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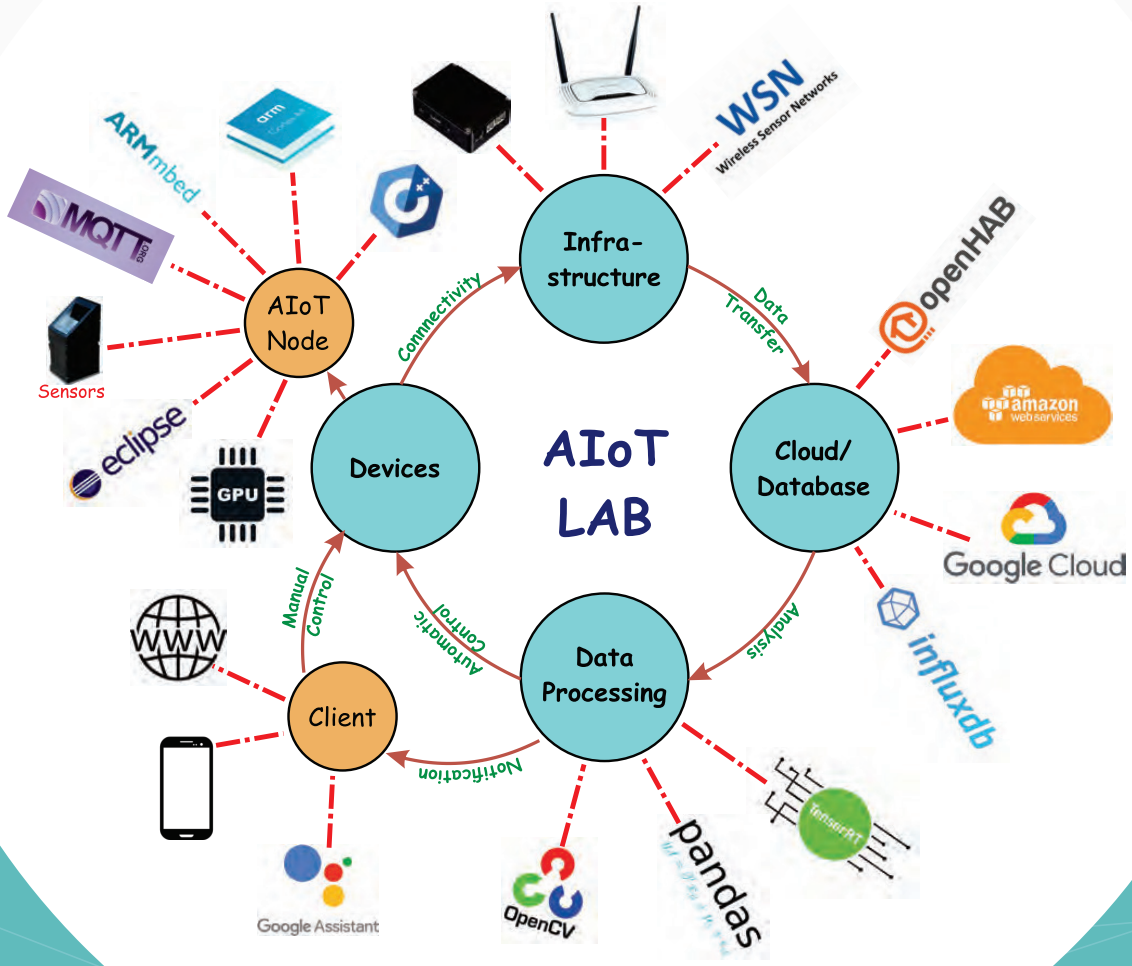
Advanced Innovative Instruments for Professional Learning

AKADEMIKA

Elevate Your Skills:



Discover Internet Of Things (IoT) With our Training Laboratory

ABOUT THE LABORATORY

- The IoT Laboratory by AKADEMIKA is specifically designed to create qualified and Skilled professional in the field of IoT and AIoT.
- This Laboratory is Aligned to meet the requirments of **NSQF Level 3 ,4 and 5**.
- Hardware and Software provided will facilitate Skill Development in the IoT Sector for Students at Diploma / Engineering Graduates and increase their employability to work in this Industry.

