapted UAV Technologies: This motor bridges the gap by offering a solution specifically engineered for Indian UAV applications, aligning with the "Make in India" initiative to promote local manufacturing and innovation.

About the Technology

- Improved Efficiency at High Speeds
- Low- Cost Rectangular PM based design
- Improved Cooling
- Designed & developed in India

Specification

- Motor Topology: Outrunner Surface Mount PM-BLDC
- Magnet Topology: Standard NdFeB Rectangular Magnets
- KV Rating: 115 KV
- Peak Output: 2 kW
- Peak Input: 2.5 kW
- DC Voltage: 48 V (12S)
- Peak Input Current: 53 A
- Peak Torque: 4.3 Nm
- Speed @ Peak Output: 4500 RPM
- Motor Efficiency: 80%@ Peak Load
- Operating Temperature: 34.1/ 26.2 deg. C on Winding/Casing

Application Areas & Use Cases

- Delivery drones for logistics
- Agricultural UAVs for crop monitoring
- Industrial inspection drones
- Defence surveillance UAVs

PI Name: Prof. Amit Kumar Jain

Institute: IIT Delhi

Technology Readiness Level (TRL): 4

Intellectual Property: PA No: 202411082084

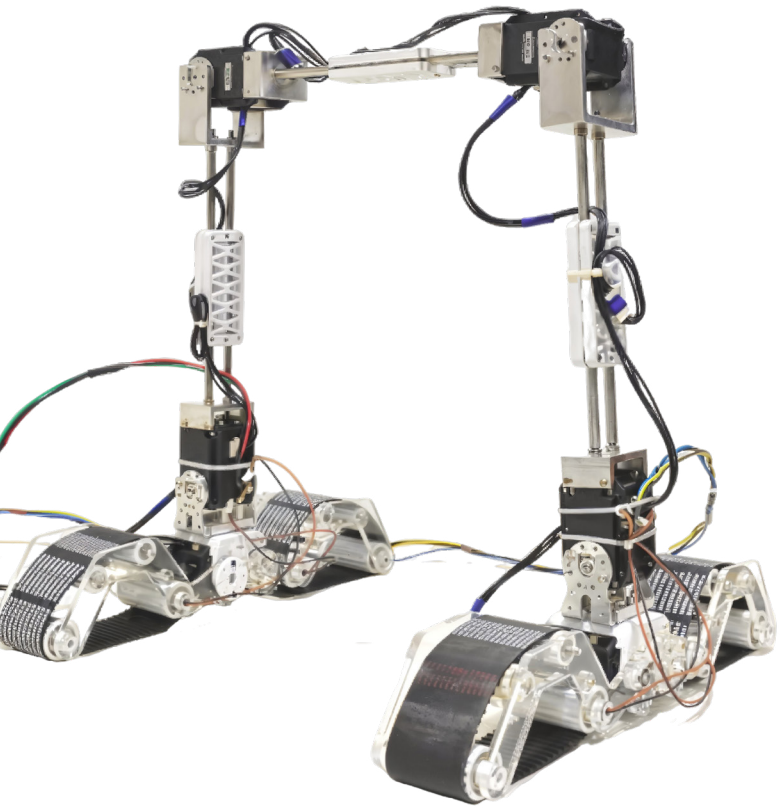
Hybrid Robotic System for Multimodal Locomotion and Grasping

A smart mobile robot with adaptive gripping that handles objects of various shapes, making it ideal for real-world industrial tasks like sorting, packing, and material handling.

Problem Addressed

Conventional mobile manipulators face limitations such as single-mode locomotion, high complexity, and limited versatility in grasping and manipulation.

These systems struggle in varied environments and require a highly structured setup, lacking interconnectedness between locomotion, manipulation, and grasping capabilities.



About the Technology

An innovative hybrid robotic platform that seamlessly integrates locomotion, manipulation capabilities, and shape-conforming grasping abilities into a single platform.

- Core Innovations:
  - Synergising Locomotion and Grasping Capabilities
  - Modular Design with a minimal number of components
- Operational Capabilities:
  - Wheeled, walking, brachiation, climbing locomotion modes.
  - Shape-conforming grasping with force control and in-hand manipulation.

Specifications

- System Architecture: Modular design with 4 degrees of freedom (4DoF) and dual grippers
- Actuation: Smart motors, onboard controllers
- Control Interface Interactive GUI interface
- Additional feature: Integrated vision sensing module

Application Areas & Use Cases

Primary Market: Research & Academic Institutions

- Advanced robotics research platform
- Testing of advanced control and planning strategies and hybrid systems

Other Potential Applications:

- Defence: Navigation in confined spaces
- Search & Rescue: Disaster zone operations
- Industrial: Pipe inspection and maintenance
- Manufacturing: Flexible automation

