ingage

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DIRECTORATE OF TECHNICAL EDUCATION
Government of Tamil Nadu

நான் முதல்வன்
உலகை வெல்லும் இளைய தமிழகம்

Mandatory Course Topic: IoT and its applications
Type: Hybrid Course

Target Group	**Polytechnic students – EEE Students**

Subject	IoT for EEE	**Total duration of the training in Hours**	60 hours (2 credits)
Theory Class Training in Hrs	15 hours (1 credit)	**Practical class Training in Hrs**	45 hours (1 credit)
Theory class focus area	Basic smart factory introduction, Industrial IoT platform, digital twins, Embedded.	**Practical class focus area**	• IoT integration to data modeling • Embedded firmware
Total credits	2 credits	**Type of training**	**Hybrid (All sessions would be offline, only support would be online)**

Introduction to Industrial IoT :

Industrial IoT is defined as a **network of devices, machinery and sensors connected** to each other and to the Internet, with the purpose of collecting data and analyze it to apply this information in continuous process improvement. There are many Industrial IOT applications out there, and they have driven an increasing number of companies to engage in this new paradigm to improve their productivity and optimize their expenses and profits.

To have access to this competitive advantage, one would be wise to know the main IIoT applications and how to implement the system.

The main Industrial IOT applications:

- Automated and remote equipment management and monitoring
- Predictive maintenance
- Faster implementation of improvements
- Pinpoint inventories
- Quality control
- Supply chain optimization
- Plant safety improvement

Course Objective:

1. Introduction to the Internet of Things and Enabling Technologies for IoT
2. Understanding the working principles of Sensors, Actuators, Controllers and various interfaces.
3. Arduino programming, embedded C program for Arduino platforms,
4. Practical exposure to communication technologies like BLE and Wi-Fi and IoT Application protocol
5. Thingspeak, Wokwi, Cloud Interface, IoT Core and IoT Analytics. Design of IoT Systems for a given use case.

Course Syllabus:

Unit – I Introduction to IoT & Industry 4.0

Introduction to loT – M2M vs IoT – IoT vs CPS – IoT vs WoT – IoT Industrial reference Architectural Stack - Industrial IoT and Industry 4.0 - Enabling Technologies of IoT – IoT end node using ESP32 - BLE mesh- Wi-

Fi mesh – Wireless Sensor networks for data acquisition in IoT. Sensing, Processing, Actuating and Communicating. Protocols for loT

Content learnt:

- Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services
- IoT hardware & protocols
- Digital Twins

Lab component:

- Introduction to Open Source IoT platform

Outcome:

Understand IoT concepts, protocols and Applications

Unit – II Simulation of physical infrastructure & micro controller

Content learnt:

- Introduction to Metaverse and Phygital environments
- Introduction to microcontroller and sensors
- What is analogue and digital data?
- Getting started with programming for microcontroller
- How to Interface Sensors with a microcontroller?

Lab component:

- Initialize Microprocessor on simulator
- Setup sensors with microprocessors on simulator
- Upload code to microprocessor on simulator
- Process sensor data on simulator

Outcome:

Knowledge on circuit simulation

Unit – III Communication between Microcontroller & Cloud computing services

Content learnt:

- Introduction to IoT and Cloud
- Features of cloud and its initialization
- How to read and write data to cloud

- Integration of microcontroller and sensors from simulator with cloud

Lab component:

- Initialise cloud
- Setup databases for platform deployment
- Upload sensor data to cloud

Outcome:

Sending And receiving data from microcontroller to cloud

Unit – IV Communication between Microcontroller & Cloud computing services

Content learnt:

- About Embedded Electronics & Industries
- HW Fundamentals
- SW used in Industry
- Digital tool exploration (Proteus, Tinkercad,etc)
- Usage techniques of multi-meter and oscilloscope
- Introduction to Firmware and board architecture

Lab component: (Arduino Board)

