

CSIR-CENTRAL ELECTRONICS ENGINEERING RESEARCH INSTITUTE, PILANI

Brief Detail of Present Projects

S.No.	Area	Project/ Work Package/ Activity Name/ Number	Brief Description of Projects
1.	CPS	Special Manpower Development Programme for Chip-to-System Design. (GAP- 3412)	The project's current activity at CSIR-CEERI aims to design, develop, and implement a system-on-chip (SoC) based on models of open source IP cores and fabricate it through multi-project wafer facility under academic / research prototyping scheme. The platform will be further developed based on the fabricated SoC and demonstrated for the application of secured speech transmission and reception.
2.	CPS	Development of 10kW, 3-phase converter with unity power factor for industrial applications. (CLP- 6120)	This project aims to develop a three phase AC-DC converter with power factor correction (PFC) and low DC output voltage. The project would involve developing proper modulation technique and control algorithms for the two stages of AC-DC converter so as to maintain power factor within the limits prescribed in IEEE-519 as well as maintain output voltage within a desired range depending upon application.
3.	CPS	Development of Cyber Physical System Based Smart Water Grid For Community Usage.	The entire project has been divided into two basic parts: Part-1 deals with the modelling of water acquisition to water-purification stage and Part-2 deals with the management aspects including elements like well-condition assessment and warning, motor-monitoring and control, pipeline monitoring, corrosion detection / prediction, leakage detection and location-identification along with corresponding actuation of appropriate valves for help prevent wastage of water due to leakage, water flow re-routing and water-quality.
4.	CPS	Nano-Biosensors and Microfluidics for Health Care: Gallium Nitride HEMTs based biosensor (HCP- 0012/ WP:1.6)	This work package aims to develop Gallium Nitride high electron mobility transistor based biosensor and circuit. This biosensor will test breast cancer related biomarkers.
5.	CPS	Nano-Biosensors and Microfluidics for Health Care: Point of care device for Prediabetes and diabetes detection. (HCP-0012/ WP:6.2)	This work package aims to develop a handheld potentiometric system for Carbon Nanotubes (CNTs) based Devices. Developed system will be used for pre-diabetes detection.
6.	CPS	Nano-Biosensors and Microfluidics for Health Care: Label free, affordable and easy-to- use point of care system for detection of Dengue virus infections in patient sample. (HCP- 0012/ WP: 1.2 and 1.3)	In this project we will make a platform device for detecting various diseases starting with a case study of Dengue virus, three different approaches will be targeted based on the sensitivity and selectivity effectiveness we will grade our platform as first, second and third. The approaches are a. Dielectric based b. Fluorescence based c. SERS based
7.	CPS	Intelligent Systems: Intelligent Technologies and Solutions - Interstitial Lung Diseases: Deep Learning of Texture Based Analysis for Quantification (HCP- 0013/ WP: 4.4)	In interstitial lung disease, it is important to distinguish fibrotic from inflammatory changes. This is best done through open lung biopsy but that carries risks, and so noninvasive tests like High Resolution Computed Tomography (HRCT) are preferred. Since the textures of lung parenchyma on HRCT varies with fibrosis vs inflammation, it is reasonable to expect that automated detection and scoring will lead to indices that can help with classification and therapeutic decision making. This is a good task for machine learning.

