IoT Basic 101 to Industry Ready

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Introduction

1) Ideology 'Who we are' 'What we do' (Open-Source Concept. 'Best way to learn is to Teach')

   IoT, What's the Hype? The Internet of Things, this wave has disrupted almost every corner of the industry and its still in his infancy. Based on a forecast model, number of connected devices by 2024 will be 10 times the population of the world. That counts to almost 84bn. Besides this much potential area of IoT is not very well understood.

   Presented course covers hands on experience in the IoT regime.

   - Product Development from concept to production
   - Edge computing and Intelligent networks
   - Enterprise level IoT Infrastructure Management.
   - Micro/Macro cluster architecture.
   - Use Case - Home Automation and Smart Lightning.
   - Use Case – Connected Health Monitoring System.

2) Prerequisite and 'Who should opt '.

   This course gives the candidate a deep dive into IoT domain from basics to full scale IoT infrastructure management. Course is recommended for any candidate interested in learning IoT aspects with below listed prerequisites.

   - Candidate should be familiar with C or C++ programming language.
   - Candidate should be ready to get its hands dirty with hardware and electronic components.
   - Basic Electronic circuit knowledge is preferable but not an absolute necessity.

Module 1 - IoT and Embedded Computing (4 weeks)

3) Introduction to IoT.
   a. Foundation Electronics.
      a) Active and Passive components.
      b) Introduction to BJT, FET and MOSFETs.
      c) Common integrated circuits. (555, ULN, Optocoupler).
   b. IoT infrastructure.
      a) *The hype*?
      b) *Desktop vs Embedded vs IoT*.
      c) *Hardware, Firmware & Software*.
      d) *Node, Hub, Edge, Cloud, Analytics*.
   c. IoT network topologies.
      a) *Network Interfaces (WiFi, Cellular, LoRaWAN, etc)*.
      b) *Topologies (Standalone, Mesh, Hybrid)*.

d. Hardware options (ESP, Pi, Photon, Arduino Ble, MKR, Nordic, STM, etc).
    a) *Introduction to commonly available hardware.*
    b) *How to choose a hardware*.
e. Introduction to IoT Coach, ESP32 and on-board sensors walk through with preloaded demo program.
    a) *Introduction to Microcontrollers*.
        1. MPU vs MCU.
        2. What to use When?
    b) *Introduction to IDE and Toolchain*.

4) Serious Embedded business.
    a. Logic Levels.
        a) *TTL vs CMOS*.
        b) *Low power devices*.
        c) *Level shifters*.
    b. IOs [Digital, Analog].
        a) *DIO Port modes (Input and Output)*.
        b) Debouncing problem
        c) *Pullup and Pulldown*.
        d) *AI and AO*.
        e) *Sensor modules*.
    c. Buses [SPI, I2C, UART].
        a) *Introduction to hardware interfaces*.
        b) *Addressable vs Non-Addressable*.
        c) *Master Slave Configuration*.
    d. Timers, PWM.
        a) *RTC*
        b) *Square Wave*.
        c) *Pulse Width Modulation*.
    e. Interrupts.
        a) *Hardware vs Software*.
        b) *IRQ*.

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f. IDE setup and Initial Kit boot up.
g. Weather Station.
h. Twilight Switch.
i. Touch less dispenser.
j. Door Alarm (Hall sensor).

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Module 2 – Expanding the Dominion (8 Weeks)

1) Cloud basics. Wifi, webserver.
    a. Wifi configuration modes (AP, ST, Dual).
    b. Webserver on microcontroller.
    c. Introduction to cloud (Free tier).
2) Data communication protocols Rest, PubSub.
    a. Http and MQTT
    b. Controlling microcontroller via Cloud.
3) Introduction to Flutter.
    a. What is Flutter.
    b. Flutter development environment.
    c. Introduction to Dart programming language.
    d. Loops, Flow Control, Conditional structures, Async operations.
    e. Introduction to widgets.
4) Introduction to BLE.
    a. Bluetooth vs BLE.
    b. Client and Server configuration.
    c. Services, Characteristics and Descriptors.
    d. Common BLE Services.
    e. Receiving Sensor Data on Android device.
5) OTA update.
    a. Local network based

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a) Mobile Controlled rover.
b) Ambient Light Controller App.
c) Self-watering Pot App.
d) Smart Home Architecture.

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Module 3 – IoT & ML (8 Weeks)

1) Basics of Python Programming. (Already Completed)
    a. Intro to Matplotlib
    b. Intro to Pandas
2) Intro to ML.
    a. Conventional vs ML
        i. Why?
        ii. Types of ML problem statements
    b. Generics of Machine learning
        i. Supervised
            1. Regression
            2. Classification
        ii. Unsupervised
            1. Clustering
            2. Association
        iii. Reinforced Learning
            1. Control
    c. Introduction to Regression analysis.
        i. Linear Regression
            1. Gradient Decent Method
            2. Normal Equation
        ii. Logistic Regression
            1. Binary Classifier
    d. Introduction to Tensor Flow.
        i. Data representation & Normalization 2d, 3d, Tensors.
        ii. Environment Setup
        iii. Training, validating and testing sample regression models.
        iv. Performance Measure
    e. Introduction to Neural Networks.
        i. Perceptron
        ii. Weight, Bias & Activation function
        iii. Backpropagation
        iv. Multi-Layer Perceptron
3) ML on Microcontrollers.
    a. Introduction to Tensor flow lite.
        I. Building and training the first Model.
        II. Performance measurement and optimization.
        III. Toolchain setup to run TFLite.
        IV. Transferring and running the trained model on IoTCoach Kit.

b. Real life problem 1
    i. Self-Watering App as Smart
        1. Formulating the problem.
        2. Model setup (Soil Moisture, Humidity, Temperature, Pressure).
        3. Training the data
        4. Validation and Testing.
        5. Transferring the model to IoTCoach
c. Introduction to Reinforced Learning
    i. Markov Decision Process
        1. Bit of Probability theory and Sets
        2. Actions, rewards, state, policies and discount
    ii. Real Life Problem 2
    i. Self-Navigating Rover
        1. Formulating the Problem
        2. Model setup (Ultrasonic and Light)
        3. Define MDP parameters (States, Actions, Transition Matrix and policy)
        4. Training and testing the model in real scenario.
        5. Evaluating the model progress.

4) IoT Security Practices (use case).
    a. Network vulnerabilities.
    b. Software vs Hardware breach.
    c. Common network attacks and measures.

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e) Smart Rover using Light and Distance sensor.
f) Connected Health Monitoring System.
g) Intelligent Self-watering Pot.

Project work (4 weeks)

Appendix

Required Hardware Components.

Foundation Course

i. *Assorted Resistors, Diodes, Capacitors and Transistors*.
ii. *ICs NE555, ULN2003, PC817*
iii. *RGB Led Strip.*
iv. *Power Supply – 5v, 12v*
v. *Bread Board -1*
vi. *Jumper wires – Male-Male, Male-Female, Female-Female*
vii. *Multimeter – 1*
viii. *Neodymium Magnets – Square piece*

a) *IoT Coach Kit*.
   OR
   Alternatively.
   a. Esp32 Dev kit.
   b. OLED SSD1306.
   c. BME280 module / DHT22.
   d. HC SR04 Ultrasonic Module.
   e. L298 Motor driver module.
   f. 5v Relay Module.
   g. LDR.
   h. Buzzer.
b) *Dual Motor Rover Chassis*.
c) *SG90 micro servo motors*.
d) *Soil moisture sensor.*