- SW Installation
- Hands on Ohms Law & Measurements of fundamental components
- Sensor
- Basic soldering techniques

Outcome:

Build a practical implementation of Ohms law using software

Unit – V Proof of Concept Development

Content learnt:

- Microcontroller basics
- Programming Environment setup

- Typical C Programming Flow and structure
- PIN Configuration
- Firmware Development
- Unit Interface level testing

Lab component:

- Interact with Peripheral interfaces through FW
- Assemble components as per PIN Configuration
- Board bring up
- FW development
- Load FW in the newly built HW
- Functional and Non-Functional testing
- Random Bugs identification
- Debugging board

Outcome:

Learnt about building an IoT application using hardware

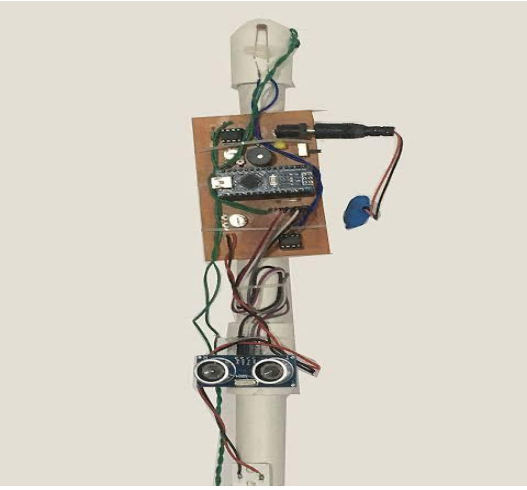
Training Outcome:

1. Develop real-time solutions by knowledge of Industrial applications with IoT capability
2. Develop an understanding of the structure and architecture involved in creation of Digital twin for Industrial IoT.
3. Develop a digital interface and connect to the physical hardware layer of IoT using cloud.
4. Apply effectively the various enabling technologies (both hardware and software) for Arduino based IoT
5. Design and build IoT system for a few interesting Use cases

Design Projects:

1. **Smart blind stick:** The smart blind stick is a modern day's blind stick that assists visually challenged people. The blind stick consists of an ultrasonic sensor that helps in detecting the obstacle. The blind stick also consists a servo motor in which the ultrasound sensor is mounted. Based on the shaft direction the obstacle direction can also be identified. The blind stick also consists of Bluetooth sensor that helps in getting connected with the smart phone for voice intimation of obstacle direction. The 2 sensors are connected with controllers.

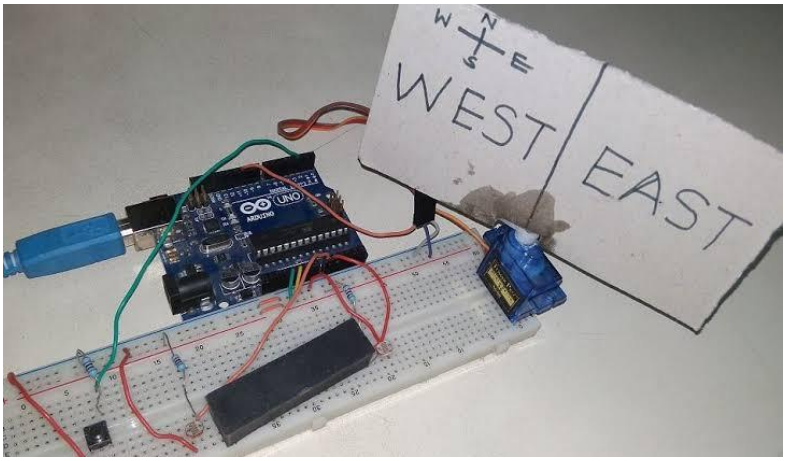
Task 1: Do research on blind people and their difficulty in using the conventional blind stick.Check out on how to upgrade the blind stick.
Task 2: List down the components required. Design the circuit in simulation software andcheck its output.
Task 3: Start developing the code for operating the microcontroller.
Task 4: Build the circuit with the components required and upload the developed program tothe microcontroller.
Task 5: Check the efficiency of all the interfaced components and rectify those components toincrease the system efficiency.