KEY FEATURES and SKILL EXPLORED USING THE IoT LABORATORY

- **Training Modules:** Educational platforms and modules for teaching IoT concepts, sensor integration, and system development.
- **Hands-On Prototyping:** Facilities for students and developers to work on real-world IoT projects, from prototyping to deployment.
- **Microcontroller Platforms:** Devices like Arduino, Raspberry Pi, and ESP32 for building and prototyping IoT systems.

SKILL SET LEARNT

PROTOCOLS	UART, SPI	I2C, WiFi	Bluetooth, CoAP	MQTT, REST	IPV4 (Ethernet)	ZigBee, LoRa
SENSORS	Driver Development	Sensor Interface	Sensor Communication	Sensor Calibration	Sensor Application	Wireless Sensor Network
LANGUAGE	C, C++	JAVA	JAVA Script	Python	XML	
CLOUD	Web Services	Event Management	Security	Event Trigger	Dynamic Allocation	
ECOSYSTEM	ARM Cortex	LINUX Mbed	RTOS	OSCi Framework	Eclipse IDE, GNU	AI-MI/DL

CURRICULAM

Introduction to IoT

- **Overview of IoT:** Introduction to IoT concepts.
- **IoT Architecture:** Basic IoT architecture—things (devices), gateways, cloud, and applications.
- **IoT Ecosystem:** Components of an IoT system (sensors, actuators, networks, and platforms)
- **IoT Applications**: Study of IoT applications.
- **Artificial Intelligence of Things (AIoT):** Combination of Artificial Intelligence (AI) technologies with the Internet of Things (IoT) infrastructure

IoT Hardware and Devices

- **Sensors and Actuators:** Study of different types of sensors (Moisture sensor, Dust sensor, Water sensor, Accelerometer, Magnetometer, Gyroscope, Pressure sensor, PIR Motion sensor, Ultrasonic Ranger, Temperature and Humidity sensor, REED switch, Vibration sensor, Touch Key sensor, Finger Print Sensor, RFID moduleetc) and actuators. Writing sensor drivers and testing the sensor output on the UART port of IOT training Node
- **Microcontrollers and Microprocessors:** Overview of microcontrollers (Arduino, ESP32) and microprocessors (Raspberry Pi) used in IoT.
- **IoT Development Boards:** Using popular IoT boards like Arduino, Raspberry Pi, and NodeMCU. IoT Communication Protocols
- **Communication Technologies:** Overview of Wi-Fi, Bluetooth, Zigbee, LoRa technologies. IoT Communication Protocols: Understanding the Networking Basics required to set up IoT Applications,Deep dive into MQTT, REST , HTTP/HTTPS, CoAP, 6LoWPAN protocols forIoT communication.
- **Edge and Gateway Devices:** Understanding edge devices and gateways in IoT systems.

Wireless for IoT

- **Overview of Wireless Sensor Network:**
  - Evaluate 802.11 (Wi-Fi) Networks, Examine wireless communication, networks, and sensor communication by reconfiguration of Radio and Network Parameters
  - Measuring Wireless media propagation and parameters affecting the communication reliability
  - Measuring parameters impacting wireless communication and network formation
  - Evaluating wireless and sensor network performance parameters
  - Formulate various defined / programmed Network Configuration
  - Explore the Network Layer parameters that are not allowed to play with in standard wireless network
  - Build Applications with available on-board sensors

IoT Cloud Platform and Data Management

- **IoT Data Collection:** Techniques for collecting and storing data from IoT devices.
- **IoT Platforms:** Introduction to IoT cloud platforms (AWS IoT, Google Cloud IoT).
- **Cloud and Edge Computing:** Configuration of the cloud platform , Exploring the cloud services like Mail, Messaging (SMS), and Tweeter etc , Using Machine Learning for IoT Application, Deployment of trained Deep Learning model on the AI node and integrating with the IoT infrastructure Concepts of cloud computing, edge computing, and fog computing in IoT.
- **Data Analytics:** Setting up of Database on cloud for data collection and analytics.