PI Name: Prof. Asokan T

Institute: IIT Madras

Technology Readiness Level (TRL): 4

Intellectual Property: PA No.: 432862

Inventory Inspection through AI Solution

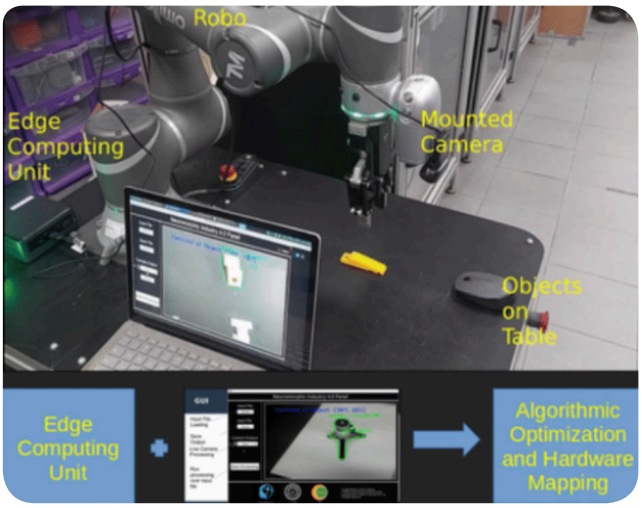
A smart AI-powered camera that instantly recognizes objects on the factory floor, processes data on the spot, and easily manage everything from its built-in screen—making complex workflows faster and more efficient.

Problem Addressed

On-the-Fly AI based tool for identification and interaction with complex shopfloor items and arbitrary objects of interest in real-time.

About the Technology

- Application specific vision sensor with Edge computing unit for processing directly on edge and easy to use GUI for Analytics and Data Management.
- Easy to use GUI SW developed
- Multiple input options (static, live, local/remote)
- Customized result export
- Live Analytics (centroid, dimensions etc.)
- Object Tagging and ID
- Hardware optimized, real-time, high FPS



Specifications

- Edge Computing Unit: CYRAN NPUv1
- Vision Sensor: Monocular based on Application GUI Software
- Multiple Sources
- Real Time Analytics
- Result Export
- Proprietary hardware optimized algorithm

Application Areas & Use Cases

- Dynamic Inventory Management: AI enables vision to recognize and retrieve various items on-the-fly, maintaining correct inventory levels and facilitating real-time stock checks.
- Robotic Arms in Warehouse Automation: Robotic arms equipped with the AI tool can identify and manipulate complex shopfloor objects, allowing for automated sorting, packing, and assembly processes. This reduces manual labor and increases efficiency.
- Historical Data Analysis: The system can analyze historical interaction data to optimize the performance of robotic arms and cobots, determining best practices for various tasks in a warehouse setting.

PI Name: Dr. Manan Suri

Institute: IIT Delhi

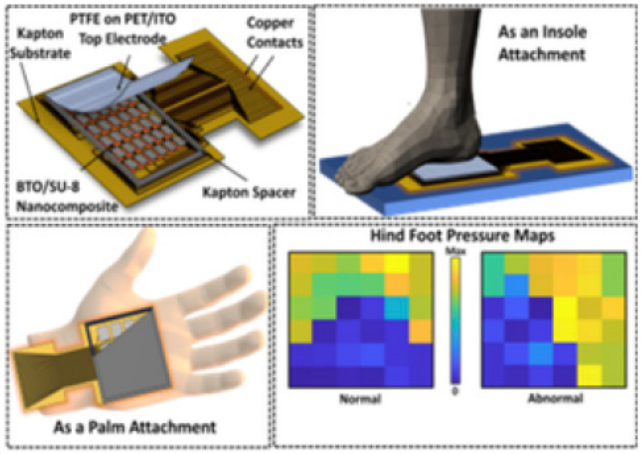
Technology Readiness Level (TRL): 4

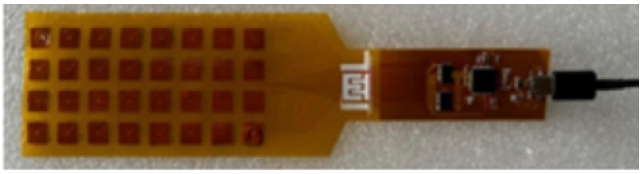
Self Powered Sensor System

A self-powered, flexible sensor that improves wearables and robots for applications like smart prosthetics, rehabilitation, gait analysis, touch-based control, gaming, and more.

Problem Addressed

Development of advanced haptic feedback sensors for strain, force, and palm sliding detection, integrated with energy harvesting solutions to enable self-powered operation. Traditional mechanical energy harvesters are often macro/meso-scale and rely on linear resonant systems, making them unsuitable for variable human motion conditions. This work focuses on designing miniaturized, wideband, nonlinear energy harvesters coupled with high-resolution piezoelectric/triboelectric sensors to enhance human-machine interaction and soft robotics applications.