			Since lung textures are different for people living in adverse environmental conditions such as Indian cities, the training sets must be local. The plan is to investigate correlation between texture based quantification parameters with pulmonary function test parameters and encode the model using deep learning as well as follow up the patients for 2 years and correlate it in a linear manner to see response; learn temporal pattern for predictive analysis.
8.	CPS	Intelligent Systems: Intelligent Technologies and Solutions - Human Action Recognition System for Industrial Activity Monitoring (HCP- 0013/ WP: 1.2)	Many faults/accidents in industries happen during operation due to inattentive / careless behavior of the workers at site of operation. Traditional video surveillance systems is not sufficient in ensuring safety in machine operation zone through manual monitoring of activities and it requires automated recognition of human actions at industrial sites. It is, therefore, proposed to develop human action recognition system for industrial activity monitoring using deep learning techniques. To detect anomalous behavior of employees in their day-to-day activities at machine operation site, AI based algorithms will be developed for detection and flagging of anomalies in video streams.
9.	CPS	Intelligent Systems: Intelligent Technologies and Solutions - AI based Healthcare Systems (HCP- 0013/ WP: 4.3)	In the healthcare sphere, continuous health monitoring of individuals is vital to understand the changes in various health parameters and also for disease diagnosis and prognosis. Unobtrusive and continuous well being, health and disease monitoring in home settings using wearable devices and multimodal anomaly detection using 360 degree cameras are envisaged. Optimized signal processing and advance machine learning techniques can be applied on the collected physiological signals for continuous and unobtrusive health and disease monitoring. Abnormalities in the vital parameters can be effectively detected to provide early warning systems which can in turn be relayed to certified medical professionals.
10.	CPS	Intelligent Systems: Intelligent Technologies and Solutions - AI based Compute Cure for Cancer (HCP- 0013 WP: 4.2)	In compute cure for cancer, it is proposed to design an open source tool for the design and development of a Drug Discovery platform to handle Big Data (Cancer Specific Molecular, Literature, Clinical, Proteomic data from publicly available FDA, NIH, NCI etc resources) automatically in a High Performance computing environment for the design of novel anti-cancer drugs utilizing machine learning and artificial intelligent systems. The proposed compute cure for cancer platform require high performance computing system to handle such large scale multi-dimensional data and efficient algorithms using deep-learning and machine learning architecture.
11.	CPS	Intelligent Systems: Intelligent Technologies and Solutions - Human Fatigue and Drowsiness Detection Applicable to Drivers and Industrial Workers (HCP- 0013/ WP: 1.1)	It is proposed to develop intelligent hardware and software solution for human fatigue and drowsiness detection for drivers and industrial workers by using ECG/PPG sensors attached at various locations (seat/backrest/steering wheel etc.) to continuously monitor physiological parameters non-intrusively. Customized hardware and electronic systems for obtaining accurate ECG/PPG signals non-invasively will be developed. These systems will be combined with smart camera systems (Visible/IR) for acquiring both behavioural measures (distraction, head movements, eye lid closure, yawning etc.) and physiological measures (using videoplethysmography). Advanced signal/image processing algorithms combined with machine learning techniques optimized for Indian drivers and workers will be developed to detect drowsiness and fatigue. Accuracy of contact, non-contact based and combined systems will be first validated in