TRAINING EQUIPMENTS

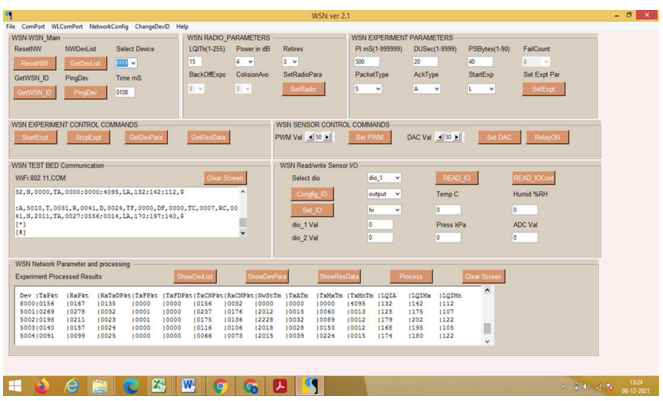
1. WIRELESS SENSOR NETWORK

The test bed allows real time emulation of wireless packet transmission and network parameters measurement along with study of wireless media behaviour. This System makes use of Patented S-WiFi Network Stack. S-WiFi is hardware (processor, radio) independent network layer , Self-Organizing and self-healing network stack.

S-WiFi allows formation of up-to 5 hop, multi-hop network. The MD and NPD can attach up-to 30 devices in star network topology. The NPDs are equipped with Temperature, Pressure, Humidity sensors along with ADC input, configurable two DIO port lines , a relay and PWM output.
“Wireless Ginie” The GUI application provides various commands to reset network, change radio, network and experiment parameters and measure the packet transmission activity parameters.

- **802.11(Wi-Fi) based (Master Device and Network Processing Device)**
  - OLED display 1.3”
  - LED indications: Power, Rx/Tx
  - Keys: Program, Reset, User key
  - Serial interface for Programming
- **Processor**:
  - Xtensa® single-/dual-core 32-bit LX6 microprocessor
- **Radio**
  - 2.4 GHz 802.11 compatible
  - Up to 20.5 dBm of transmitting power, adjustable transmitting power
  - Receiver sensitivity –90 dBm
  - TX/RX current 95~100 mA @ 0 dBm
  - 3.3V operation
- **Battery: 3500mAh**
- **Sensors**
  - Integrated Temperature, Pressure and Humidity Sensor
  - PWM, Relay, DAC, ADC & two programmable DIO

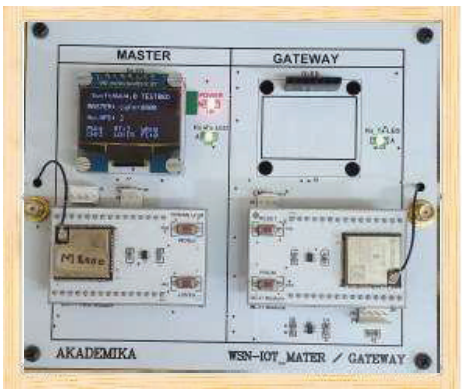
- **“Wireless Ginie”: GUI Application Software**



TRAINING EQUIPMENTS

WSN Control Commands to establish Network

- Radio/transmission setting: Power, LQI threshold, message transmission Retries
- Experiment settings: Packet interval, Packet size, Acknowledge type, Experiment Duration,
- Change device address and Role
- Reset network
- Ping



WSN Sensor Control Command

- Set PWM
- Configure DIO
- Set/Get DIO val,
- Read sensor and ADC values

Configurable Parameters

Radio Parameters

- Power: 0 dBm to 19.5 dBm in steps of 11.5 dBm Specific to WiFi (LR) setup
- Radio Channel
- LQI Threshold, connectivity range: 0-255
- Number of packet transfer retry: 1- 3

Experimental Parameters

- Packet interval time: 0-999999 mS
- Experiment duration: 1-9999 seconds
- Data size in packet: 0-99 Bytes
- Packet type: Sequential, Random
- ACK for packet: No ACK, Hardware ACK
- Start of experiment: Start on reset, Start after command

Network Configuration Setting

Facility to emulate and define Network Configuration. The user can set the list of devices in the MD and NPD to allow or to block these devices during network formation. This facility allows the user to create user defined network topology as well create multi-hop network within the laboratory space.