About the Technology

A low-cost, pixelated, fully flexible, wearable, AI-enabled, high-efficiency pressure sensor based on novel dual transduction nanocomposites for human gait analysis, AI-enabled, high efficiency sensing for industry X.O. Technology highlights include:

- Self-powered
- Cost-effective
- Flexible and circuit miniaturization
- Hybrid - TENG + PENG

Specifications

- Sensing range: 5 - 170 kPa
- Sensitivity: 34 kPa.mV-1
- Hysteresis: 2.7 %
- Reliability: 3.2 % variation in 60 days
- Transduction: Piezoelectric/ Triboelectric
- Photopatternability: Yes
- No. of cells: 36
- Active Area: 20-25 cm^2
- Response Time: 14 msec

Application Areas & Use cases

- Sports and Healthcare: Measurement of grip strength and foot pressure

PI Name: Prof. Dhiman Mallick

Institute: IIT Delhi

Technology Readiness Level (TRL): 4

Photonic FMCW Radar Module

A smart light-based radar that tracks cars, drones, and more with 3D precision—delivering fast, accurate detection for safer navigation, surveillance, and defense.

Problem Addressed

- RF Front end for radar systems
  - Photonic generation of multi-band dual and cross LFM waveform
  - Photonic generation & filtering of tupled chirp waveforms up to a factor of four
- Photonic FMCW Radar receiver module
  - Range & Speed estimation of targets
  - 3D imaging using inverse synthetic aperture radar

About the Technology

- An optical filter-less photonic trans-receiver FMCW radar model that comprises an analog photonic link based on a dual-drive Mach Zehnder modulator (DDMZM) with direct detection at the receiver.
- The system is theoretically analyzed and experimentally tested for detecting targets at different distances ranging from 150 cm to 210 cm and for multiple targets (up to 4), showing a range resolution of < 15 cm
- Photonic generation
  - Dual & Cross chirp at 3 GHz, 9 GHz , 6 GHz and 18 GHz covering L, S, X and Ku bands
  - Multi-carrier up-chirped generation & filtering using SBS in S, C, X and Ku bands
- Photonic receiver
  - Multi-target detection range; error of < 5 cm & a range resolution of < 15 c
  - Velocity Estimation of toy car; error of < 0.25 m/s
  - Imaging of targets using ISAR technology

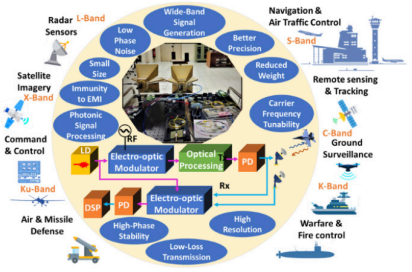
Specifications

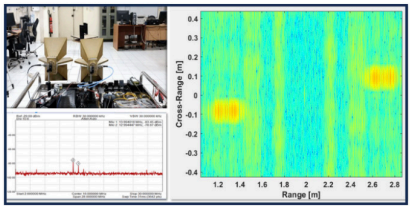
- LFM Frequency tupled to 4x:
  - LFM at 3, 6, 9,12 GHz
  - LFM at 4, 8, 12, 16 GHz
  - Bandwidth of 500 MHz and 1 GHz
- Photonic Up Chirp generation and filtering using SBS: 4 GHz, 8 GHz, 12 GHz, and 16 GHz
- Photonic receiver model: Optical filter-less model for multi-target detection
- Two-target Imaging: ISAR imaging

Application Areas & Use Cases

Photonic Front-end for high bandwidth Radar waveform generator in different frequency L, S, C, X and Ku bands

- Ground Surveillance, Sensing, and Drone Hunting, Photonic receiver model for multitarget detection, velocity estimation and imaging for Drone detection
- Tracking and Imaging drones





PI Name: Prof. Amol Choudhary

Institute: IIT Delhi

Technology Readiness Level (TRL): 4

Intellectual Property: PA No. 202211010851, 202411039577

Magnetic Sensors for Proximity Detection

A dual-sensor technology combining high-performance thermal sensors and ultra-sensitive magnetic field detectors—giving precise, flexible sensing for everything from navigation to advanced electronics.

Problem Addressed

Current magnetic sensing technologies often lack the precision, adaptability, and integration capabilities required for advanced applications like robotics and healthcare. There's a growing need for compact, durable, and high-sensitivity sensors that can function in diverse environments and on flexible surfaces.

About the Technology

This innovation includes two major sensor types:

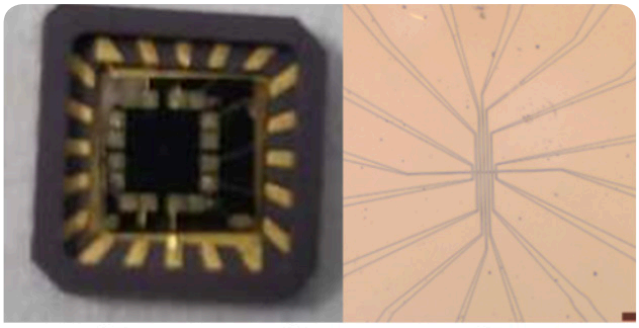
- Hard Sensors based on III-V semiconductors, offering high electron mobility and thermal stability.
- Flexible Magnetic Field Sensors, which detect magnetic fields in the millitesla range and are responsive to geomagnetic signals (~50μT).
- High electron mobility and robust performance in hard sensors.
- Flexible magnetic sensors that are lightweight and suitable for wearable or deformable integration.
- Precise magnetic field detection capabilities.
- Developed by Quantum Materials and Devices Lab, IIT Delhi.

