Department of Computer Science & Application

Atal Bihari Vajpayee University, Bilaspur (C.G.)
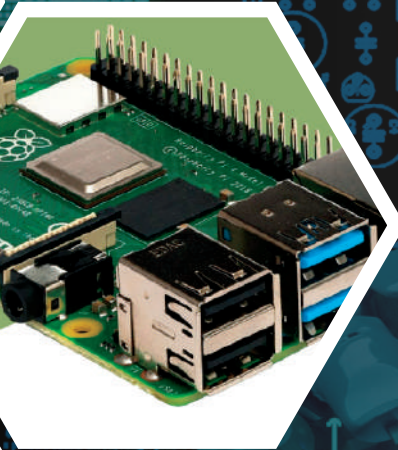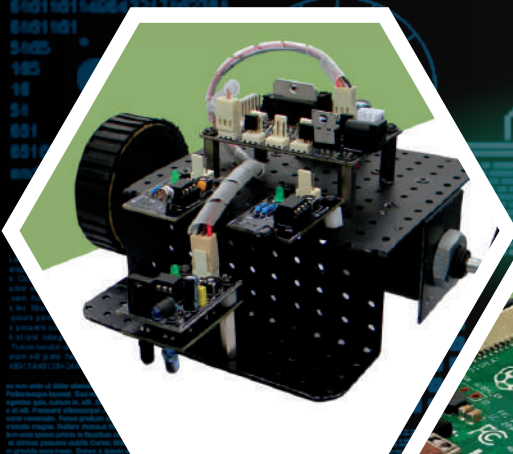
BOOKLET

of

Centre of Excellence (CoE)

for

Artificial Intelligence - Machine Learning and Internet of Things

(AI-ML and IoT)

Established :- June, 2023

उमेश पटेल

मंत्री

छत्तीसगढ़ शासन
उच्च शिक्षा, कौशल विकास,
तकनीकी शिक्षा एवं रोजगार,
विज्ञान और प्रौद्योगिकी,
खेल एवं युवा कल्याण विभाग

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कार्यालय: 70004-77747

क्रमांक ....0641/MINISTER/CG/KHS/GOVT/2023   दिनांक ....15/06/2023.........

Message

I am delighted to know the establishment of the Centre of Excellence (CoE) for Artificial Intelligence, Machine Learning, and Internet of Things (AI-ML and IoT) in the department of Computer Science and Application of Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh. This remarkable initiative aims to create a hub for cutting-edge research and innovation in various domains, including IoT, Smart Agriculture, Smart Health, Robotics, Machine Learning, and Smart building technologies.
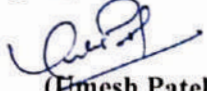
I am happy to know that the Centre of Excellence has been equipped with state-of-the-art facilities, High power computer (HPC) and sophisticated equipments to facilitate advanced research and experimentation in the aforementioned thrust areas. Researchers, teachers and students will have access to these resources to conduct their pioneering research and explore the vast potential of these emerging technologies. Our vision is to foster an environment of collaboration and excellence, where the brightest minds can come together to push the boundaries of knowledge and innovation. Furthermore, I came to know that this Centre of Excellence is the first and only facility of its kind in the state of Chhattisgarh. This distinction brings great responsibility and opportunities for us to become pioneers in the field, setting new benchmarks for research and development in emerging technologies.

I hope that this Centre of Excellence will not only provide an opportunity to the teachers, researchers and students of Atal Bihari Vajpayee University to enhance their knowledge and skills in advanced technologies but also will open door for the students of higher education of the state for research and learning.

I extend my heartfelt gratitude to the Vice Chancellor, Registrar and Dr. H.S. Hota, Head of the department, Computer Science and Application who have worked tirelessly to establish this Centre of Excellence. Your dedication and enthusiasm will undoubtedly pave the way for groundbreaking discoveries and technological advancements. I congratulate you all to take this unique initiative for the benefits of teachers, researchers and students of the state to learn emerging technologies with world class facilities available at Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh. Let us embark on this journey together, united in our commitment to pushing the boundaries of knowledge, innovation, and technological advancements.

Thank you.

Warm regards,

(Umesh Patel)

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कुलपति

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No. 3463/VC Sec./2023   Bilaspur, Date: 20 June, 2023

Message

I am extremely happy to know about establishment of the Centre of Excellence for Artificial Intelligence (AI), Machine Learning (ML), and Internet of Things (IoT) by the Department of Computer Science and Application. This momentous achievement reflects our department's commitment to advancing research and innovation in the field of emerging technologies. I extend my heartfelt congratulations to the entire team of the Computer Science and Application Department for their dedication and hard work in making this vision a reality. The Centre of Excellence for AI-ML and IoT will serve as a hub for advanced research in various domains of emerging technologies. It will provide a world-class facility for our faculty members, researchers, and students to collaborate, explore, and push the boundaries of knowledge in these transformative areas.

I am confident that the Centre of Excellence will not only strengthen our department's research capabilities but also foster collaborations with industry partners and other academic institutions. Through these partnerships, we can leverage external funding from various agencies of the Government of India to support innovative projects and further enhance the Centre's impact.

I urge the faculty members and researchers to utilize this opportunity to propose groundbreaking projects and secure research grants. Let us harness the power of AI, ML, and IoT to address complex challenges and contribute to the advancement of knowledge and the betterment of society.

I reiterate my best wishes to the Department of Computer Science and Application as it embarks on this exciting journey with the Centre of Excellence for AI-ML and IoT. Together, let us make significant strides in research, innovation, and academic excellence, positioning our institution at the forefront of technological advancements.

(A.D.N. Bajpai)

'गढ़बो नवा विश्वविद्यालय'

Message

I am happy to know about establishment of the Centre of Excellence on Artificial Intelligence, Machine Learning, and Internet of Things (AI-ML and IoT) at our esteemed university. This initiative marks a significant milestone in our pursuit of academic excellence and technological advancements.

The Centre of Excellence has been specifically designed to provide exceptional facilities and resources to our researchers, students, and teachers, enabling them to conduct their research projects on emerging technologies within our university premises. With the availability of advanced equipment and high-performance computers, this Centre of Excellence will set our department apart and position us as pioneers in the field within our state.

One of the most significant advantages of having the Centre of Excellence within our university is the convenience it provides to our researchers, students, and teachers. They no longer need to seek external resources or go outside our campus to conduct their research projects. The availability of advanced equipment and state-of-the-art infrastructure within our university premises ensures a seamless and productive research experience.

Moreover, the Centre of Excellence will foster collaboration and interdisciplinary research among our faculty members, researchers, and students. By bringing together diverse perspectives and expertise, we can collectively address complex problems and generate impactful outcomes. We encourage everyone to actively participate in this collaborative ecosystem and leverage the unique opportunities presented by the Centre of Excellence.

I would like to express my gratitude to Dr. H.S. Hota, Head Department of Computer Science and Application who have worked tirelessly to establish this Centre of Excellence. His unwavering commitment and efforts have made this vision a reality.

Wishing you all great success in your research endeavors.

Best regards,

Shri Shailendra Dubey

Registrar, Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh

Message

I am happy to share with you all, about establishment of the Centre of Excellence (CoE) for AI-ML and IoT in the Department of Computer Science and Applications. This milestone achievement is the culmination of our efforts to create a hub for learning and research in emerging technologies.

Artificial Intelligence (AI) is a dynamic branch of computer science, enabling us to develop systems that mimic human intelligence. Machine Learning (ML), a subset of AI, focuses on algorithms and statistical models that enable computers to learn and make predictions without being explicitly programmed. On the other hand IoT applications can be found in various domains, including smart homes, healthcare, transportation, agriculture, manufacturing, and more.The data collected by IoT devices can be analyzed to gain insights, improve decision-making, and enable intelligent automation. Overall, IoT has the potential to revolutionize industries and enhance our daily lives by creating interconnected systems that improve efficiency, convenience, and sustainability.These fields hold immense potential and are at the forefront of technological advancements.

