Module Name: The Internet of Things

Module Acronym: IOT

Module Manager: Dr Ryan Grammenos

Course Summary:

The module is designed to provide students with a solid technical introduction to the Internet of Things (IoT). The course is broadly divided into two parts, namely development at the edge and development in the cloud. A systems engineering approach is adopted reviewing the key technologies employed at different levels of the IoT stack and how they are integrated to form complete IoT systems.

The course has a significant practical element in that 50% of the technical content will be delivered during lab sessions in which students are expected to complete exercises involving system design, device programming and cloud development.

It is assumed that students will have a background in electronic engineering or a related subject. They will need to have an understanding of basic networking along with basic programming or coding experience (in any language). For the development at the edge, familiarity with functional C/C++ programming would be useful since these languages are used to configure the sensors and edge computing platforms. For the development in the cloud, JavaScript and HTML are widely used though prior knowledge of these languages is not required.

A number of devices, platforms and software tools will be introduced during the course from different vendors including but not limited to Texas Instruments (TI), ARM and IBM. Examples include:

- Devices: Raspberry Pi, TI CC3200 Launchpad, TI STK2650 SensorTag.
- Edge programming: TI Energia.
- Cloud development: IBM Bluemix, NodeRED.

The course will be complemented with guest speakers from industry who will demonstrate how the Internet of Things fits within the context of “Smart, Connected Products and Services” and generally within the ICT industry.

The module is assessed by means of a group project which carries 100% of the marks. Students will be given 3 weeks to complete the technical aspects of the project (by the end of Term 2). Submission of reports comprising group and individual sections will then be required right at the start of Term 3 followed promptly by a project demonstration and viva. The project will be based on one of a selection of scenarios proposed for students to choose from and will require each group of students to build and demonstrate a complete IoT system to perform specific tasks.

Intended Learning Outcomes:

On completion of this course, students should be able to:
• Explain the definition and usage of the term “The Internet of Things” in different contexts.
• Understand where the IoT concept fits within the broader ICT industry and possible future trends.
• Appreciate the role of big data, cloud computing and data analytics in a typical IoT system.
• Differentiate between the levels of the IoT stack and be familiar with the key technologies and protocols employed at each layer of the stack.
• Design a simple IoT system comprising sensors, edge devices, wireless network connections and data analytics capabilities.
• Use the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis.

Course Content:

1. Introduction to the Internet of Things
   o What is the IoT and why is it important?
   o Elements of an IoT ecosystem.
   o Technology drivers.
   o Business drivers.
   o Typical IoT applications.
   o Trends and implications.

2. Sensors and sensor nodes
   o Sensing devices.
   o Sensor modules, nodes and systems.

3. Connectivity and networks
   o Wireless technologies for the IoT.
   o Edge connectivity and protocols.
   o Wireless sensor networks.

4. Analytics and applications
   o Signal processing, real-time and local analytics.
   o Databases, cloud analytics and applications.

5. Industry perspective
   o Business considerations.
   o Legal challenges.

6. IOT lab exercises and mini-project
   • Local processing on the sensor nodes.
   • Connecting devices at the edge and to the cloud.
   • Processing data offline and in the cloud.
   • Mini-project: Designing an IoT system (group exercise).

Assessment:

Assessment is by group and individual project reports, as well as a demonstration and viva examination.
Guest Speakers:

Visiting speakers from industrial partners (for example IBM, ARM, Intel) will be invited to share their perspective on the current state-of-the-art in the IoT industry.

Suggested Reading:

- European Alliance for Innovation (EAI), "Internet of Things: Exploring the potential", Innovation Academy Magazine, Issue No. 03, 2015
- Digital Greenwich, "Greenwich Smart City Strategy", 2015
- ITU and Cisco, "Harnessing the Internet of Things for Global Development", A contribution to the UN broadband commission for sustainable development

Pre-work:

Students will be expected to carry out some pre-work to setup and familiarise themselves with the platforms and tools that will be used during the course. Further details will be provided nearer to the start date of the course.