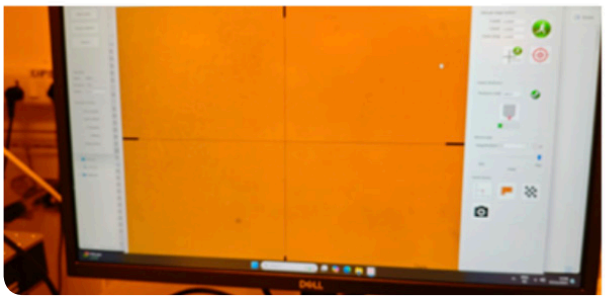
Specifications

- Sensor sensitivity: ~50 microtesla (μT).
- Operation range: Millitesla.
- Material base: III-V semiconductors, Py (20 nm), and gold (Au) contacts.

Application Areas & Use Cases

- Industrial robotics and collaborative robots (cobots).
- Augmented reality systems.
- Wearable health monitoring devices.
- Soft robotic systems and medical devices require precise field sensing.





PI Name: Prof. Pintu Das

Institute: IIT Delhi

Technology Readiness Level (TRL): 3-4

FMCW Radar Transmitter

A low-noise radar transmitter that sends signals at 6, 12, and 24 GHz simultaneously-giving rare, flexible control for high-precision radar performance.

Problem Addressed

- Simultaneous linear Chirp Generation at three center frequencies (6GHz, 12GHz and 24GHz).
- Getting the linear chirp at these frequencies is always challenging.
- Phase noise is better than state of art.
- No such wide-tuning-range VCO is available in the market to enable this level of flexibility.
- This project addresses these gaps through the indigenous.
- Development of a low-phase-noise FMCW radar transmitter with multiple center-frequency options and a wide, programmable chirp rate.

About the Technology

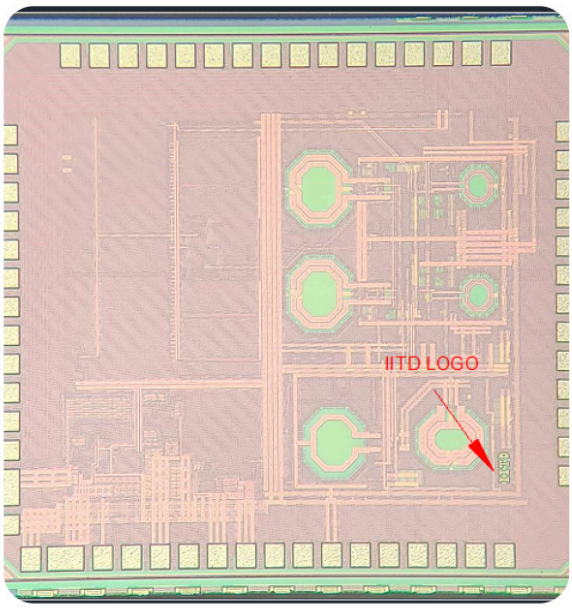
- Indigenous development of FMCW RADAR Transmitter with wide chirp rate
- Low Phase Noise
- Support Multiple Center Frequency
- Programmable chirp rate
- Wide Chirp rate in the market

Specifications

- Technology Node: 65nm LP
- Power Supply: 2.5V/1.5V/1.2V
- Center Frequency: 6,12 and 24 GHz
- Chirp Rate: 500MHz/10us
- Ref Freq: 19.53125 KHz
- Power: 250mW
- Phase Noise referred to 6GHz: -70dBc/Hz @10KHz offset

Application Areas & Use Cases

Altimetry for aircraft landing, speed guns, runway debris monitor, avalanche detection etc



PI Name: Prof. Rakesh Kumar Palani

Institute: IIT Delhi

Technology Readiness Level (TRL): 4

Intellectual Property: PA No. 202511000804

Nanorobotics Drug Delivery System

Magnetically guided nanorobots that deliver drugs precisely for cancer treatment and nerve repair, while also enabling fast pathogen detection through a Lab-on-Chip system.