The Centre of Excellence has been established with the aim of providing a platform for students, teachers, and researchers to explore and engage in various areas related to robotics, the fundamentals of AI, smart agriculture, smart buildings, and more. By fostering an environment conducive to innovation and research, we strive to empower our community to contribute meaningfully to these rapidly evolving fields.

I would like to express my deepest gratitude to the Honorable Vice-Chancellor and the Registrar of the university for their invaluable support and assistance in making this dream a reality. Their unwavering commitment to promoting excellence in education and research has paved the way for the establishment of this Centre of Excellence.

With its state-of-the-art facilities, dedicated faculty, and a vibrant community of enthusiastic learners, we envision the Centre of Excellence becoming a vital resource for researchers, students, and teachers alike. It is our firm belief that this initiative will enhance the learning experience and foster groundbreaking research in the fields of AI-ML and IoT.

We invite all interested individuals to take advantage of the opportunities offered by the Centre of Excellence. Whether you seek to explore the intricacies of AI, delve into the depths of machine learning, or harness the potential of the Internet of Things, our Centre is here to support and guide you in your journey.

We are excited about the future prospects and the positive impact that the Centre of Excellence for AI-ML and IoT will have on our department and the broader academic community. Together, let us embrace this opportunity to unlock new frontiers of knowledge and shape the future of technology.

Thank you once again for your continued support, and we look forward to the remarkable discoveries and advancements that will emerge from the Centre of Excellence.

Warm regards,

Dr. H.S. Hota

Professor and Head, Department of Computer Science and Application

About Department

The Department of Computer Science was established in the year 2013 with the vision to become a center of excellence in computer education and research. The department took its first major step towards achieving this vision by launching its undergraduate program in the year 2013. Since then, it has grown significantly, offering a wide range of programs to cater to the evolving needs of the computer science field. Currently, the department offers undergraduate (UG) and postgraduate (PG) programs, including Master of Computer Applications (MCA) and Master of Technology (M.Tech.) in Computer Science. These programs are approved by the All India Council for Technical Education (AICTE), ensuring high-quality education and adherence to industry standards.

One of the key strengths of the department is its dedicated and well-qualified faculty members. The department takes pride in its team of experienced professors and industry experts who are passionate about teaching and research. These teachers bring a wealth of knowledge and practical experience to the classroom, ensuring that students receive a holistic education that combines theory with real-world applications.

The department boasts state-of-the-art infrastructure, including four programming labs equipped with more than 200, latest I7 computers and interactive panels. These labs provide students with a conducive environment for hands-on learning and practical implementation of concepts. Additionally, the department has a smart classroom facility that enhances the learning experience through modern teaching aids and technologies. The department is committed to fostering a culture of continuous learning and knowledge exchange. To achieve this, it organizes various workshops, seminars, and expert lecture series on a regular basis. These events bring together industry experts, researchers, and students to share insights, discuss emerging trends, and explore the latest advancements in the field of computer science.

In line with its commitment to staying at the forefront of technological advancements, the department has established a Centre of Excellence for Artificial Intelligence (AI), Machine Learning (ML), and Internet of Things (IoT). This center will provide world-class facilities to teachers, researchers, and students for conducting cutting-edge research in these emerging areas. It will serve as a hub for innovation, collaboration, and knowledge creation, further elevating the department's stature in the field of computer science.

Mission

Our mission is to cultivate a dynamic and innovative environment that fosters excellence in computer science education and research, with a strong focus on real-world applications. We aim to equip our students with the necessary knowledge, skills, and mindset to thrive in the rapidly evolving field of computer science and make meaningful contributions to society.

Through our commitment to excellence, innovation, and ethical practices, we aim to shape the future of computer science education, research, and application. We strive to produce well-rounded computer science professionals who are equipped to tackle complex challenges, drive technological advancements, and make a positive impact on society.

1. Quality education
2. Research and Innovation
3. Industry partnerships
4. Ethical and Social responsibilities
5. Lifelong learning

Centre of Excellence on AI-ML and IoT

A Centre of Excellence (CoE) for AI-ML and IoT is a specialized hub dedicated to advancing research, innovation, and knowledge in the fields of Artificial Intelligence (AI), Machine Learning (ML), and Internet of Things (IoT). It focuses on harnessing the potential of these emerging technologies and promoting their applications across various domains. Here are some key aspects of a Centre of Excellence for AI-ML and IoT:

RESEARCH AND DEVELOPMENT

The CoE conducts research in AI, ML, and IoT, exploring novel algorithms, methodologies, and applications. It aims to stay at the forefront of advancements in these fields, contributing to the development of new techniques, models, and frameworks.

The CoE may collaborate with industry partners, academia, and government organizations to undertake research projects of strategic importance.

INNOVATION AND TECHNOLOGY TRANSFER

The CoE acts as a hub for innovation, fostering the development of new ideas, prototypes, and proof-of-concepts. It promotes technology transfer by bridging the gap between academic research and real-world applications.

The CoE may engage in commercialization activities, supporting the transition of research outcomes into practical products, services, or startups.

SKILL DEVELOPMENT AND TRAINING

A CoE for AI-ML and IoT offers training programs, workshops, and courses to develop the skills and expertise of researchers, students, professionals, and practitioners. It aims to equip individuals with the knowledge and tools required to leverage AI, ML, and IoT effectively.

The CoE may provide hands-on training in programming, data analytics, algorithm development, and IoT infrastructure.

COLLABORATION AND PARTNERSHIPS

Collaboration is a key aspect of a CoE. It fosters partnerships with industry leaders, research institutions, and other stakeholders to promote knowledge exchange, joint research projects, and shared resources. Collaborations may involve co-development of technology, data sharing, access to specialized infrastructure, and collaborative funding opportunities.

INDUSTRY ENGAGEMENT AND CONSULTANCY

The CoE engages with industry partners to understand their challenges, identify opportunities for AI-ML and IoT applications, and provide consultancy services. It offers expert advice, feasibility studies, and recommendations for implementing AI-ML and IoT solutions in diverse industries.

The CoE may also facilitate technology adoption, pilot projects, and industry-academia collaboration.

POLICY ADVOCACY AND STANDARDS DEVELOPMENT

As a leading authority in AI-ML and IoT, the CoE may contribute to policy discussions, regulatory frameworks, and standardization efforts. It can provide insights, expertise, and nd recommendations to government bodies and industry associations in shaping policies a related to privacy, ethics, security, and responsible AI deployment.

OUTREACH AND AWARENESS

The CoE organizes events, seminars, conferences, and public lectures to raise awareness about the potential of AI-ML and IoT. It may engage with the wider community through outreach programs, knowledge sharing initiatives, and public-private partnerships. The CoE aims to educate and inspire individuals, organizations, and policymakers about the benefits and implications of AI-ML and IoT.

Details of Equipment

Sr. No	Name of Equipment	Quantity
1	High Performance Server	
2	Educational Robot with five axis moving arm	
3	AI+IoT Builder Workstation	
4	Ardunio compatible interface module	
5	IoT Smart Health Kit	
6	IoT Builder Kit with accessories (GSM IoT Gateway and Wireless Sensor Node)	
7	IoT enabled system for green house	
8	Basic Robo Car	
9	Raspberry Pi	
10	IoT Smart Building	
11	EEG Device	
12	Sensor Lab (with 10 Nos. Sensor)	
13	AIoT SerBot (Robote)	

High Performance Server

The Dell PowerEdge R750 is a full-featured enterprise server, that delivers outstanding performance for the most demanding workloads. Powered by the 3rd Generation Intel® Xeon® Scalable processors is a rack server to address application performance and acceleration. The PowerEdge R750 is a dual-socket/2U rack server that delivers outstanding performance for the most demanding workloads. It supports 8 channels of memory per CPU, and up to 32 DDR4 DIMMs @ 3200 MT/s speeds. In addition, to address substantial throughput improvements the PowerEdge R750 supports PCIe Gen 4 and up to 24 NVMe drives with improved air-cooling features and optional Direct Liquid Cooling to support increasing power and thermal requirements. This makes the PowerEdge R750 an ideal server for data center standardization on a wide range of workloads including; Database and Analytics, High-performance computing (HPC), Traditional corporate IT, Virtual Desktop Infrastructure, and AI/ML environments that require performance, extensive storage, and GPU support.