S.NO	Component	Quantity
1	ESP 8266	1
2	Ultrasonic sensor	1
3	Servo motor	1
4	HC-05	1
5	Bread board / PCB board	1
6	Connecting wire	Required quantity

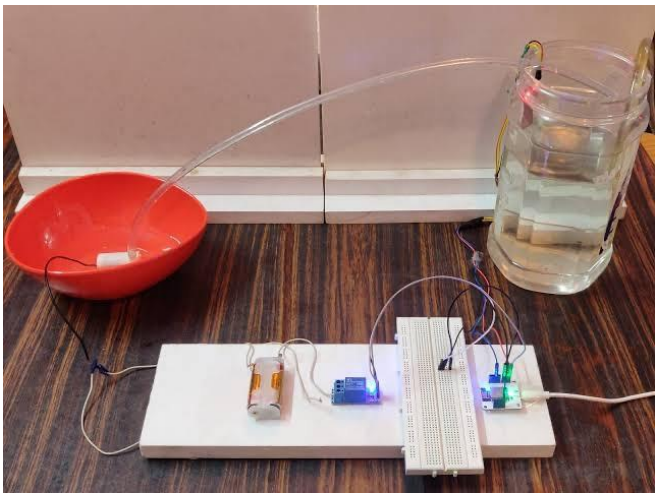
2. **Sunlight based solar panel system:** The sunlight based solar panel system is used to increase the productivity in solar power generation units. In this system the solar panel will turn based on the direction of sun. This leads to more solar light interaction with the solar panel. This results in the more productivity of electricity using solar power. Light dependent sensors are used for light(solar) intensity detection. The panels are installed on the servo motor which moves in accordance with the sunlight.

Task 1: Do research on relationship between solar panel positioning and sun movementdirections.
Task 2: Design a solar tracker circuit on simulation software to increase the solar energyproductivity.
Task 3: List down the components required for building the solar tracker. Develop the code for microcontroller to control the solar tracker system.
Task 4: Interface the components as per the circuit diagram that is developed. Upload theprogram to the microcontroller
Task 5: Check the efficiency of a fixed solar panel and a solar panel in the solar tracker. Andgive a report on this.



S.NO	Component	Quantity
1	ESP 8266	1
2	LDR sensor module	1
3	Servo motor	1
4	Bread board / PCB board	1
5	Connecting wire	1

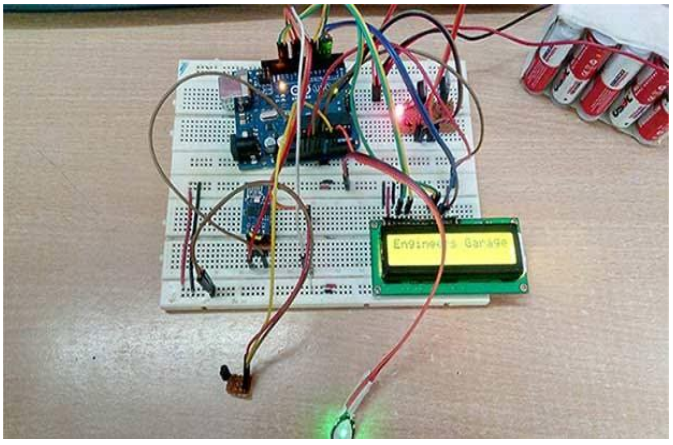
3. **Automatic motor-controlled system:** Home automation is growing rapidly in this decade, thisproject is one of the best products in this domain. In this system a water level sensor is used fordetecting the water level in the tank. Relay circuit is used in switching on and off of the motorpump. Both the relay circuit and water level detecting circuit is communicated via the ESP8266 controller.



