Internet of Things: Embedded software development

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IOT: ESD is course in which students are taught to develop microprocessor based software solutions. During education, students are introduced to the basics of electronic circuits and the physical characteristics of various electronic components. The development of the solution includes the design of the circuitry and the development of the background application in C / C ++. Used microprocessor and basic components are based on Photon Particle development board. In addition to the development of applications, students are introduced to different types of sensors and actuators that they can use when designing their projects. Thanks to the IOT features of the Photon Particle Component, education also involves connecting and managing devices over the Internet

Planned ECTS: 2

Number of learners: 29

Mode of delivery: Blended

Status: COMPLETED

Course public access: Public

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Course learning outcome	Level	Weight
Interpret and use ESD development documentation	Understanding	6
Develop a prototype IOT application	Creating	11
Program an ARM-based micro-controller using C / C ++ development tools	Creating	15
Develop an IOT solution and connect it to existing business systems	Creating	15
		Total weight: 47

Topic / Unit name	Workload	Learning type	Mode of delivery	Groups	Collaboration	Feedback	Mandatory activity	Assessment		
								Points	Type	Providers

Internet of Things introduction

IOT Devices												
Introduction to the IOT devices IOT device can be various objects in everyday work and living. Device can be a factory as well as a human	60 min	Acquisition	Hybrid	Synchronous	Teacher present	No	No	No	No	5	Formative	Automated
Particle ecosystem Explore ecosystem of Particle devices in the field of Internet of Things	60 min	Acquisition	Hybrid	Synchronous	Teacher present	No	No	No	No	5	Formative	Automated
Total unit workload	2h											
IOT project												
Project - design Group up and work on a project description	60 min	Discussion	Online	Asynchronous	Teacher not present	No	Yes	Teacher	No	5	Formative	Teacher
Project - feedback Discussion about each project with all teams	50 min	Discussion	Onsite	Synchronous	Teacher present	No	No	Teacher, Peer	No	No		

Project - development Group activity where students work on an IOT prototype.	1600 min	Production	Online	Asynchronous	Teacher not present	No	Yes	No	No	No		
Project - presentation Each team of students have a time to prepare project presentation, after that i a pitch style presentation students will present their project. After that starts a short discussion between peers and teacher	60 min	Discussion	Onsite	Synchronous	Teacher present	No	Yes	Teacher, Peer	No	50	Formative	Teacher
Total unit workload	29.5h											

Inputs, EEPROM and OLED

Interpret and use ESD development documentation (**10%)**, Program an ARM-based micro-controller using C / C ++ development tools (**10%)**

Inputs

Input and output interface Detailed insight into inputs and outputs of an IOT devices. Input may include sensors where outputs are various actuators.	60 min	Acquisition	Hybrid	Synchronous	Teacher present	No	No	No	No	5	Formative	Automated
Demo - I/O Reading the sate of the button and displaying the state as a LED state	90 min	Practice	Hybrid	Synchronous	Teacher present	No	No	Teacher	No	No		
Test video	50 min	Production	Online	Asynchronous	Teacher not present	No	No	No	No	No		
Total unit workload	3.33h											
EEPROM												

EEPROM memory system for permanent storage Teacher will provide lecture on EEPROM memory that used for storing values permanently, regardless of the state of IOT device.	60 min	Acquisition	Hybrid	Synchronous	Teacher present	No	No	No	No	5	Formative	Automated
Demo - EEPROM Students will learn to store and read values from EEPROM memory in the form of demo with buttons and LED.	90 min	Practice	Hybrid	Synchronous	Teacher present	No	No	Teacher	No	No		
Total unit workload	2.5h											
OLED												

OLED sceen Teacher will provide information regarding basic features of OLED screen as well as instructions how to use it and how to connect it to the hardware.	60 min	Acquisition	Hybrid	Synchronous	Teacher present	No	No	No	No	5	Formative	Automated
Demo - OLED Students will run basic and advanced OLED demo from the official library. After that they can explore various features of OLED screen.	90 min	Practice	Hybrid	Synchronous	Teacher present	No	No	Teacher	No	No		
Total unit workload	2.5h											

Sensors and PWM

Interpret and use ESD development documentation (**5%)**, Program an ARM-based micro-controller using C / C ++ development tools (**10%)**