Major Configuration:

- 02 INTEL XEON GOLD 5320 2.2G, 26C/52T, 11.2GT/S, 39M CACHE, TURBO, HT (185W) DDR4-2933
- 8 64GB RDIMM, 3200MT/S, DUAL RANK, 16GB
- 3 1.92TB SSD SATA READ-INTENSIVE 6GBPS 512 2.5IN HOT-PLUG AG DRIVE, 1 DWPD
- 1 NVIDIA AMPERE A40, PCIE, 300W, 48GB PASSIVE, DOUBLE WIDE, FULL HEIGHT GPU
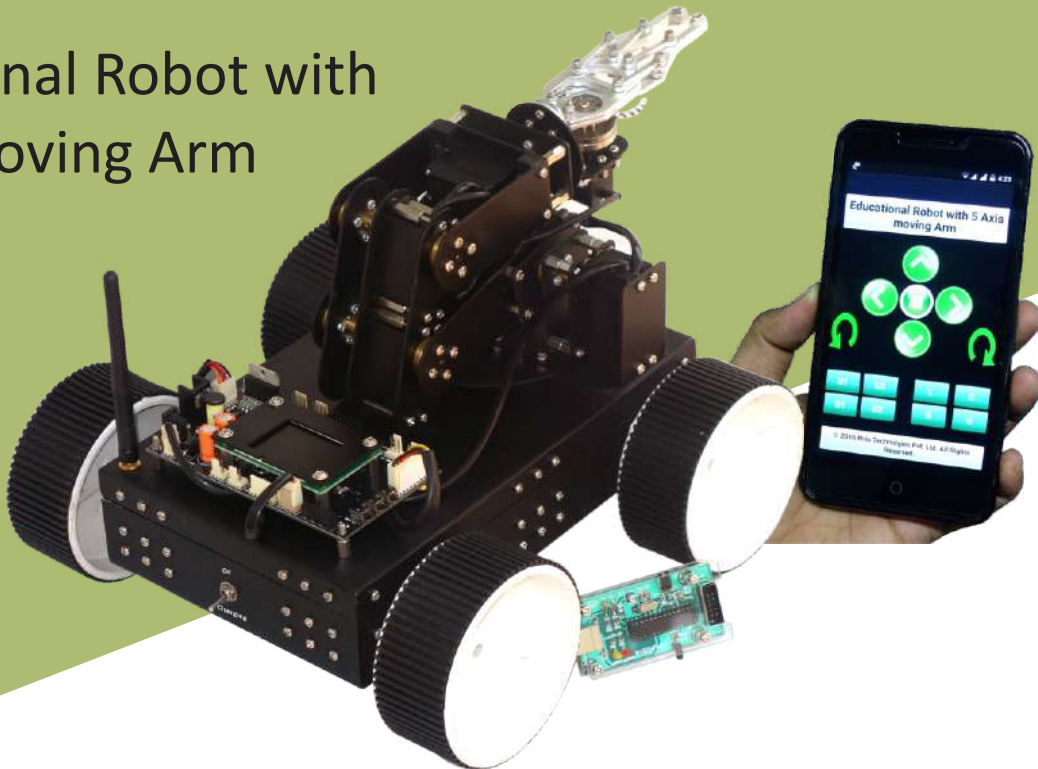
Features

- Built-in telemetry streaming, thermal management, and RESTful API with Redfish offer streamlined visibility and control for better server management
- Intelligent automation lets you enable cooperation between human actions and system capabilities for added productivity
- Integrated change management capabilities for update planning and seamless, zero-touch configuration and implementation
- Full-stack management integration with Microsoft, VMware, ServiceNow, Ansible and many other tools
- Operate your workloads on a secure platform anchored by cryptographically trusted booting and silicon root of trust
- Maintain server firmware safety with digitally signed firmware packages.
- Prevent unauthorized configuration or firmware change with system lockdown
- Securely and quickly wipe all data from storage media, including hard drives, SSDs and system memory with System Erase

Scope of Learning:

- Artificial Intelligence
- Deep Learning
- Data Analytics
- High-Performance Computing
- Computer vision
- Machine Learning
- And many other high Computing tasks.

Educational Robot with 5 Axis moving Arm

Educational Robot with 5 Axis Moving Arm an educational robotic arm based on ATmega 128 which provides knowledge about basic mechanical design concepts and also deals with very fascinating features like Servo motor interfacing and controlling, wireless control, graphical TFT interfacing etc. This Moving Arm driven by the RC servo motors consists of 5 degree of freedom (DOF) which can be represented by the rotating base, shoulder, elbow, wrist and the gripper. DC motors at its base makes it a moving robotic arm

Features   and

- Moving Robotic Arm
- Wireless Wi-Fi control
- 160x128 TFT Color LCD interface
- DC motor interface & control
- Servo motor interface
- Switch interface
- Expansion connectors for more experiments
- Onboard battery charger
- PC based programming
- Gripper for pick and place
- Online Product Tutorial

Scope of Learning

- interface RC servo motor with ATmega128 microcontroller
- concept of RF communication
- interface LCD with ATmega128 microcontroller
- interface DC motor with ATmega128 microcontroller
- concept of Pick and Place Robot
- interface color sensor and study of application like color detection and sorting
- Gaining knowledge about Robotics and ATmega128 microcontroller
- Wi-Fi Module Interface

Main board

Compact AVR USB Programer

AI+IoT Builder WorkStation

Sensors

| Temperature & Humidity | Carbon dioxide | Oxygen | PM2.5 & PM10 |

Interfaces

| Bluetooth | WiFi | Ethernet | USB |

The field of Artificial Intelligence (AI) has witnessed tremendous growth in recent years with the advent of Deep Neural Networks (DNNs) that surpass humans in a variety of cognitive tasks. The algorithmic superiority of DNNs comes at extremely high computation and memory costs that pose significant challenges to the hardware platforms executing them.

AI+IoT Builder WorkStation is a powerful system that lets users to run multiple neural networks in parallel for applications like image classification, object detection, segmentation, and speech processing with real time sensor interface. It covers the basic theory of AI to algorithms using TensorFlow for machine learning and deep learning. In addition experience high-performance services such as object and character recognition through learning, face recognition and edge detection through image processing. AI+IoT Builder is also supported by NVIDIA JetPack™, which includes a board support package (BSP), Linux OS, NVIDIA CUDA®, cuDNN, and TensorRT™ software libraries for deep learning, computer vision, GPU computing, multimedia processing, and much more.

Features and Scope of Lerning

- Explore the theory and algorithm development of IoT, Machine learning, Deep learning, and NLP.

- Explore TensorFlow and Keras for high performance numerical computation.

- Work on real time image processing applications using computer vision.

- Real time sensors interface for Machine Learning provided.

- Explore C, C++. R and Python programming.

- AI voice assistance and chatbot using NLP available.