S.NO	Component	Quantity
1	ESP 8266	1
2	Water level sensor	1
3	DC motor pump	1
4	Relay	1
5	Bread board / PCB board	1
6	Connecting wire	Required quantity

4. **Patient monitoring system:** PMS is one of the most important equipment in intensive care units (ICU) and critical care units (CCU). In this device various vital parameters like temperature, respiration rate, pulse rate, oxygen level and many other parameters are monitoredcontinuously. Using thermistor, flex sensor, pulse rate sensor interfaced with controller we can monitor such vital parameters.

Task 1: Do a study on various bio vital parameters and select the parameters that we are goingto monitor.
Task 2: Do research on how the selected parameters can be received from the human andmonitored.
Task 3: Design a circuit to measure the selected bio signals in a simulation software and verifyits output.
Task 4: Develop code for the microcontroller to measure all the bio-signals. And also developa protection circuit as human interaction takes place.
Task 5: Build the circuit with the components and upload the developed program to thecontroller. Once the assembly gets completed check its functioning.



S.NO	Component	Quantity
1	ESP 8266	1
2	Thermistor	1
3	Max30102	1
4	Flex sensor	1
5	Bread board / PCB board	1
6	Connecting wire	Required quantity

5. **Sensor guided embedded robot:** Sensor guided embedded robot is a made of a three tire chassis in which two wheels are sensor controlled and another is a castor wheel. The sensor usually used is an IR sensor which makes the robot avoid obstacle or follow a line. The sensoris connected with the controller which gives the information for the motor driver that makes the motor function.

Task 1: Confirm the application of the robot that we are going to develop and do a study on it.

Task 2: List down the sensors and microcontroller unit that is needed for developing the robot.

Task 3: Design the circuit in simulation software and check whether the circuit designed can make the robot run.

Task 4: Develop the code for the microcontroller system. Compile the program to avoid errors in it.

Task 5: Interface the sensors, chassis and microcontroller and upload the program to the microcontroller and check the functioning of the robot.

S.NO	Component	Quantity
1	ESP 8266	1
2	Three tire chassis	1
3	IR sensor	3
4	Motor driver L293D	1
5	Bread board / PCB board	1
6	Connecting wire	Required quantity

6. **Automated home-based fan and light system:** In this project the basics of home automationcan be studied. The fan and light are controlled by the controller which gets the input from the sensors. For controlling the fan thermistor is used. When the temperature crosses the cut-off temperature the controller makes the fan run. Similarly light is controlled by the LDR. When the light intensity falls below the cut-off point the controller turns the light on.

Task 1: Do research on home automation and plan the appliance that we are going toautomate.

Task 2: Design a circuit for automating the fan and light from the temperature and lightintensity data.

Task 3: List down the components and sensors required for developing this project. Simulatethe circuit in the simulation software and evaluate its functioning.

Task 4: Develop the code for microcontroller for automating the fan and light from the datareceived from the sensors.

Task 5: Build the circuit with the required components and upload the program to the microcontroller.

S.NO	Component	Quantity
1	ESP 8266	1
2	LDR	1
3	LED	3
4	Motor driver L293D	1
5	Thermistor	1
6	Motor	1
7	Relay	1
8	Bread board / PCB board	1

7. Embedded based irrigation system: It is an automated system that makes the pump on only when the soil is dry. The soil moisture sensor is inserted in the soil which continuously monitors the soil moisture level and gives input to the controller. Once the soil moisture reachesthe dry level the controller turns on the pump through which the water is passed to the soil andmoisture level can be maintained.

Task 1: Do research on the water requirement for agriculture and benefits of drip irrigationsystem.

Task 2: List down the components required for building the automated drip irrigation system.Design the circuit in simulation software and check its output.

Task 3: Start developing the code for operating the microcontroller. The microcontroller willcontrol the functioning of water pump from the sensor data

Task 4: Build the circuit with the components required and upload the developed program tothe microcontroller.