WSN Network Parameters and Processing Display

Facility to display Device list with details like Device, Parent, Hops, DevLQI,

Facility to display Device Parameters like Device, packet Interval, duration, expected Data packets, packet size, Retry, Ack Type, LQI Th, Facility to display processed Results like device, data/control transmitted packets, Communication Load %,Dev Efficiency %, Expected NW Efficiency%, NW Efficiency %

2. BASIC ARDUINO BASED INTERNET of THINGS TRAINING SYSTEM

This Basic IoT Kit allows you to add connectivity to devices around the home or workplace. It comes complete with a set of 8 Internet of Things self assemble projects ready to show you how to turn everyday appliances into 'smart appliances' and build custom connected devices that can be controlled with your mobile phone.

- Remote Controlled Lights - change color, light modes and switch on/off via your mobile
- Personal Weather Station - record and monitor local weather conditions
- Home Security Alarm - Detect motions and trigger warnings
- Solar System Tracker - retrieve data from planets and moons in the Solar System
- Inventory Control - track goods in & out
- Smart Garden - monitor and control the environment for your plants
- Thermostat Control - smart control for heating and cooling systems
- Thinking About You - send messages between the Oplà and the Arduino IoT Cloud

For more advanced users this kit provides them with the potential to create their own connected devices and IoT applications through the open programmable platform providing the ultimate control.

This Kit acts as the physical interface with the Arduino IoT Cloud providing you with total control at your fingertips via the Arduino IoT Remote app. Configure and manage all the settings via the Arduino IoT Cloud, with easy to create dashboards providing real-time readings from your smart devices around the home or workplace. Adjusting settings, switching devices on/off, watering plants etc is all controllable on the go with the Arduino IoT Remote app

Technical Specifications:

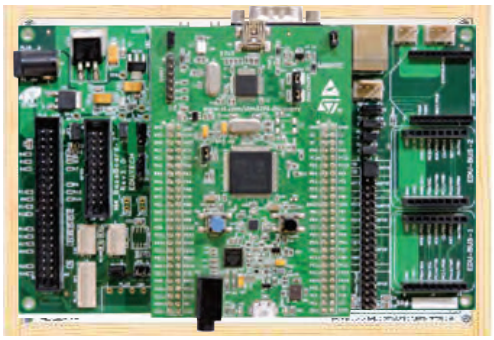
The kit includes the following Hardware:

- MKR IoT Carrier designed for this kit, including:
- Round OLED Display
- Five capacitive touch buttons
- On-board sensors (temperature, humidity, pressure and light)
- Two 24 V relays
- Micro SD card holder
- Plug and play connectors for different sensors
- RGBC, Gesture and Proximity
- IMU .
- 18650 Li-Ion rechargeable battery holder (battery not included)
- Five RGB LEDs
- Arduino MKR WiFi 1010
- Plastic encasing
- Micro USB cable
- Moisture sensor
- PIR sensor
- Plug-and-play cables for all the sensors

3. ADVANCE SMART INTERNET of THINGS TRAINING SYSTEM

Lab Components

IoT Node



- STM32F407VGT6 ARM 32-bit Cortex'"-M4 CPU with real- time accelerator (ART Accelerator'"), frequency up to 168 MHz, 1 Mbyte of Flash memory,192 Kbytes of RAM, 16- stream DMAcontroller Serial wire debug (SWD), JTAG interface
- On Board Data Transfer interfaces include USB connector for UART4, DB9 connector for UART6, 3Pin and 4Pin Header for UART4 &; 6, USB OTG, Flash Drive interface, EDU-BUS connector with ADC, PWM, UART, I2C and SPI, 20 pin GPIO interface connector
- On Board ZigBee - WSN feature to be used within an IoT system.
- Special on Board Functionality includes Ethernet, Audio jack interface, MIC for audio recording, Accelerometer, Camera Interface

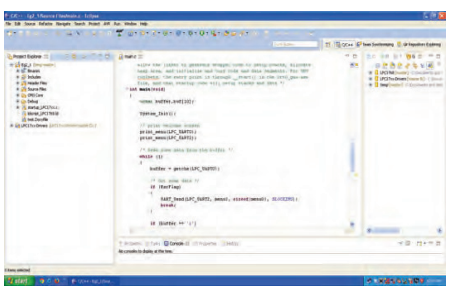
AI Node

- A small, low power, powerful AI computer node that lets you run multiple neural networks in parallel for applications like image classification, object detection, segmentation, and speech processing thus demonstrating a complete AIoT concept.