Problem Addressed

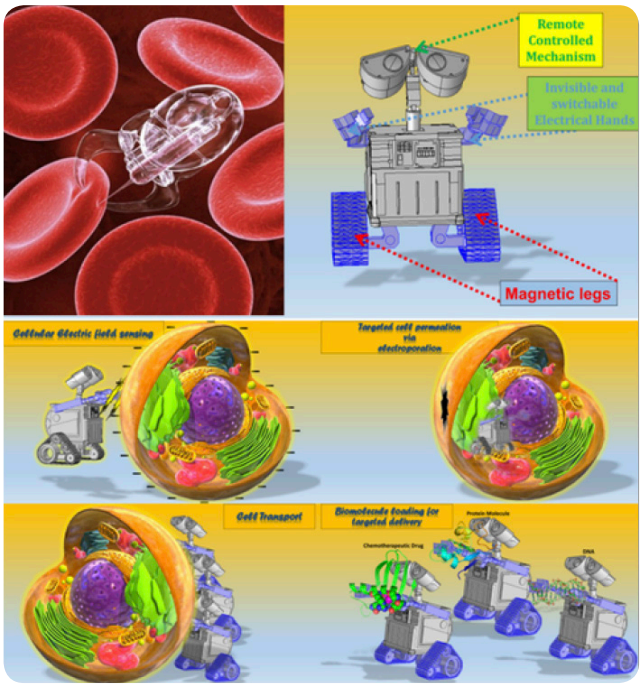
- Developed a remotely controlled targeted treatment method of cancer using magnetoelectric nanorobots without harmful side-effects.
- Developed Lab-On-A-Chip platform for swift pathogen detection.

About the Technology

- Remotely controlled targeted treatment of cancer using magnetoelectric nanorobots.
- Propelling and guiding the nanorobots to targeted cells while dynamically avoiding untargeted cells via electrostatic repulsion.
- Cell-specific targeted permeation by opening nanopore on the phospholipid bilayer membrane of a single targeted cell using the localized electric field generated by the nanorobots, a process known as electroporation.
- Dynamically attaching nanorobots to the cell membrane of targeted cells via electrostatic bonding and transporting these cells to desired locations in a microvascular environment with microscale accuracy.
- Dynamic sensing of minute electric field differences and membrane properties while moving trajectory among different cell types (both healthy and cancerous cells).

Application Areas & Use Cases

- Remotely controlled targeted cell permeation by Nanorobots provides phenomenal advancement in targeted drug delivery, safe cell electroporation. Based on type of targeted cell, pores can be electrostatically opened for permeation of cell type.
- Most importantly, the remotely guided localized treatment of cancer by nanorobots in microvascular environment avoids harmful side effects of the existing chemotherapy treatment method.
- Avoiding untargeted cell toxicity and localized drug exposure in Oncotherapy.
- Remotely controlled targeted cell transport by Nanorobots to microfluidic and precise Lab-on-a-chip platform with tunable lab adjustments to detect pathogens in microvascular environments with immunological reagents and Pathogen–Specific Antibodies, which is exceptionally important for actual clinical use.



PI Name: Prof. Soutik Betal

Institute: IIT Delhi

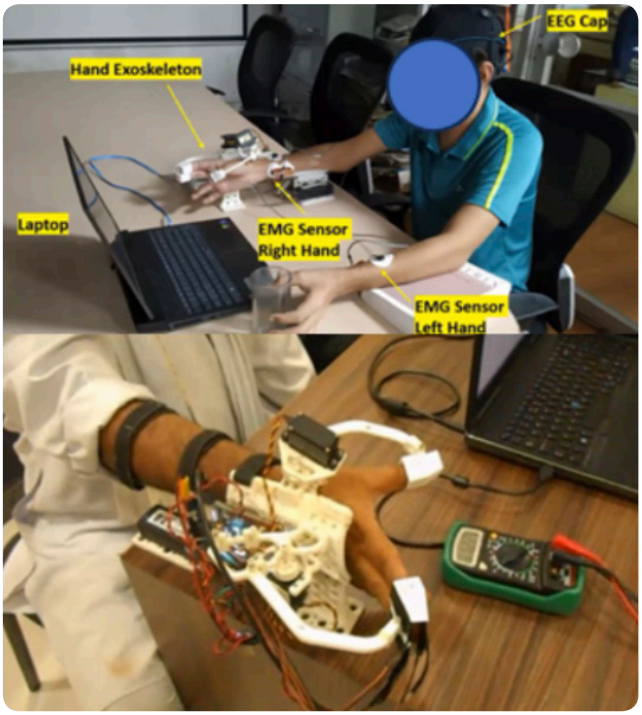
Technology Readiness Level (TRL): 4

BCI Based Hand and Arm Exoskeletons

A lightweight, brain-controlled exoskeleton for hand and arm rehabilitation that detects movement intent—helping to recover strength and independence with less therapist support.

Problem Addressed

Stroke is a leading cause of disability worldwide, with rising cases in India due to increased life expectancy. It often impairs motor functions, affecting quality of life. A BCI-controlled robotic hand and arm exoskeleton can aid post-stroke rehabilitation by combining mental imagery (MI) with physical practice (PP). This integration stimulates brain plasticity and enhances motor recovery. The BCI detects the patient's intent and activates the exoskeleton, reducing the need for constant physiotherapist supervision and encouraging functional independence.



About the Technology

A lightweight, modular hand and arm exoskeleton has been developed for stroke rehabilitation, integrated with a computer interface that combines EEG, EMG, and IMU signals for precise control. Pilot trials have been successfully conducted, and clinical approval has been obtained from Apollo Hospitals.