- Build applications for :
  - Natural language processing.
  - Internet of things.
  - Preventive maintenance.
  - Cyber security .
  - Agriculture and food industry.
  - Remote healthcare monitoring.
  - Environment monitoring and forecast.
  - Warehouse and logistics.
  - Retail analysis.
  - Intelligent traffic management.
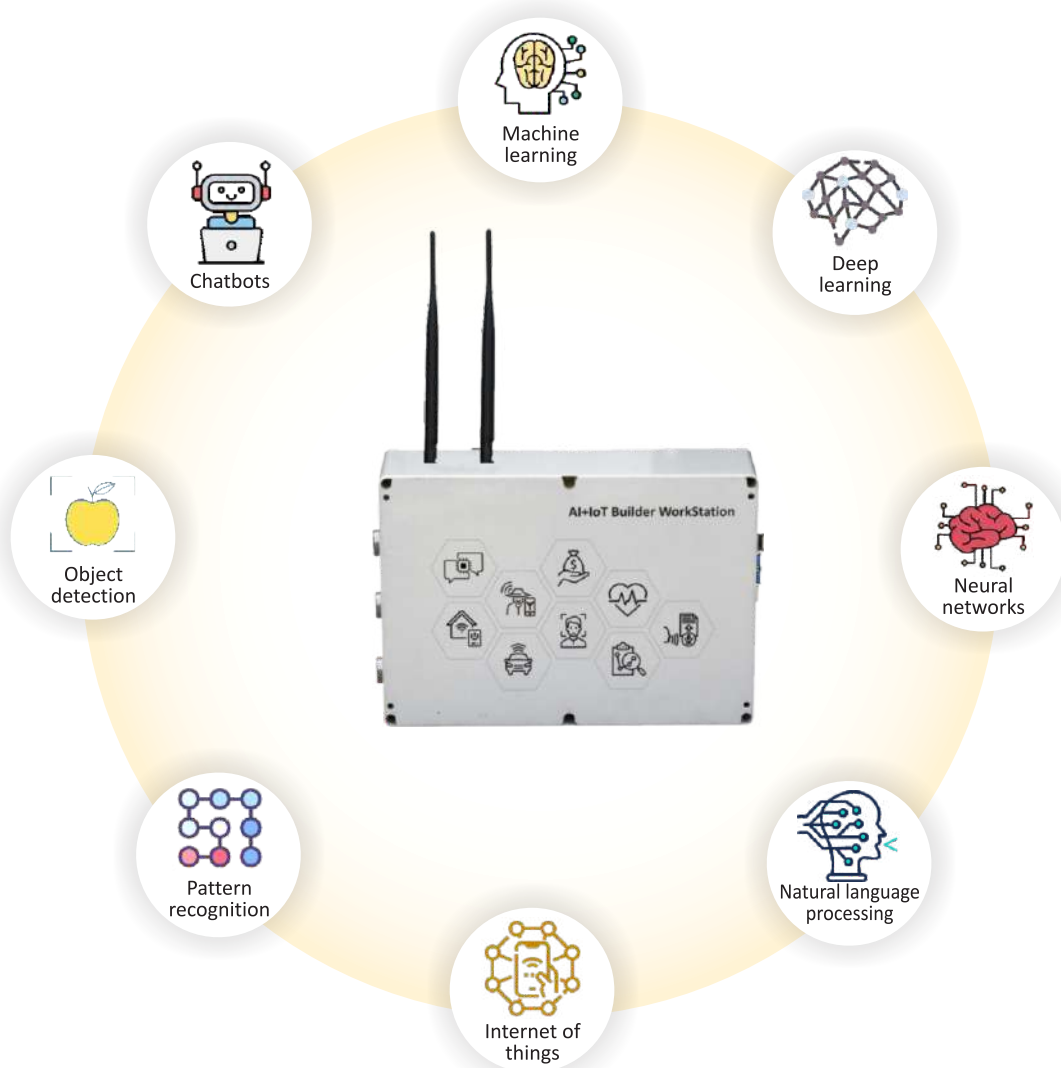
Scope of Learning

- Introduction to IoT, AI, Machine Learning, Neural Network & Deep Learning.

Supervised and Unsupervised learning

- Linear regression.
- Logistic regression.
- Gradient descent.
- Decision tree.
- Random forest.
- Bagging & boosting.
- KNN.
- K-Means.
- Hierarichal clustering.

Deep Learning

- Neural Network overview and representation.
- Convolutional Neural Networks.
- Recurrent Neural Networks.
- Activation Function.
- Loss Function.

Testing and understanding of:

- Air temperature & humidity sensors.
- Air quality PM1, PM2.5 and PM10 sensors.
- CO2 sensor.
- O2 sensor.

Learn and explore:

- Python programming.
- C and C++ programming.
- AI frameworks like TensorFlow, Keras, PyTorch GoogleAI, Amazon web services and Caffe.
- IoT sensors and cloud application.

Interfacing of:

- LED and switches program.
- Sensor and actuators.

Applications using machine learning and OpenCV

- Face detection & tracking.
- Face recognition.
- Emotion recognition
- Gesture recognition.
- Smile detection.
- Vehicle detection.
- Object detection using YOLO algorithm.
- Drowsiness detection.
- License plate recognition.
- Fingerprint recognition.
- Text identification.
- Traffic sign recognition.
- Motion detection.

Applications using audio processing and deep learning:

- Audio fingerprinting.
- Music recommendation.
- Speech recognition.
- Sentiment analysis.
- Dialog flow – Chatbot using NLP.
- Text classification using NLP.
- Machine translation using NLP.
- Named entity recognition using NLP.

Arduino Compatible Interface Module

Arduino Compatible Interface Module is a full featured development platform for ATmega328P microcontrollers. It a convenient way to teach the principles of the Arduino & the family of AVR microcontrollers through programming and interfacing on the ATmega328P device. It is an ideal platform to implement and test the designs both for the beginners and the experts. Using the platform a range of projects in various domains like telecommunication, robotics, consumer electronics etc can be done.

Arduino Interface Module is a platform designed for students. It will help them to get aware with the world of microcontroller and embedded systems.

Features

- ATmega328P MCU clocked at 16MHz
- USB Boot loader to program ATmega328P device
- On board ISP connector for PC based programming
- Every pin is marked in order to make understanding easier
- Master Reset/Restart key for hardware reset
- On board variable supply
- On board Temperature Sensor
- All GPIO's are provided on 3 connectors (10X2)
- On board 10-bit ADC provides variable analog output
- On board External Power Socket
- USB or External power, selectable with a jumper
- CD with sample project code, Programmer software & useful documents

Scope of Learning

- Learn the concept of Arduino IDE
- Learn to interface AVR series microcontroller
- Pin to pin study of MCU
- Study of serial protocol
- Study and Interface Temperature sensor
- Study of Internal ADC & PWM

IoT Smart Health Kit

This is a healthcare practice equipment with IoT technology. It is capable of analyzing up to 11 types of biomedical signals and transmitting or receiving the data through Wi-Fi or Bluetooth. It also can be remotely monitored from PC and Smart Phone through Hybrid Web.

Features

- It is possible to learn about implementation and analysis of measurement algorithm based on principle of bio-signal.
- Measurement of up to 11 sensors is available including sensors such as ECG, EEG, EMG+HHI, EOG, PCG, Respiration, NIBP, BT, SpO2, HR and Bio-impedance.
- It is convenient to monitor measurement data using 10.1 inch electrostatic touch LCD.
- Each sensor module has a rechargeable battery and can be linked with Wi-Fi and Bluetooth.
- AVR MCU with Arduino is applied to the sensor module and the receiving module for more various exercises.
- Measured sensor values can be monitored on PC and Smart Phone through Hybrid Web.
- Provides SMS and e-mail service for specific sensor values by using alarm process and IFTTT.
- Supports interface linked with Android and Arduino for comprehensive application practice.
- Supports both on-board type and module type at the same time.