			the lab environment and subsequently tested in the real world conditions. In future, the proposed systems combined with predictive analytics can be used to design early warning systems for improved driver and worker safety.
12.	CPS	Intelligent Systems: Intelligent Technologies and Solutions - Development of Communication Tower Monitoring and Power Line Monitoring application using drones. (HCP- 0013/ WP: 2.2)	Here it is also proposed to develop a Standard Operating Procedure for deployment of Commercial Off The Shelf (COTS) drones for doing Cellular Tower Inspection and Power Line Monitoring using various sensor payloads available in industry. The data analysis shall be conducted with COTS software available. The scope of the present project shall include usage of COTS systems and during the course of execution, indigenous components for further development will be identified.
13.	CPS	Intelligent Systems: Intelligent Technologies and Solutions - Interface Development of MAV/Drone Control Based Upon Cognitive Load Estimation Using BCI Methods (HCP- 0013/ WP: 2.1)	Cognitive Load or attention have a high impact on the performance of safety-related or defence related tasks. Using BCI technology, brain signals can be analyzed to infer information about the cognitive states of the user. This information can be fed to a system to improve its performance, in a way which is non-voluntarily driven by the user. Using this information certain commands can be triggered, while controlling an UAV or Quadcopter/MAV, depending on the cognitive state of the users, without them intentionally triggering the actions and thereby allowing the system to adapt to the users.
14.	CPS	Intelligent Systems: Intelligent Technologies and Solutions - Development of Artificial Intelligence (AI) controlled Linear Displacement Actuator (LDA) based on thermo-responsive smart materials (SMAs/SMPs) ‘SMAILDAS’ (HCP-0013/ WP: 1.7)	It involves the development of Linear bi-directional displacement actuator with self-sensing positioning dully controlled by AI based position estimation and feedback. Moreover, AI/ANN model suitable for SMA, considering variation of electrical resistance (ER) to specify the relative position of the actuator and Electronic controller system for actuator device (PID-PWM/Fuzzy-PWM/Fuzzy tuned PID-PWM) for various engineering applications will be implemented for the SMA actuator.
15.	CPS	HCP- 0013 (WP: 4.1) Intelligent Systems: Intelligent Technologies and Solutions - OncoMechanics: Software & Diagnostic Tool for Cancer-related Predictions and Drug Target Screening. (HCP-0013/ WP:4.1)	A new integrated computational tool/software, OncoMechanics, for predicting the chances of occurrences of cancer in an individual patient, detecting the cancer grades, identifying the suitable and potential drug targets, and the chances of appearing of drug resistant relapsed cancer cells etc. is proposed to be developed in this project. Development of the efficient algorithms for query processing technique and semantic analysis to extract sensible information from the huge volume of raw and unstructured data.
16.	CPS	HCP- 0013 (WP: 5.1) Intelligent Systems: Intelligent Technologies and Solutions - Development of Technologies for Connected Vehicular Security and its Application to Healthcare as a Proof-of-concept. (HCP-0013/ WP:5.1)	Development of deep learning framework for Intrusion Detection System (IDS), which alerts the vehicle operator or person sitting in a vehicle about the security breach. The IDS assist the vehicle operator and makes the reliable decision support system. This process involves the online and offline learning. The online learning will takes place at edge level (vehicle dashboard) and the offline learning will happen at the Cloud level.
17.	CPS	Intelligent Systems: Intelligent Technologies and Solutions – Intelligent Biometric Authentication System: “Financial Transaction and Access control” as use-case. (HCP-0013/ WP:5.2)	The objectives of this project is to provide intelligent security solutions for authentication with the aim of achieving secure financial transaction, access control and tracking. Development of multi-modal biometric based solution for secured financial transactions and access control.