- Integrated BCI System
- Modular & Lightweight Design
- Clinically Validated
- Reduced Therapist Dependency

Specifications

- EEG Integration: Yes (non-invasive cap-based EEG)
- EMG Sensor Placement: Both hands (for muscle activity monitoring)
- IMU: For motion tracking and calibration
- Exoskeleton Type: Hand and arm, modular and robotic
- System Interface: Laptop-based control with real-time feedback
- Clinical Validation: Completed with approval from Apollo Hospitals

Application Areas & Use Cases

- Stroke Rehabilitation
- Motor Function Recovery in Neurological Disorders

PI Name: Prof. Ashish Dutta

Institute: IIT Kanpur

Technology Readiness Level (TRL): 5-6

Soft Exo-Suit for Arm

A soft, wearable suit that assists arm movement, helping users regain mobility for daily tasks and rehabilitation through elbow, wrist, and shoulder support.

Problem Addressed

Development of a soft exo-suit for the arm that facilitates movement with specific degrees of freedom (DOF) in elbow and wrist joints, enhancing mobility and functionality.

About the Technology

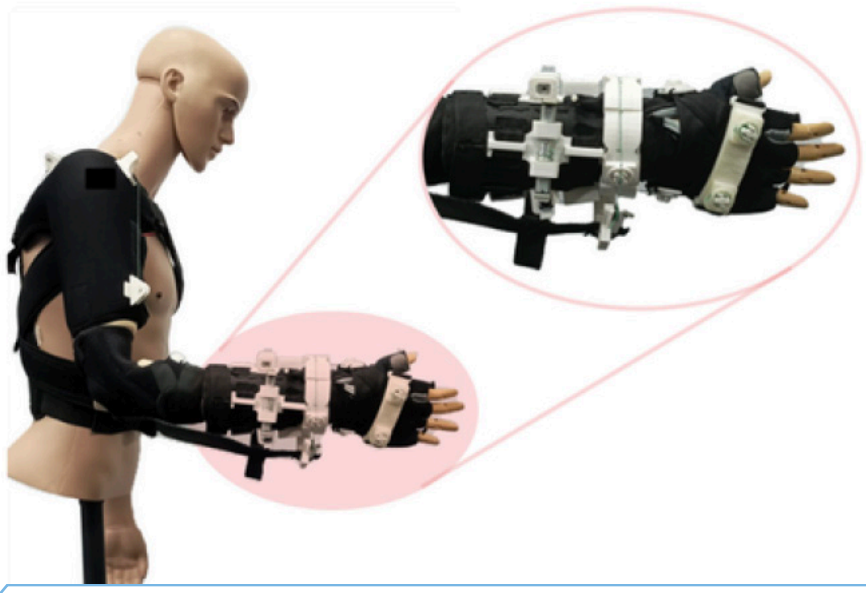
- The technology involves a soft exo-suit designed to support arm movement
- Incorporating three degrees of freedom (3 DOF) that include elbow flexion/extension and wrist flexion/extension as well as adduction/abduction
- Degrees of Freedom: Involves 3 DOF for comprehensive arm movement.
- Joint Controls: Incorporates control of all joints to operate within a designated range of motion.

Specifications

- Cable Actuated Exosuit: Nylon Braided cable
- 4 DOF Wearable Robot: Fabric: Nylon
- Motor Torque - 0.5 N-m: Weight: 2.5 KG
- No. of Actuators - 6: Weight w/o Motors: 0.4 Kg
- Gravity assisted joint - 1: Anchor Points: ABS/PLA
- controller: NI - sbRio: Motor Type: DC Geared
- Feedback: NI Encoder: Biosignal: EMG

Application Areas & Use Cases

- The exo-suit can potentially be used in rehabilitation, and assistive devices
- Enhancing the functional capabilities of individuals requiring support in elbow and wrist movements



PI Name: Dr. Deep Seth

Institute: Mahindra University

Technology Readiness Level (TRL): 4

Rehabilitation Robotics

Human Intent Driven Control for Assistive Devices

A smart, muscle-sensing wearable that adapts in real time to movement needs—offering natural, flexible support for easier rehabilitation and mobility.

Problem Addressed

The project addresses the lack of impedance regulation in current collaborative robots and assistive devices. While Cobots can follow human-guided motion, they struggle with safe force modulation during physical interaction. Existing exoskeletons often use bulky or inefficient actuators. High-pressure PAMs are unsuitable for mobile, wearable applications. Additionally, most systems fail to detect and interpret both motion and impedance intent from the user.

About the Technology

The technology combines human intent detection with adaptive actuation systems. It uses EMG, motion, and force sensors to interpret both motion and impedance intent. Variable Impedance actuators and soft pneumatic muscles mimic human-like compliance. A soft elastomeric exoskeleton with embedded variable stiffness is developed for rehabilitation. Real-time machine learning models drive the control for responsive physical assistance. Technology highlights include:

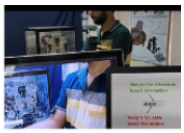
- Dual-mode intent recognition: Simultaneous identification of user's motion and impedance intent using EMG and sensor fusion.
- Biomimetic actuation: Use of variable Impedance actuators and soft pneumatic muscles to replicate human muscle behavior.
- Low-pressure soft exoskeleton: A hyperelastic silicone-based wearable with embedded variable stiffness for adaptive rehabilitation.