Scope of Learning

- How to Measure & Interlock
- ECG (Electro CardioGram)
- Respiration
- SpO2 (Pulse Oximeter) NIBP (Non-Invasive Blood Pressure)
- NIBP (Non-Invasive Blood Pressure)
- Bio Impedance
- EEG (Electro EncephaloGram)
- EMG (Electro MyoGraphy)
- EOG (Electro OculoGraphy)
- PCG (Phono CardioGram)
- BT (Body Temperature)
- HHI (Human-Human Interface)

IoT Builder
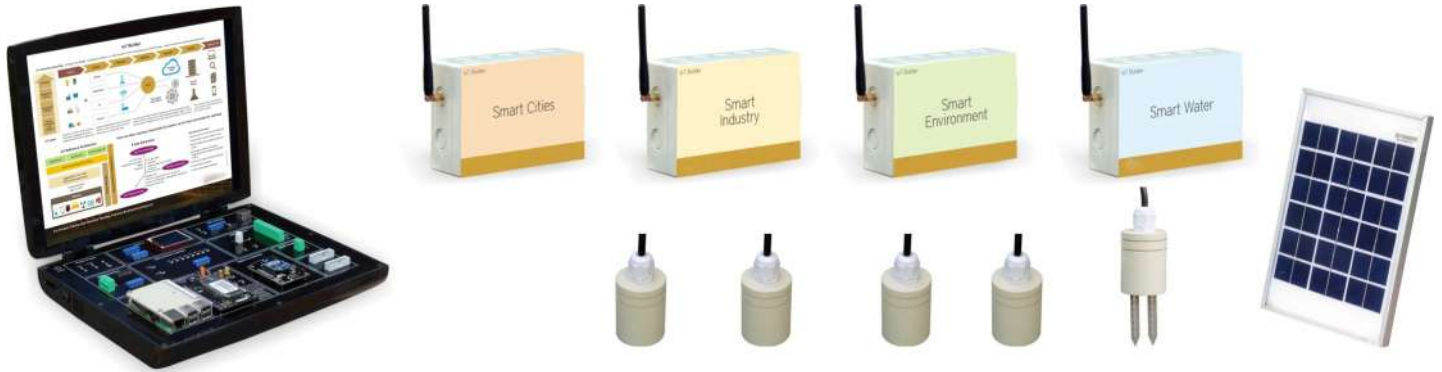
IoT Builder is an environment in which objects, animals or people are provided with unique identifiers and the ability to transfer data over a network without requiring Human-to-Human or Human-to-Computer interaction. IoT has evolved from the convergence of Wireless Technologies, Micro-ElectroMechanical Systems (MEMS) and the Internet. IoT is more than smart homes and connected appliances. IoT is about connecting devices over the Internet, letting them talk to us, applications, and each other. Essentially, it is an overarching platform that allows a variety of devices or machines to communicate with each other by "Machine to Machine" communication (M2M)

IoT Builder is a unique solution which allows user to explore Architecture, Working, and Applications of Internet of Things. The Internet of Things (IoT) is the network of physical objects or "Things" embedded with electronics, software, Sensors, and network connectivity, which enable these objects to collect and exchange data.
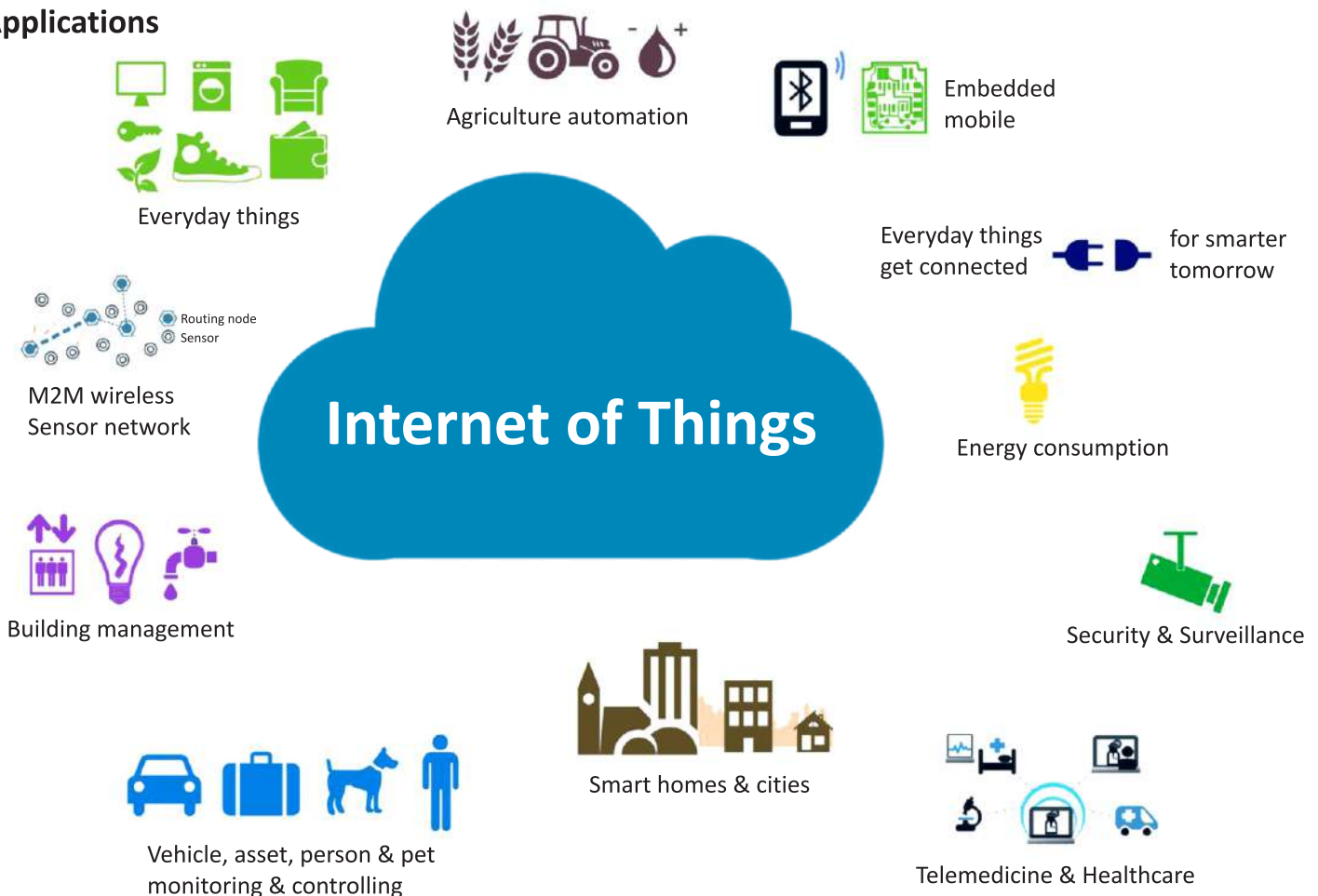
Features

- In-depth practical learning on IoT
- In-depth practical learning on WSN
- Linux based design
- Linux Operating System porting
- Linux python programming
- Machine learning and Deep learning algorithms
- Qt IDE based GUI development
- Study of Sensor and Actuator interfacing
- Local cloud & server configuration
- Over the air (OTA) node configuration
- GUI based parameter configuration
- GUI Base IoT application development
- IoT Gateway Using WiFi and Ethernet
- Sensor node re-programmable using Arduino
- Bluetooth and Zigbee interface
- HDMI interface for display

- USB HID and CDC interface
- Ethernet interface
- 4 channel ADC for Voltage input
- Input for Resistance measurement
- Input for 4-20mA measurement
- RS485, I2C, SPI Protocol interface
- LEDs interface
- Motor driver interface
- Color TFT display
- Serial to USB converter
- microSD card socket
- Office Suite
- Switches interface
- Camera connectivity
- Connectors for external module interface

Applications

Everyday things

Agriculture automation

Embedded mobile

Everyday things get connected

for smarter tomorrow

M2M wireless Sensor network

Routing node
Sensor

Internet of Things

Energy consumption

Building management

Security & Surveillance

Vehicle, asset, person & pet monitoring & controlling

Smart homes & cities

Telemedicine & Healthcare

Complete setup

Scope of Learning

Introduction to Internet of Things (IoT)
- Definition of the Internet of Things (IoT)
- The Importance of the Internet of Things (IoT)
- IoT Architecture
- History of IoT, M2M and Web of Things
- Overview of IoT Builder Hardware platforms
- The Layering concepts, IoT Communication
  Pattern, IoT protocol Architecture, 6LoWPAN
- Understand IoT Market perspective in different
  segments.