Task 5: Place the system in an agriculture field to check its working efficiency.

S.NO	Component	Quantity
1	ESP 8266	1
2	Soil moisture sensor	1
3	DC pump	1
4	Motor driver L293D	1
5	Bread board / PCB board	1

Debug Projects:

Project 8: Troubleshooting of low voltage power supply in SMPS

Problem statement: Output voltage is not coming properly

Bugs/Issues introduced in the board:

1. **AC input**
2. **Transformer**
3. **Rectifier**
4. **Regulator**
5. **Missing of connection**

Task 1: know the AC and DC fundamental and lows related with low voltageTask 2:
Role of active and passive components in circuit designing

Task 3: fault detection in electrical and electronics through the step-by-step routing

Task 4: Finding the fault component and give the solution for that fault

Skills to be taught:

- Voltage and current knowledge
- Testing knowledge of AC and DC power supply components (like rectifier, voltageregulator and so on)
- Various application mode of multi meter (AC, DC, Continuity)

Components

- Low voltage board
- Multimeter

Outcome

- Troubleshoot & Fix of Active and Passive components related bugs in the board
- Usage of safety and testing tools

Project 9: Troubleshooting of high voltage power supply in inverter board

Problem statement: Fluctuation in output voltage

Bugs/Issues in the board:

1. DC input
2. Inverter IC
3. MOSFET
4. Booster circuit
5. Missing of connection

Task 1: Know the AC and DC fundamental and lows related with high voltage
Task 2: Role of semiconductors and integrated circuit components in circuit designingTask 3: fault detection in electrical and electronics through the step by step routing Task 4: Finding the fault component and give the solution for that fault

Skills to be taught:

- Voltage and current knowledge
- Testing knowledge of DC and high voltage AC component Knowledge (likeMOSFET, transformer, open and short circuit and so on)
- Various application mode of multimeter

Components

- Inverter board
- Multimeter

Outcome

- Troubleshoot & fix High frequency components and Booster circuit bugs

Project 10: Troubleshooting of wireless data transmission circuits

Problem statement: Communication broken.

Bugs/Issues in the board:

1. Tx connection
2. Rx connection
3. Communication protocol
4. Oscillator
5. Connection issue

Task 1 Various wireless communication technology in embedded system designTask 2 Suitable wireless technology for industrial application
Task 3 checking the data transformation through troubleshooting techniqueTask 4 solve the issue and check the communication status

Skills to be taught:

- Testing knowledge of electronic and communication component
- Testing knowledge of communication components using oscilloscope

Components

- Wireless data transmission boards (Tx Rx or Bluetooth, Wi-Fi boards)
- Oscilloscope

Outcome

- Debug & fix data communication bugs

Project 11: Checking the clock signal for given controller board

Problem statement: Not connecting issue

Bugs/Issues introduced in the board:

1. Tx connection
2. Rx connection
3. Communication protocol
4. Oscillator
5. Connection issue

Task 1 Need of clock signal in communication systemTask 2 Clock signal in various state of communicationTask 3 Clock signal testing techniques
Task 4 Clock signal correction techniques

Skills to be taught:

- Clock signal configuration
- Program based signal information

Components

- Microcontroller
- Oscilloscope

Outcome

- Importance of clock in communication
- Checking of clock signal
- Logic analyzer

Project 12: Serial data communication analysis using logic analyzer /oscilloscope

Problem statement: Communication not happened in serial communication systemBugs/Issues in the board:

1. Encoder and Decoder
2. Rx connection
3. Tx connection
4. Oscillator
5. Connection issue

Task 1 Need of serial communication
Task 2 serial Communication protocols and hardware Task 3 logic analysis for data in serial communication Task 4 Correction techniques data in serial communication**Skills to be taught:**

- Communication protocols
- Binary data information
- Logic analyzer

Components

- Microcontroller
- Logic analyzer/oscilloscope

Outcome

- Debug Serial communication and its hardware
- Data checking in serial communication
- Use Logic analyzer

