IoT with Raspberry Pi Course Syllabus

Module (1/8)
Module Name: Overview of IoT and High level Architecture

Objectives:

- To walk though technology timeline(brief history) and evolution of IoT
- Gain knowledge about IoT applications across various segments
- Understand IoT architecture and its building blocks
- Introduction to various IoT platforms
- Understand the technology and skills required in building and IoT product.

Detailed course contents:

- What Is the Internet of Things (IoT)?
- Brief History and evolution of IoT
- IoT Architecture and Protocols
- Various Platform of IoT
- Overview of IoT components and IoT Communication Technologies
- Trends in the Adoption of IoT
- IoT is Powerful and Pervasive
- Societal Benefits of IoT
- Risks, Privacy, and Security

Module (2/6)
Module Name: Setting up IoT Workflow

Objectives:

- Setup IoT platforms, by understanding the knowledge gained in the previous module
- Become familiar with the building blocks in IoT architecture
- Implement IoT use cases using various IoT platforms

Detailed course contents:

- Arduino Simulation Environment
- Arduino Uno Architecture
- Setup the IDE, Writing Arduino Software

- Arduino Libraries

Module (3/6)
Module Name: Advanced / Embedded C Programming

Objectives:

- Clearly understand concepts of C language
- To obtain good quality and style in programming
- Gear you up for programming in Embedded environment
- To induce confidence in you!

Detailed course contents:

- Basics of C:
- Operators
- Conditionals
- Arrays
- Functions
- Advanced C programming:
- Structures
- Unions
- Files
- Deep dive into pointers
- Pre-processor directives
- Recursion
- Project environment - Creating & Building a project, Makefiles
- Deep dive - Logic to program translation, Creating your own library, Dry-run
- Data Structures
- Basics of Embedded C programming for Arduino
- Interfacing LED, push button and buzzer with Arduino
- Interfacing Arduino with LCD

Module (4/6)
Module Name: Micro-controller programming using Arduino platform

Objectives:

- Understand Embedded Systems and its components
- Learn how to build embedded applications using Arduino Platform

- Become familiar with hardware interfacing using Arduino
- Should be able to read device datasheets and board schematics
- Learn basic communication protocols and communicate using Arduino Libraries
- Build IoT applications using wired and wireless protocols (ex: Bluetooth, Wifi)
- Debug applications using Arduino IDE

Detailed course contents:

- Overview of Embedded Systems
- Components of Embedded Systems
- Micro-controller Architecture and Properties
- Installing and Setting up the Arduino development environment
- Blinky Sketch – A walk through
- Arduino Sketches
- Classes
- Sketch Structure
- Pins
- Arduino Shields
- Hands-on working with GPIOs, Analog I/Os, Memory usage
- Micro controller peripherals usage - Timers, Counters, Interrupts and its sources
- Communication protocols I - UART, SPI, I2C, CAN
- Interfacing IoT sensors and Actuators
- Debug applications using Arduino IDE
- Communication protocols II – Wired and Wireless communication
- Ethernet Client Server Implementation
- Build WiFi Application
- Build Bluetooth Application

Module (5/6)
Module Name: Building IoT Applications using Raspberry Pi

Objectives:

- Become familiar with Raspberry Pi (Rpi) hardware
- Setup and Install Raspbian OS on Rpi
- Understand how Rpi can be leveraged as an IoT gateway
- Become familiar with Linux OS
- Setup Rpi as an IoT gateway
- Using Python Interface with Arduino using Serial Port Interface
- Build Socket applications to communicate to Arduino device using Ethernet, Wifi and

- Bluetooth interfaces
- Build IoT applications using HTTP and MQTT protocols
- Learn to use Node Red programming tool

Detailed course contents:

- Overview of Raspberry Pi (RPi) hardware platform
- Peripherals on Rpi
- Setup and Install Raspbian OS on Rpi
- Overview of Linux OS and its sub-systems
- Process
- Memory Mangement
- Multi-Threading
- IPC
- Linux CLI and important commands
- Linux File System
- Everything is a file concept in Linux
- Device Access using system calls
- Install packages on Raspbian OS
- Setting up Raspbian as an IoT gateway
- Write Python program to interface with Arduino using serial libraries
- IoT Communication Models and Protocols
- Request-Response, Publish-Subscribe, Push-Pull, Exclusive Pair
- Application Protocols: HTTP, CoAP, MQTT, AMQP
- Communication APIs: REST-based, WebSocket-based
- Network Layer: IPv4, IPv6, 6LoWPAN
- Building python based programs to communicate to cloud server using various application
- protocols
- Develop a complete python based application IoT application
- Rpi as a device
- Interfacing with sensors and actuators using GPIO pins
- Interfacing with camera on Rpi

Module (6/6)
Module Name: Performance and Security in IoT

Objectives:

- Learn how to benchmark IoT applications and platforms
- Understand the security risks in IoT, counter measures and design consideration
- Get an understanding of using crytography in IoT

Detailed course contents:

- Benchmarking IoT applications and Platforms
- MQTT vs HTTP performance
- Security considerations
- Firmware updates
- Cryptography basics
- Cryptography in IoT
- Privacy considerations and design guidelines