Operating System used for IoT
- Linux Operating System introduction
- Working with the command line and the Shell
- Managing directories and files
- Managing user access and security
- Setting up a Linux file system
- Connecting a system to the network

Shell Scripting Programming for IoT
- Introduction
- Creating Shell Scripts
- Flow control in the Shell
- Advanced Shell features

Programming Language used in IoT
- C Programming
- Python

Hardware Interfacing for IoT
- Sensors interfacing
- Actuators interfacing

Communication Protocol study for IoT
- UART Communication
- RS485 Communication
- I2C and SPI Protocol device interfacing
- Ethernet configuration
- Zigbee interfacing
- MQTT Protocol
- Wi-Fi AP and Router interfacing

Database, Cloud Configuration for IoT

Qt based GUI and C++ Programming for IoT

Web and Application Development Tools for IoT

Implement supervised and unsupervised machine learning algorithms

Undertake plant disease detection using machine learning

Create simple linear and multiple regression models

Implement classification and prediction models using Support Vector Machines (SVM)

Learn face recognition using deep learning

Study object classification using Deeplab model

Importance of Wireless Sensor Network (WSN) in IoT

Study of Zigbee router, end device and coordinator configuration

Case study & advanced IoT Applications with :
- Smart Agriculture Sensors
- Smart Environment Sensors
- Smart Industrial Sensors
- Smart Water Sensors
- Smart Home Automation
- Smart Security Solutions

IoT enabled System for Green House

Solar radiation

Soil moisture

NO₂

Nitrogen dioxide

Soil temperature

Atmospheric pressure

Temperature & humidity

Carbon dioxide

Oxygen

VOC — Volatile organic compounds

Leaf wetness

Greenhouse structure

Climatic change is a major challenge for the farmers. More than 95% of farmers follow traditional farming techniques. If a farmer wants to earn more profit from agriculture, then he has to adopt modern farming techniques such as Greenhouse farming (polyhouse farming) or hydroponic farming.

A Greenhouse is a framed structure covered with a transparent or green shaded net material and large enough space inside to grow crops under partial or fully controlled environmental conditions with few sensors to get optimum growth and productivity. Greenhouse farming requires proper environmental conditions for optimal plant growth and health. Most critical to productivity, quality, and energy conservation is the monitoring and control of carbon dioxide (CO_2) concentration in combination with temperature, humidity, and many other parameters.

The use of the greenhouse is very fruitful for the production of seasonal and non- seasonal crops, for the production of high-quality flowers, vegetables, and the preparation of nursery.

IoT enabled system for Greenhouse is a comprehensive setup providing the understanding of sensors used in greenhouse farming. Greenhouse consists of carbon dioxide(CO_2), oxygen (O_2), volatile organic compound (VOC), air temperature & humidity, atmospheric pressure, soil moisture, soil temperature, nitrogen dioxide (NO_2), leaf wetness and solar radiation sensors.
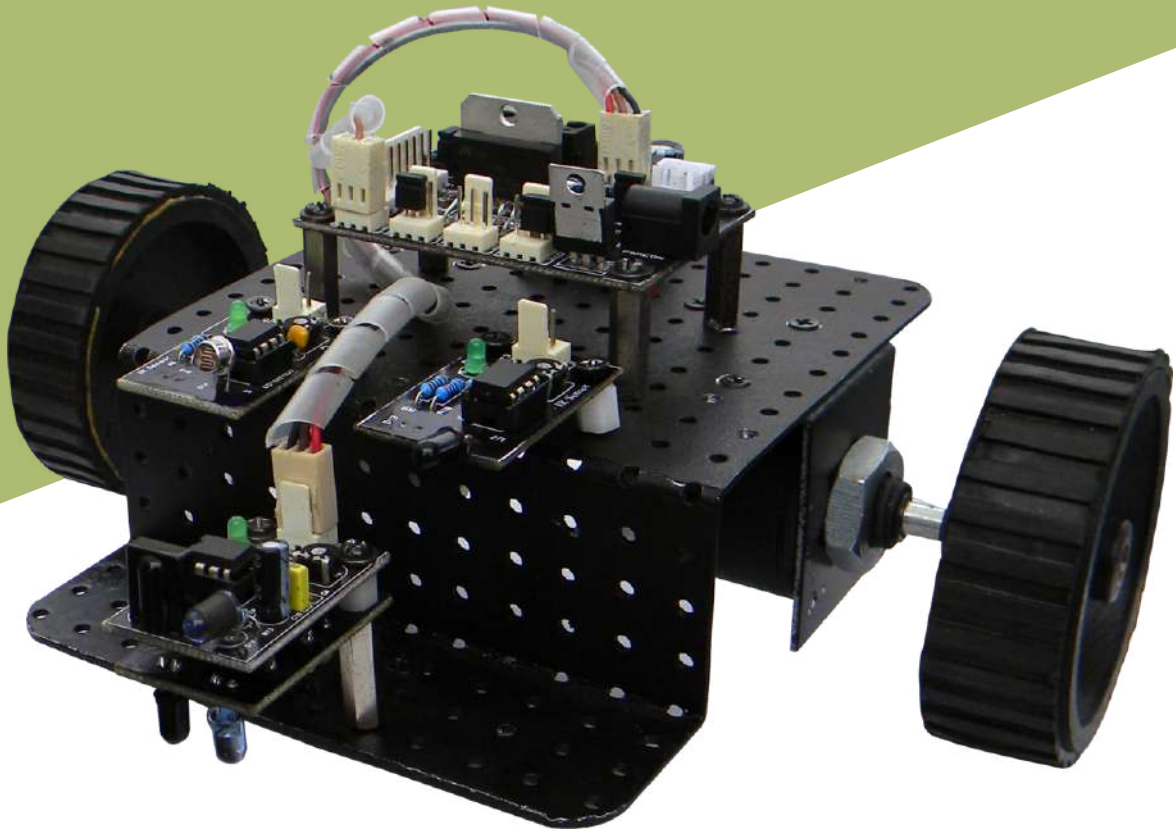
PVC structure
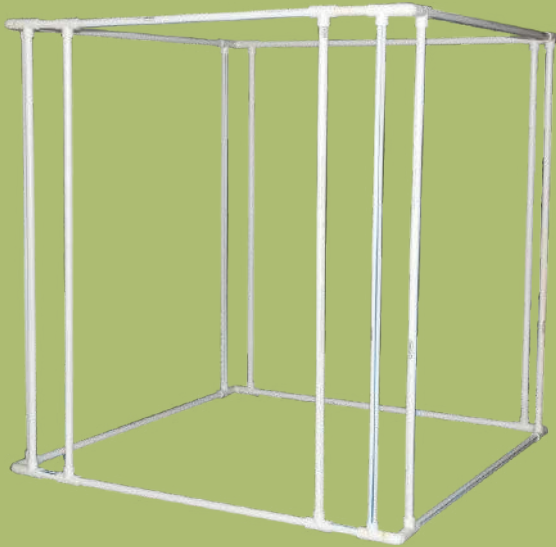
Complete greenhouse

Features

- A friendly platform for experimenters to learn, explore and develop IoT skills in protected cultivation.
- Strong PVC frame and green shaded cover with zip for easy access and ventilation for greenhouse.
- Ideal for pots and seed trays.
- Arduino software compatible hardware.
- IoT based plant monitoring system.
- CO_2 sensor, O_2 sensor, VOC sensor and NO_2 sensor.
- Air temperature & humidity and atmospheric pressure sensor.
- Soil moisture, Soil temperature, Leaf wetness and Solar radiation sensor.
- Battery operated smart sensor gateway for sensor connectivity.
- USB and Zigbee connectivity for personal computer (PC) interface.
- Python, Arduino programming, embedded C and app development.
- Wi-Fi connectivity for cloud interface.
- Sensor gateway with color LCD display.
- Software to view sensor's real time graph analysis on PC and mobile.
- 10 din sockets for sensors and actuators interface.
- On board charging and protection circuit for battery.
- Signal test points and switch faults.
- Inbuilt voltmeter and ammeter.
- User friendly modular setup.

