Macao Polytechnic University

Faculty of Applied Sciences

Master of Science in Big Data and Internet of Things

Module Outline

Academic Year 2022/2023 Semester 1

Learning Module	Introduction to the Internet of Things			**Class Code**	COMP6121
Pre-requisite(s)	Nil				
Medium of Instruction	English			**Credit**	3
Lecture Hours	45 hrs	**Lab/Practice Hours**	0 hrs	**Total Hours**	45 hrs
Instructor	K. L. Eddie Law		**E-mail**	eddielaw@mpu.edu.mo	
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Description

This module provides a comprehensive overview of the Internet of Things (IoT) from the global context, and introduces the design fundamentals of the IoT. An IoT environment should facilitate interactions among intelligent machines, smart devices, ubiquitous computers, physical objects and human users. A number of underlying technologies enabling IoT will be discussed, for example, the sensing technologies, wireless sensor networks, machine-to-machine communications, Cloud and Fog computing technologies, etc. In particular, the core system architectures, such as the middleware to design single device and multi-device systems, will be discussed. In order to obtain more hands-on experience in building IoT applications, project-based system constructions through interconnecting different smart sensing devices and programming Raspberry Pi and Arduino single board computers will be covered

Learning Outcomes

After completing the learning module, students will be able to:

1. Justify the need of IoT in a range of complex application domains; (SM1fl, SM2fl, ET2fl)
2. Critically evaluate heterogeneous devices; (EA1fl)
3. Synthesize functional IoT systems through various programmable sensors/devices; (EP2fl, EP1fl, EP3fl)
4. Justify the roles of various technologies in enabling IoT; (SM3fl)

5. Analyze and determine the domain requirements for building different complex IoT solutions; (ET3fl)
6. Design advanced the IoT-based applications based on user needs. (D1fl, D2fl, D3fl)

Content

1. Introduction (3 hours)
   - 1.1 Understand the design fundamentals of IoT and some feature applications
   - 1.2 Incorporate design ideas of wireless sensor networks (WSNs) and machine-to-machine (M2M) communications
   - 1.3 Outline the functionalities of sensing devices and sink/gateway components

2. Models and architectures of IoT (3 hours)
   - 2.1 Discuss different architectural models of IoT and their basic operating components
   - 2.2 Identify the functional models of the Internet and Cloud Computing in IoT
   - 2.3 Outline the relationship between edge / fog computing and WSNs

3. Sensing devices (6 hours)
   - 3.1 Elaborate the physics underneath different sensing devices
   - 3.2 Apply sensing devices to different operating scenarios for different applications

4. Hardware platforms for IoT (3 hours)
   - 4.1 Discuss available single board computing platforms for IoT systems
   - 4.2 Review common coding languages for different single board computers (SBCs)
   - 4.3 Understand basic coding platforms for, e.g., Arduino and Raspberry Pi devices

5. Hardware platforms for IoT (12 hours)
   - 5.1 Review in detail some common link layer (BLE, BT mesh, ZigBee), and transport layer (UDP, TCP) technologies for sensing devices
   - 5.2 Explore 6Lo protocols for interfacing higher layer protocols
   - 5.3 Review IPv6 (cross reference to IPv4) and interoperability to link layer wireless protocols
   - 5.4 Define routing protocols among sensors and gateways, e.g., the IPv6 Routing Protocol for Low Power and Lossy Networks (RPL)

6. Application layer protocols (12 hours)
   - 6.1 Understand the needs of sensor management
   - 6.2 Introduce and discuss features and functionalities of different application layer protocols, such as, Constrained Access Protocol (CoAP), Message Queue Telemetry Transport (MQTT, MQTT-SN), and Advanced Message Queueing Protocol (AMQP), etc.

7. Security and privacy issues (3 hours)
   7.1 Investigate with case studies

8. Other design issues (3 hours)
   8.1 Topic: Describe interoperability and reliability issues
   8.2 Topic: Analyse performance with a selected IoT platform

Teaching Method

Lectures, case studies, group presentation and discussion

Attendance

Attendance requirements are governed by the "Academic Regulations Governing Master's Degree Programmes" of Macao Polytechnic University. Students who do not meet the attendance requirements for the module shall be awarded an 'F' grade.

Assessment

The learning module is graded on a 100 point scale, with 100 being the highest possible score and 50 being the passing score.

	Item	Description	AHEP3 LO	Percentage
1.	Assignments	Knowledge assessment	EA1fl, EP1fl, EP2fl, EP3fl	35%
2.	Test	Knowledge assessment	SM1fl, SM2fl,SM3fl, ET2fl	25%
3.	Group project	System design exploration	EA1fl, EP1fl,EP2fl, EP3fl, D1fl, D2fl, D3fl	40%
			Total Percentage:	100%

Teaching Material(s)

Textbook(s)

There is no official text for this module. Module notes are distributed in classes.

Reference

Reference book(s)

1. Lea P. (2020) Internet of Things for Architects, Second Edition, Packt Publishing.
2. Cirani S., Ferrari G., Picone M., Veltri L. (2019) Internet of Things – Architectures, Protocols and Standards, John Wiley & Sons Ltd.

Website(s)

1. Arduino Reference – https://arduino.cc/references/en/
2. Raspberry Pi Documentation – https://raspberrypi.org/documentation/