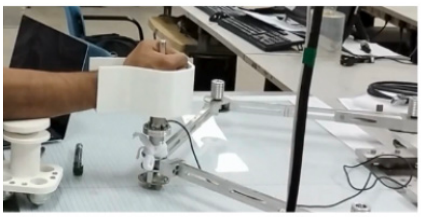
Specifications

- Actuators: Variable Impedance actuators (motor-based and soft pneumatic muscle actuators)
- Sensors: EMG sensors and Multi-axes Force/Torque sensors
- Controllers: Motion and Impedance Controllers using ML-based software
- Soft Materials: Hyperelastic silicone (Polysiloxane) for soft, safe actuation
- Prototyping Tools: 3D Printer and Precision Moulds for actuator fabrication

Application Areas & Use Cases

- Rehabilitation: Assists stroke patients and the elderly with mobility and muscle therapy.
- Industrial Support: Enhances worker performance in load handling and precision tasks like assembly or drilling.
- Defence: Provides wearable support systems to reduce fatigue and improve mobility for soldiers.





PI Name: Dr. Soumen Sen

Institute: CSIR CMERI Durgapur

Technology Readiness Level (TRL): 4

Motor Imagery Brain Computer Interface

A brain-controlled neuroprosthesis system that combines motor imagery with action observation to boost neural activity helping speed up recovery and improve movement control in neurorehabilitation.

Problem Addressed

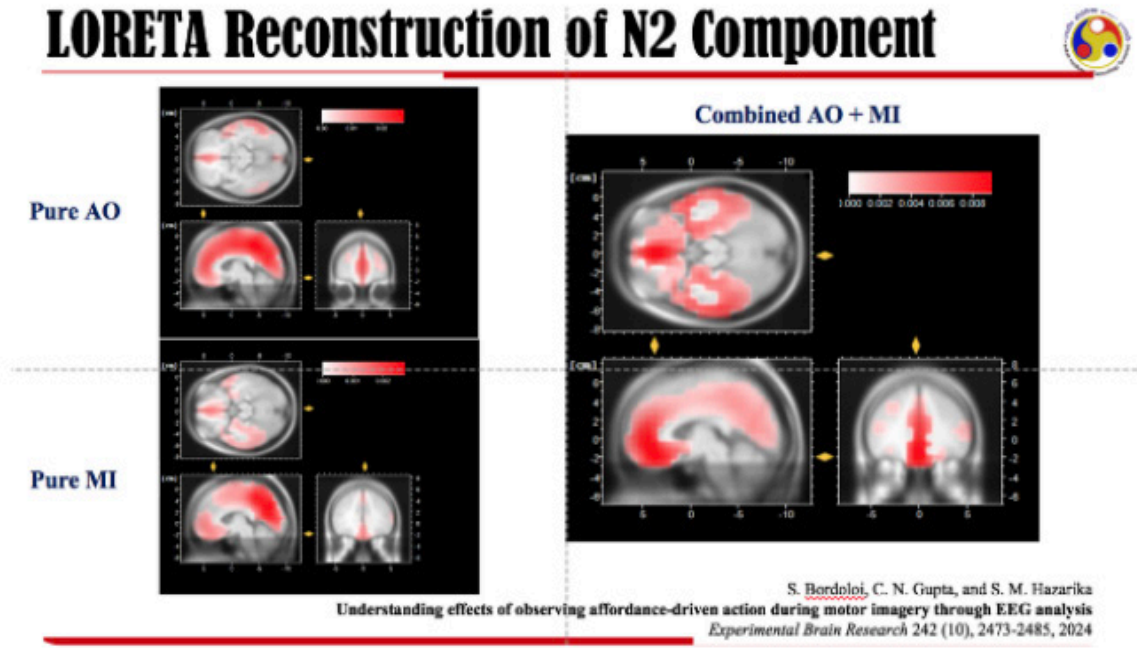
The project worked towards developing Algorithms for Cognitively Enhanced Neuroprostheses / Hand Exoskeleton for Adaptive Neurorehabilitation.

About the Technology

- Exploit Neural Correlates of EEG- MI during AO in Affordance-based actions for neurorehabilitation paradigms.
- Neural Correlates of EEG- MI during AO in Affordance-based Actions.
- Affordance driven motor priming during AO+MI indicates stronger electrophysiological and behavioural changes.

Application Areas & Use Cases

The more vigorous neural activity observed during combined AO+MI suggests that affordance-driven actions hold promise for neurorehabilitation.