Scope of Learning

- Understanding of Arduino IDE software.

Interfacing of:

- LED blink program.
- ACD and UART programs.
- Color LCD.
- Wi-Fi and Zigbee module.

Testing and understanding of:

- CO_2 sensor.
- O_2 sensor.
- VOC sensor.
- Air Temperature & humidity sensor.
- Atmospheric pressure sensor.
- Soil moisture.
- Soil temperature.
- NO_2 sensor.
- Leaf wetness.
- Solar radiation sensor.

Design and develop:

- Smart greenhouse application programs.
- Program to configure events and alarms.
- Interfacing of Wi-Fi and Zigbee modules.
- Transpiration & respiration application.
- Photosynthesis application.
- Implementation of python program to collect data and upload on cloud.

Software window

Sensor interfacing code

Data logging

Temperature & Humidity graph

Basic RoboCar

Basic RoboCar is a variant of RoboCar Series which does not need any microcontroller interface for its functionallity. This RoboCar specially assembled for electronics students and is capable of sensing environment using various sensor modules and acts accordingly. RoboCar consists of metallic chasis, L-clamps and wheels, with different sensor modules and motor driver circuit mounted on it. The machine is driven by DC motors which are powered by rechargeable battery. This RoboCar is used for various applications like fire sensing, clap sensing, light detecting, object following, obstacle avoiding, wall following, path detecting and many more. Apart from all these features, the control unit and all the Sensors can be interfaced with any microcontroller board.
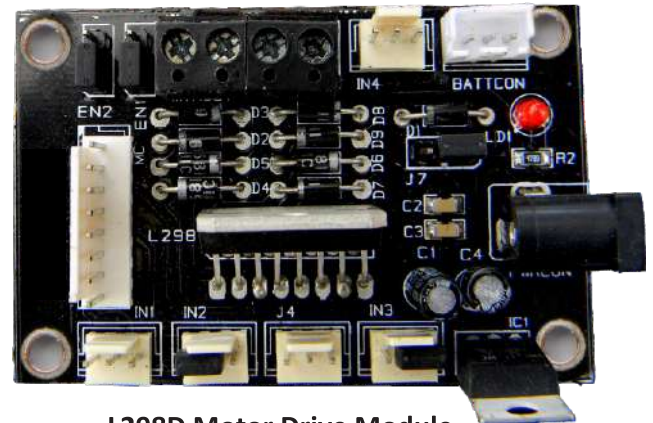
Features

• IR Sensor module interface

• TSOP-IR Sensor module interface

• Fire Sensor module interface

• Clap Sensor module interface

• Light Sensor module interface

• DC motor interface & control

• Expansion connectors

• Onboard battery charger

Scope of Learning

• Learn to implement Robots from basic to high level

• Learn to drive DC motors with H bridge motor driver based on L298 IC

• Learn to interface various Sensor modules like:

  - Fire Sensor module

  - Clap Sensor module

  - Light Sensor module

  - TSOP-IR Sensor module

  - IR Sensor module

Main Board

L298D Motor Drive Module
MCS08

Infrared Sensor
MCS02

TSOP-IR Sensor
MCS03

Fire Sensor
MCS04

Light Sensor
MCS05

Clap Sensor
MCS06

Raspberry Pi

Features

- Hardware and Software required on-board:
- Fully equipped Embedded microcontroller module.
- Able to interface different Digital, Analog modules and such other modules.
- Based on min 64bit ARMv8 processor

Has the following on-board:

- Wi-Fi on board,
- Bluetooth Low Energy (BLE) on board
- Min. 1GB RAM,
- Min. 4x USB 2 ports,
- Min 40pin extended GPIO,
- HDMI output
- Accompany different interfacing modules (14 Nos) to be interfaced on:

  Digital ports

  Analogue ports

  I2C ports

  Serial port of Embedded microcontroller module

Accessories:

All Standard Accessories are included

Scope of Learning

- To interface Temperature and humidity sensor module with Arduino using the Rpi Embedded Microcontroller Training System
- To interface Barometric Pressure sensor module with the Rpi Embedded Microcontroller Training System
- To interface LDR (Light Dependent Resistor) sensor module with the Rpi Embedded Microcontroller Training System
- To interface Ultrasonic Sensor module with the Rpi Embedded Microcontroller Training System
- To interface Accelerometer and Gyro sensor module with Rpi Embedded Microcontroller Training System
- To interface Joystick sensor module with Rpi Embedded Microcontroller Training System
- To interface a GPS sensor module with the Rpi Embedded Microcontroller Training System
- To interface Hall sensor module with Rpi Embedded Microcontroller Training System
- To interface Temperature sensor module with Rpi Embedded Microcontroller Training System
- To interface Touch sensor module with Rpi Embedded Microcontroller Training System
- To interface IR sensor module with the Rpi Embedded Microcontroller Training System
- To interface an Rotary Encoder module with the Rpi Embedded Microcontroller Training System
- To interface Tilt Vibration sensor module with Rpi Embedded Microcontroller Training System
- To interface Sound sensor module with Rpi Embedded Microcontroller Training System

Smart Building

With advances in technology, there is a constant demand for improvement in standard of living, security and energy efficiency. Every building be it residential, commercial or industrial runs on some or the other form of energy, thus there is a need to reduce and optimize this energy consumption. Efficient energy management not only reduces consumption but also reduces energy costs.

Smart Building training setup is specially designed to help understand the concept of smart buildings and how various sensors can be deployed and their data can be used to generate events and trigger alarms. Smart building comes with various sensors. The data from these sensors can be used to generate various events like switching on and off lights, triggering an alarm, providing access to a user using RFID tags and readers. This product helps explore various aspects of smart building intended to optimize energy usage and security.

Applications

Hospitals

Buildings

Offices

Banks

Factories

Universities

Features

- Platform to learn, explore, and develop IoT skills.
- Three floors with six blocks table top building structure.
- Each block of building with LED lights.
- Arduino software compatible hardware.
- LPG gas, smoke, fire, PIR, temperature, humidity, and CO_2 sensors.
- RFID module for access control application.
- Touch switch panel with 4 power sockets and bulb intensity control output.
- Wi-Fi camera interface.
- Battery smart sensor gateway for sensor connectivity.
- USB and zigbee connectivity for personal computer (PC) interface.
- Wi-Fi connectivity for cloud interface.
- Sensor gateway with color LCD display.
- Buzzer and input/output switch for testing.
- Wi-Fi connectivity and android app for field testing.
- Software to view sensor's real time graph analysis on PC and mobile.
- 10 din sockets for sensors and actuators interface.
- On board charging and protection circuit for battery.
- Signal test points and switch fault.
- Inbuilt voltmeter and ammeter.
- Compact tabletop ergonomic design.
- Ready experimental details.
- User friendly, self explanatory system.

Software window

Scope of Learning

- Understanding of arduino IDE software.