PWM

Pulse width modulation - PWA Teacher will provide a lecture on theoretical basis of PWM as well as techniques to encode information and use formulae to determine PWM parameters.	60 min	Acquisition	Hybrid	Synchronous	Teacher present	No	No	No	No	5	Formative	Automated
Demo - PWM Students will use PWM to control LED as well as to control servo engine.	60 min	Practice	Hybrid	Synchronous	Teacher present	No	No	Teacher	No	No		
Tone and music PWM can be used to encode tones thus making a music	60 min	Acquisition	Hybrid	Synchronous	Teacher present	No	No	No	No	5	Formative	Automated
Demo - Tone Students will make a demo that plays single tone sounds, after that actual music scores will be encoded and played on a speaker.	90 min	Practice	Hybrid	Synchronous	Teacher present	No	No	Teacher	No	No		

Total unit workload	4.5h											
Sensors												
Temperature and humidity sensors Teacher will provide basic introduction to the sensors as well as single wire interface for DHT22 temperature and humidity sensor	60 min	Acquisition	Hybrid	Synchronous	Teacher present	No	No	No	No	5	Formative	Automated
Demo - DHT22 Students will connect and read values from DHT22 temperature and humidity sensor.	90 min	Practice	Hybrid	Synchronous	Teacher present	No	No	Teacher	No	No		
Total unit workload	2.5h											
Energy in IOT Interpret and use ESD development documentation (**15%)**, Develop a prototype IOT application (**5%)**, Program an ARM-based micro-controller using C / C ++ development tools (**15%)**												
Energy												

Energy in IOT Lecture on energy issues in the IOT as well as techniques on energy harvesting, storing and saving.	60 min	Acquisition	Hybrid	Synchronous	Teacher present	No	No	No	No	5	Formative	Automated
Deep sleep Lecture on deep sleep modes and how can they be used for managing power consumption	60 min	Acquisition	Hybrid	Synchronous	Teacher present	No	No	No	No	5	Formative	Automated
Demo - Deep Sleep Demo on Deep sleep modes on actual device.	90 min	Practice	Hybrid	Synchronous	Teacher present	No	No	Teacher	No	No		
Total unit workload	3.5h											

Communication technologies

Develop a prototype IOT application (**10%)**, Program an ARM-based micro-controller using C / C ++ development tools (**10%)**, Develop an IOT solution and connect it to existing business systems (**25%)**

Communication

Communication technologies Lecture on communication technologies in the field of IOT. Communication is the basis of "Internet" segment of Internet of Things	60 min	Acquisition	Hybrid	Synchronous	Teacher present	No	No	No	No	5	Formative	Automated
Total unit workload	1h											
Sigfox												
Sigfox Introduction to the global network for IOT devices that uses low power and low data rate communication.	60 min	Acquisition	Hybrid	Synchronous	Teacher present	No	No	No	No	5	Formative	Automated
Demo - Sigfox Sigfox demo where single button press will transmit data over the Sigfox network.	90 min	Practice	Hybrid	Synchronous	Teacher present	No	No	Teacher	No	No		
Total unit workload	2.5h											

Cloud operations

Develop a prototype IOT application (**60%)**, Program an ARM-based micro-controller using C / C ++ development tools (**25%)**, Develop an IOT solution and connect it to existing business systems (**55%)**

Cloud system

Cloud Lecture on Cloud interface for the Particle devices. Introduction to various cloud concepts like function, variable and events.	60 min	Acquisition	Hybrid	Synchronous	Teacher present	No	No	No	No	5	Formative	Automated
Demo - cloud Demo where board is controlled using the cloud as well as controlled by 3rd party service using REST integration services.	90 min	Practice	Hybrid	Synchronous	Teacher present	No	No	Teacher	No	No		
Total unit workload	2.5h											

Final project

Final project Lecture where final teaching project assignment is presented and explained.	30 min	Acquisition	Hybrid	Synchronous	Teacher present	No	No	No	No	No		
Final project - on site Each student should individually create final teaching project	180 min	Practice	Hybrid	Synchronous	Teacher present	No	No	Teacher	No	No		
Exam Final theoretical exam.	60 min	Assessment	Hybrid	Synchronous	Teacher present	No	No	No	No	20	Formative	Automated
Total unit workload	4.5h											
Total course workload	**60.83h**											