IoT Gateway

- Embedded gateway featuring CPU up to 1.2GHz Quad Core, 1GB RAM
- On board Wifi and Bluetooth for wireless connectivity
- Nodes can be connected to the gateway via Ethernet, Serially or using Wifi or Bluetooth
- Collects the data from the nodes and posts it to cloud

Eclipse based Integrated Development Environment (IDE) Tool:



Eclipse IDE is an easy to use development platform which can be used for windows as well as Linux environment. This IDE tool supports different micro-controller platforms like 8051, PIC, AVR, ARM7 & Cortex-M4. It can be interfaced with the debugger using external plug in. This tool is unique as it allows users to work with multiple controller platforms thus reducing the learning time and making it easy to develop applications, projects and lab exercises.

TRAINING EQUIPMENTS

All-in-one General Purpose Board

The All-in-one GPIO board is specially designed to suit the experimentation on different GPIO devices with the micro controllers.

Features:

- On board display options includes 8 LED, 16x2 character LCD, 2 digit7-segment display
- Switches include 4 general purpose keys and 2x2 matrix keyboard
- I2C and SPI based EEPROMs for p rotocol demo nstration experiments
- Stepper motor interface with built-in H-bridge driver
- DC motor interface
- Relay output
- Facility to provide 2 channel ADC input using potentiometer and unity gain amplifier for protection
- Compatible with different Educational Practice Board

DELIVERABLES

Sr. No	Name of Equipment	Qty
1	**Wireless Sensor Network :**	
	a. 802.11 Master Device with Gateway	1 No.
	b. Network Processing Device (NPD) Wireless Nodes	10 nos.
2	**Basic Arduino Based IoT kit**	
	a. MKR Wi-Fi	5 Nos.
	b. MKR IoT Carrier	5 Nos.
3	**Advance Smart IoT Training System**	
	a. IoT Nod – Cortex M4	5 Nos.
	b. Preconfigured AI-Node with power supply	1 No.
	c. All in One General Purpose Board	5
	d. IOT Gateway	1
	e. Bluetooth Module	1
	f. Router	1
	g. Portable Sensor Kit	1
	h. IOT sensor kit	1
	i. RFID Module	1
	j. Finger Print Module	1
	k. Stepper Motor	2
	l. DC Motor	2
	m. Amazon Echo device with AWS configuration	1
	n. WSN/Zigbee Trainer Kit	1
	o. LoRa IoT Trainer Kit	1
	p. IDE Configured for Cortex Platform	1

LAB TUTORIALS / EXPERIMENTS

Introduction to Internet of Things and Various Protocols

- Implementation of various types of nodes with different operational modes like sleep, deep sleep, power down, and wake up modes using interrupt handling for integration with sensors and actuators
- Nodes with Debugging facility enabling the students to debug the codes
- Using ARM Cortex architecture-based nodes to explore the art of writing sensor drivers, implementation of communication protocols etc. which enables a powerful IoT solution
- Cloud configuration and using cloud services with IoT system & implementation of Gate way system
- Creation of database on the cloud platform and store the IoT data for further use and analytics

Using Serial and Ethernet Protocol

- Programs to monitor analog data received on ADC remotely on cloud
- Program to toggle LEDs remotely using cloud application
- Programs to remotely toggle relay using cloud application
- Control speed and direction of stepper motor remotely using cloud application
- Control speed and direction of DC motor remotely from cloud
- Interfacing various sensors to the node and reading the data on the cloud and perform necessary action based on the information received

Using Wireless Protocol (BLE and Wi-Fi)

- Program to interface Bluetooth and Ultrasonic Ranger to monitor distance and send to the cloud
- Program to interface Bluetooth and implement DC Motor
- Program to interface WiFi and interface various sensors and actuators to the node and sending the data on the cloud and perform necessary action based on the information received.

Using Cloud Service

- Program to cross communicate between nodes
- Program to add trigger to send email if ADC value is above certain level or below
- Program to add trigger to send twitter message if ADC is above certain level or below
- Program to add trigger to send SMS with message bird if ADC is above certain level or below

Using Database

- Program to monitor ADC and store values in InfluxDB and visualize it.
- Program to store and restore Relay state from MapDB.