Interfacing of :

- Wi-Fi and zigbee module.
- ESP8266 for online cloud interfacing.
- LED blink program.
- ACD and UART programs.

Implementation of:

- Color LCD.
- RFID control application.
- Python program to collect data and upload on cloud.

Testing and understanding of:

- Motion sensor.
- Temperature and humidity sensor.
- CO_2 sensor.
- LPG, fire and smoke sensor.

Design and develop:

- Smart building automation programs.
- Light control applications.
- Program to configure events and alarms.

Smart sensor gateway

EEG/ECG Device

EEG/ECG device is an electronic medical device that measures a patient's vital signs and displays the data so obtained. With the help of four sensors device is capable of producing information of ECG, HR, RESP, Temperature, SPO_2, PR, NIBP parameters of the body. Device is vital to care in operating and emergency rooms, intensive care and critical care units.

Features

- High resolution 12.1" color TFT display
- Light weight, compact and portable
- ECG, SPO_2, NIBP, RESP, 2-TEMP, PR
- Built-in rechargeable lithium battery
- ECG waveforms of 7-leads on the same screen
- 72-hours graphic and tabular trends of all parameters
- 72-alarm events of all parameters recall
- 32 seconds full-disclosure waveform review
- 400 NIBP measurement data can be stored and recall
- Data and waveform color can be adjustable
- Arrhythmia analysis and S-T segment analysis
- PVC analysis
- Suitable for adult, pediatric and neonatal patient
- Optional: 2-IBP, $ETCO_2$ and thermal printer
- 1 Year Warranty

Scope of Learning

- Brain-Computer interface
- EEG, ECG, monitoring
- Word prediction
- Human Imagination prediction
- Attention Detection

SensorLab
(with 10 Nos. Sensor)

Temperature Sensors	Light Sensors	Infrared Sensors

SensorLab are compact and user friendly learning platforms to provide a modern, portable, comprehensive and practical way to learn Technology. Each TechBook is provided with detailed Multimedia learning material which covers basic theory, step by step procedure to conduct the experiment and other useful information.

SensorLab comprises of Sensors and Transducers which provide the fundamental knowledge of sensing Light, Pressure, Temperature, IR and many more non electrical entities.

Since, most of the sensors give signal which show small variation and are of low level output, these signals need to be converted into a form that is measurable and could be used efficiently. The lab consists of various signal conditioning blocks which perform amplification, filtration, signal conditioning and all the required operations which are acceptable to the input devices.

7" capacitive touch screen LCD is inbuilt for output device with easy to use instructions and graphical user interface, to display waveforms, to plot characteristics with the help of graphs, for reading operating manual and watching tutorials. SensorLab is a stand alone TechBook. It does not require external Oscilloscope for measuring, or observing the output and characteristics of the Sensors interfaced.

Features

- IoT enabled Android based 7" Graphical touch LCD with inbuilt cortex processor & DAQ for acquiring analog data and software for viewing the output waveforms, reading the operating manual, tutorial, video etc, with USB storage and HDMI output. Ethernet port to connect real world.

- Inverting, Non-Inverting, Power, Current, Instrumentation and Differential Amplifier, Buffer, Frequency to Voltage, Voltage to Frequency, Current to Voltage, Voltage to current Converter, High Pass and Low Pass Filter, Buffer, LED , Buzzer, Relay, Square Wave generator.

- Inbuilt DAQ

- User can design any circuit on bread board and test

- Stand alone TechBook

- USB Port for Keyboard and Pendrive interface

- Ethernet Port to connect with real world

- HDMI Port

- PC Interface

- Data Login in .csv format

- Ethernet connectivity for remote view application (supported operating system : windows / Linux)

- Online update / USB update

- On board Graph capture and store

- Office tools are inbuilt to view PDF and doc files

- Scientific calculator

- On Board Circuit Simulation

Scope of Learning

- Learn the detailed fundamentals of signal conditioning.

- Learn in-depth study of sensors and it's circuit diagram.

- Learn how automation can implement using sensors and actuators.

- Testing and understanding graph various Sensors for Light Intensity like Photo Diode, Photo Transistor, Photo Voltaic Cell and LDR.

- Testing and understanding graph of various Sensors for Temperature like NTC Thermistor, Platinum RTD, K and J type Thermocouple , AD590 and Lm35.

- See the sensor real timer graph using PC based software

- Sensors data logging using PC based software

- Fault finding to Types of signal conditioning and Sensors.

- Testing, Fault finding of Sensor and understanding graph of IR Sensor like L14G1 and TSOP1738. Characteristics of other Sensor modules.

- Testing and understanding the working of Amplifiers like Inverting amplifier, Non inverting amplifier, Differential amplifier, Instrumentation Amplifier, Current Amplifier

- Testing and understanding the working of Filters like High Pass filter and Low Pass Filter

- Testing and understanding the working of Types of and Converters like Frequency to Voltage and Voltage to Frequency convertor, Current to Voltage and Voltage to current convertor.

- Study of output blocks like LED, Buzzer , Relay.

AIoT SerBot
Series

SerBot • SerBot Plus • SerBot PrimeX
(Excluding LiDAR)

Kustom Version
(Supply Case : The Korea Military Academy)

Sensor Pack
Module provided for AIoT SerBot Plus

AIoT Tiny MCU
Modules provided for AIoT SerBot PrimeX

Feature

- AI and IoT Convergence Training Equipment based on Indoor Service Robot Platform
- Drive part adopts 3-axis omni-wheel to maximize robot's movement efficiency and minimize rotation radius
- The main module is an edge supercomputer that supports all existing AI frameworks
- Provides a 7-inch touch display with 1280x720 resolution and a 160-degree wide-angle camera with 8M pixels
- Provides Gigabit Ethernet, dual-band Wi-Fi and Bluetooth
- Digital microphones and speakers support Speech-to-Text and Text-to-Speech as well as voice command
- Supports various IoT sensor modules through 4 dedicated expansion interfaces
- High-capacity battery and dedicated charging system enable continuous experiment while charging
- Soda OS and Pop library, the exclusive AIoT operating system
- Interpreter-based C/C++ development environments optimized for beginners to programming, including Python 3
- A dedicated web browser-based learning environment for training Python 3 and C/C++ simultaneously on PCs and tablets
- mDNS/DNS-SD based distributed name resolution and network service publishing and discovery support
- Open Integrated development environment based on Visual Studio Code for professional application development
- Educational contents for artificial intelligence and deep learning based service robot
- AIoT SerBot Plus provides high-performance 360 degree lidar and dedicated library
- AIoT SerBot Plus provides 8 types of IoT sensor modules connected to a dedicated expansion interface
- AIoT SerBot PrimeX provides 6 ultrasonic sensors and 3 PSD sensors for obstacle detection
- AIoT SerBot PrimeX provides Cortex-M series high performance MCU module and CAN module
- AIoT SerBot PrimeX's main module contains edge supercomputer up to 21TOPS supporting all popular AI frameworks

SCOPE OF LEARNING

Introduction to AIoT SerBot

Structure of AIoT SerBot
Practice environment of AIoT SerBot

AI Technology

Supervised learning and unsupervised learning
Theory and Practice of Pop.AI-based Linear and Logistic Regression
Theory and Practice of Pop.AI-based Perceptron
Theory and Practice of Pop.AI based ANN, DNN, and CNN
Theory and Practice of Pop.AI & OpenAI-based Reinforcement Learning
Understanding Tensorflow

Data Processing Technology

Numpy for fast multi-dimensional matrix operations
Pandas for analyzing time series and tabular data
Matplotlib for data visualization

Service Robot Application Technology

UI Exercise
Exercise for TTS (Text to Speech) & STT (Speech to Text)
Exercise for audio playback & recording
Camera exercise
Basic driving exercise
Voice command driving exercise
Remote control exercise
Deep learning-based driving exercise