18.	CPS	Intelligent Systems: Intelligent Technologies and Solutions - AI engine Design and Setup. (HCP-0013/ WP:6.2)	The objective is to establish a scalable AI engine for heavy computational application like deep learning. The facility provides cloud based AI engine for different activities under the CSIR mission program on intelligent systems.
19.	CPS	Information Access from Document Images of Indian languages . (GAP-3413)	Development of a recognition engine for low resolution images that results in robust and efficient recognition and retrieval from Indian language document images.
20.	CPS	Intelligent Systems: Intelligent Technologies and Solutions - Intelligent Data Analytic algorithms for Air Quality Monitoring. (HCP-0013/ WP:1.6)	The rampant rise in the level of air pollution has been one of the most glaring problems plaguing people worldwide. The main objective of the proposed project is to forecast heatmaps of major air pollutants and updating current Air Quality Index Visual Map using uMap/Google map services on web and App.
21.	CPS	Intelligent Systems: Intelligent Technologies and Solutions - Smart “TPMS” for Intelligent Vehicle. (HCP-0013/ WP:1.5)	The project involves development of “TPMS” for tyre temperature, pressure and burst prediction system development. The execution will require candidates with knowledge on analog circuit design, idea on data converter and filter, PCB design issues understanding, CAN bus knowledge and microcontroller programming.
22.	CPS	Nano-Biosensors and Microfluidics for Health Care: Carbon Nanotubes (CNTs) based Devices for Invasive Prediabetic Detection. (HCP-0012/WP:6.1)	This work package aims to develop a handheld potentiometric system for Carbon Nanotubes (CNTs) based Devices. Developed system will be used for pre-diabetes detection.
23.	CPS	Indoor Environmental Quality (IEQ) Monitoring and Control System Based on Wireless Sensor-Actuator Network for Smart Indoor Environments GAP- 6219	This proposal seeks to develop an integrated Wireless Sensor–Actuator Network (WSAN) based real-time indoor environmental quality monitoring and control that incorporates the sensory input of the users’. The main objectives are: (i) To develop an Indoor Environmental Quality (IEQ) monitoring system. (ii) To develop sensor array and signal processing for indoor environmental quality monitoring system.
24.	SS	Nano-Biosensors and Microfluidics for Health Care: Design and Development of platform devices (CNTFETs). (HCP-0012/WP: 1.5)	The project aims to design and development of technology to fabricate the carbon nanotubes (CNTs) based field effect transistors for biosensors applications.
25.	SS	Nano-Biosensors and Microfluidics for Health Care: Design and development of photonic crystal (PhC)-based platform. (HCP-0012/ WP:1.7)	Design and development of photonic crystal based nano-structured sensor platform for early diagnosis of disease with a case study of lung cancer detection. Smartphone-integrated sensor module for point-of-care application will also be developed.
26.	SS	Nano-Biosensors and Microfluidics for Health Care: Si Wire FET. (HCP-0012/ WP:1.4)	This work package aims to develop Si wire FET platform for chemical/ bio-chemical sensing applications. The targeted use case is towards disease diagnostics.
27.	SS	Nano-Biosensors and Microfluidics for Health Care: Point of care device for Prediabetes and diabetes detection. (HCP-0012/ WP:6.2)	This work package aims to develop MEMS gas sensor platform for acetone sensing in breath. MEMS based gas sensor will be fabricated and interfaced with suitable electronics.
28.	SS	Nano-Biosensors and Microfluidics for Health Care: Typhoid detection (Optical platform development) (HCP-0012/ WP:2)	The project involves development of optical platform development. The execution will require candidates with knowledge on analog circuit design, idea on data converter and filter, PCB design issues understanding and LED working.

29.	SS	High resolution air quality monitoring and air pollutant data analytics. (GAP-3235)	This project aims to develop air pollution sensing nodes. For which in-house gas sensors will also be developed. These gas sensors are mainly metal oxide sensors targeting various VOCs. Sensors will be integrated with Read –out Electronics which need to be developed in- house.
30.	SS	Nano-Biosensors and Microfluidics for Health Care: Microfluidic or lateral flow Devices (HCP- 0012/ WP: 1.1)	Development of point of care microfluidic based platform for Electrochemical detection of different Biomolecule with use case of typhoid.
31.	SS	Nano-Biosensors and Microfluidics for Health Care: Carbon Nanotubes (CNTs) based Devices for Invasive Prediabetic Detection. (HCP-0012/WP:6.1)	Low-temperature-cofired ceramics (LTCC) and Thick-film alumina technology shall be utilized for packaging of nano biosensors under this activity. LTCC/ thick-film alumina based design strategy and layout for packaging of device shall be developed, different materials and their compatibility with device shall be explored, compatible packaging techniques shall be evolved and fabrication process shall be carried out for prototype development
32.	SS	Reactive ion etching (RIE) for InGaN/GaN Laser structure on GaN and Sapphire substrate. (GAP- 3236)	Reactive ion etching (RIE) of laser structure will be performed on the laser samples on Sapphire/GaN substrate provided by SSPL using chlorine based chemistry. The etch depths should be optimized with different mask thicknesses and scheme (metal, photoresist, dielectric or their combination). After optimizing the etching parameters , RIE on InGaN/GaN lasers for facets formation will be done.
33.	MWD	High current density (>500 A/cm ²) sheet-beam plasma cathode electron gun for sub-mm microwave source. (GAP- 3323)	The main aim of this project is to design and develop sheet-electron-beam plasma cathode electron gun and its design parameter optimization to produce high current density and energetic electron beams suitable for sub-mm wave generation