Project 13: Parallel data communication analysis using logic analyzer/oscilloscope

Problem statement: Communication not happened in parallel communication system

Bugs/Issues in the board:

1. Encoder and Decoder
2. Rx connection
3. Tx connection

4. Oscillator
5. Connection issue

Task 1 Need of parallel communication
Task 2 serial Communication protocols and hardware parallel Communication protocols andhardware
Task 3 logic analysis for data in parallel communication Task 4
Correction techniques data in parallel communication

Skills to be taught:

- Communication protocols
- Binary data information
- Logic analyzer

Components

- Microcontroller
- Logic analyzer/oscilloscope

Outcome

- parallel communication and its hardware
- Data checking in parallel communication
- Logic analyzer

Project 14: Trace the embedded software operation using logic analyzer

Problem statement: Embedded system not working

Bugs/Issues in the board:

1. Power supply issue
2. Communication issue
3. Clock signal issue
4. Logic issue
5. Connection issue

Task 1 Find the correct problem
Task 2 Find the reason for the problemTask 3
Solve the issue
Task 4 Check the performance

Skills to be taught:

- Hardware and software about embedded system
- Application of embedded system

Components

- Embedded project
- Logic analyzer

Outcome

Circuit hardware knowledge Communication protocol Troubleshoot and solution techniques

Software Required:

- MPLAB IDE Tool (Student Version)
- C Compiler Evaluation version

Lab Hardware Required (to be provided by the college):

- Soldering Kit
- Oscilloscope
- Multimeter
- PC – i5 with windows - 64 bit & 8GB RAM

Mode of Delivery: Hybrid

Hybrid of 60 hours with:

- 45 hours of physical practical/lab classes
- 15 hours of on-line theory classes

Student Enrolment Plan

- Each college will be provided an "College Admin" login for their students.
- They will login to Ingage LMS and choose one of the 6 Batches available per day for enrolling their students.
- Upon successful enrolment student will need to accept the confirmation email and join class in the same link until the semester end.
- The Online classes will be assisted with PowerPoint and augmented with a live instructor
- Certain theory session would require students learn the concept and join the class for a group discussion as advised by the online instructor
- Attendance will be sent to "College Admin" for reconfirmation and for other office uses.
- During course progression student will have to submit their assignment, project work, and complete the MCQ Quiz to be eligible for the final certification.
- Their final grade will be shared with college and once approved it will be shared as a final email for students.
- Students will get access to course material and other learning content until the validity of the course or up to one year whichever is applicable

Faculty:

A team of 45 trainers distributed across all districts

- Trainers are all experienced in developing 3d design projects
- A reserve of 25 trainers in place to deal with new scenarios/issues
- Each trainer will have a hardware & software kit

Project Evaluation:

There would be exercises after every unit and a project at the end of the course in Unit 5. The exercises in units 1 to 4 would be evaluated online through virtualization screen (mirroring mode) and physically (face-to-face) of the project implementation at the end of the course when Ingage visits the college campus.

Course Evaluation:

Yes. There would be 2 evaluations through the semester including the final project and one for the theoretical contents of the course.

Multiple hybrid branch for students:

The graphic design course is being offered to multiple departments. The course content will be the same for all branches but the exercises and the final mini-project can be chosen from the respective departments so the subject matter expertise of the student can be leveraged.

Train-the-trainer:

- We are providing the TOT physical training to all the selected faculty

Personalized Students support system:

- Support for competitions, Hackathons & Tech Jam
- Physical & virtual Internships & jobs supported
- Access to mentorships during & post course completion

Financials:

- Our cost for Naan Mudhalvan Initiative: Rs 1450 per student + GST for a minimum of 14,000 students.
- The price includes all the hardware & software infrastructure required for student learning
- The price includes the “Training Of the Trainers” (ToT) program