Using Voice Control

- Program to control LEDs using Amazon Alexa.
- Program to control relay using Amazon Alexa.
- Program to control DC motor using Amazon Alexa.
- Program to control Stepper motor using Amazon Alexa.

Using Personal Cloud Platform

- Program to control LEDs using OpenHAB service running on Amazon cloud.
- Program to control Relays using OpenHAB service running on Amazon cloud.

Using Wireless Sensor Network (WSN)

- Wireless network Setup
- Measurement of Distance and Signal Strength (LQI). Find relation between distance and LQI
- To study LQI and packet delivery efficiency with No ACK, Hardware ACK and Soft ACK
- To study LQI variations through different media (e.g. concrete wall of different thickness, brick wall etc.)
- Measurement of Packet Delivery Ratio.
- Measurement of Routing overhead
- Measurement of Bandwidth overheads with No ACK, Hardware ACK and Soft ACK.
- To study Effect of packet payload on network throughput
- To study Effect of packet transmission rate over network throughput
- Measurement of Average Transmission Delay.
- To study Effect of hops over network transmission delay
- Use of Network Nodes as IoT Sensor (Temperature / Pressure / Humidity)
- Use of Network Nodes as Actuator- Driving PWM Based LED , Relay
- Use of Network Node for measuring Voltage using ADC.

Using Artificial Intelligence

- Deployment of Trained Deep Learning Model on the AI node to demonstrate applications which needs image classification, segmentation etc.
- Case studies on Deep learning and Machine Learning based applications

IoT Applications:

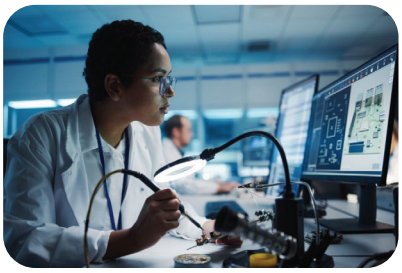
- Remote Controlled Lights , Personal Weather Station , Home Security Alarm , Solar System Tracker , Inventory Control ,Smart Garden, Thermostat Control

KEY BENEFITS OF THE LABORATORY

- Will Gain Professional Knowledge in Hardware and Software to Implement IoT Applica tions and Dashboards
- Will Gain Profession Skills in selection of Hardware and Software Tools and provide Solu tions to real world problems by using IoT

JOB OPPORTUNITIES AS

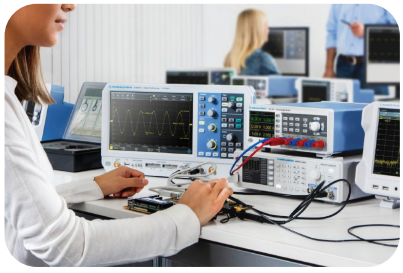
Junior R&D Engineer in IoT:
Assisting in Research and development based activities in the field of IoT



Research assistant in IoT:
Assisting in Development of IoT based ecosystems

IoT Network Engineer:
responsible for implementing, maintain- ing, supporting and developing IoT communication networks

Home automation Engineer:
Working on Internet of Things based Home Automation system



IoT Test Engineers:
Checking functionality of various IoT based systems and products

OUR PRODUCTS

- FIBER OPTIC NETWORK
- COMPUTER NETWORKS
- ANALOG & DIGITAL COMMUNICATION
- DRONE TECHNOLOGY
- RF/MICROWAVE/ ANTENNA
- TEST & MEASURING INSTRUMENTS

FIBER OPTIC NETWORK

COMPUTER NETWORKS

ANALOG & DIGITAL COMMUNICATION

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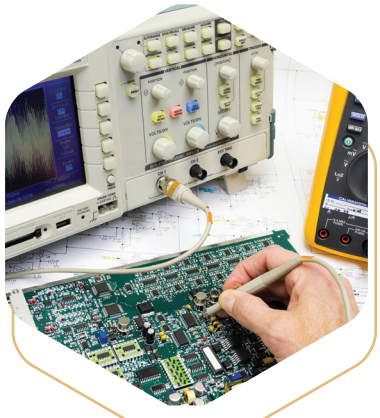

TEST & MEASURING INSTRUMENTS

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