PI Name: Dr. Shyamanta M Hazarika

Institute: IIT Guwahti

Technology Readiness Level (TRL): 4

Rehabilitation Robotics

Cable Driven Ankle Foot Orthosis

A lightweight, soft ankle exosuit that helps walk more easily with foot drop—using cable-driven support to improve mobility and strengthen muscles.

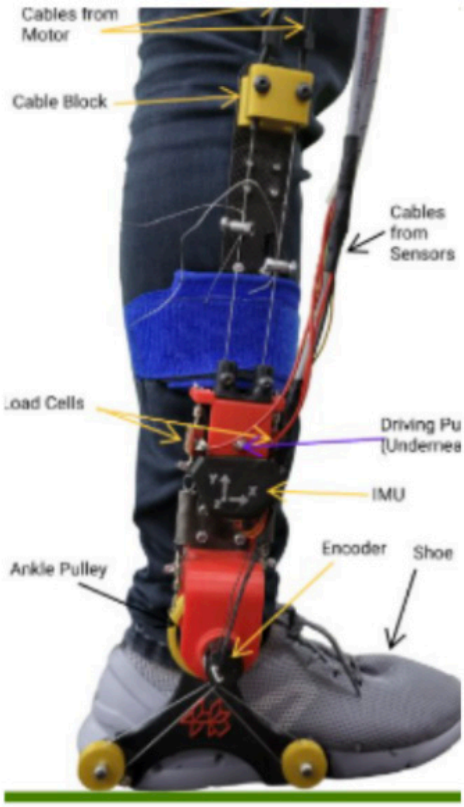
Problem Addressed

Foot drop is a condition that makes it hard to lift the front of your foot, causing you to drag your toes and increasing the risk of tripping and falling. It's often caused by nerve or muscle problems. It's also a symptom of various neurological conditions like stroke, multiple sclerosis, or muscular dystrophy, which affect the brain, spinal cord, or muscles themselves.

About the Technology

It is a soft exosuit that uses cable-actuated systems to assist ankle movement. It is an alternative to rigid powered ankle-foot orthoses.

The assistive ankle-foot orthosis offers several key technological features. It provides active physical therapy through muscle stimulation and natural movement encouragement utilizing a cable-driven mechanism for precise ankle joint control. The device boasts a compact, lightweight design for daily use and adaptability, along with remote monitoring capabilities for patient progress and therapy compliance.



Application Areas & Use Cases

- Rehabilitation
- Mobility Assistance
- Sports & Fitness
- Military & Industrial applications

PI Name: Prof. Vineet Vashista

Institute: IIT Gandhinagar

Technology Readiness Level (TRL): 4

Wearable Soft Robotics Myo-Processor

A soft, wearable robotic shoulder support that reads muscle or brain signals to assist movement-making easier, reducing fatigue, and helping prevent injury.

Problem Addressed

The project tackles the challenge of preventing musculoskeletal disorders (MSDs), especially shoulder instability during overhead tasks, by developing wearable robotic systems that estimate joint torque using biological signals like EEG and EMG.

About the Technology

This wearable soft robotic myo-processor estimates joint torque through EMG/EEG signals. It combines a tunable bistable actuator with soft exosuit components and custom algorithms to assist shoulder movement and reduce fatigue or injury risk.

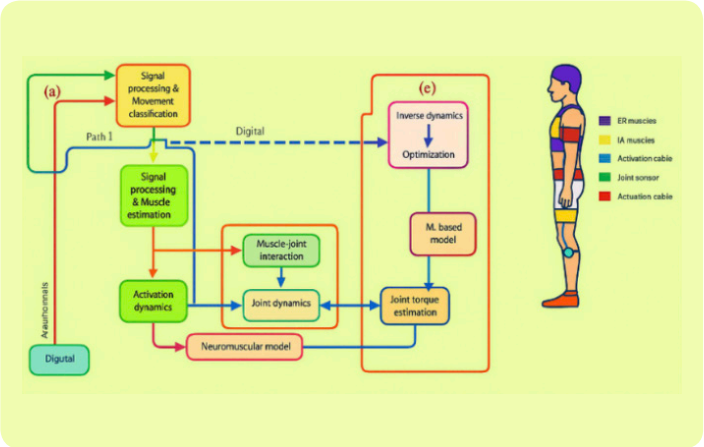
- Tunable bistable actuator for posture holding
- Fishing line polymer—based twisted and coiled actuator (TCA)
- Soft exosuit design for wearability
- EEG/EMG-driven torque estimation algorithm
- Active/passive assistive modes
- High weight-to-power ratio actuator

Specifications

- Actuator Material: Fishing line polymer (TCA); silver-coated nylon (under review)
- Inputs: EEG, EMG, MOCAP
- Form: Soft wearable sensor suit
- Status: Prototypes and simulations in progress

Application Areas & Use Cases

- Rehabilitation robotics for shoulder recovery
- Support devices for industrial workers
- Assistive wearables for people with mobility issues
- Prosthetics control
- Sports injury prevention



PI Name: Prof. Sitikantha Roy

Institute: IIT Delhi

Technology Readiness Level (TRL): 3-4

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