67233 - Electronic Sensor Networks

Información del Plan Docente

Academic Year	2017/18
Faculty / School	110 - Escuela de Ingeniería y Arquitectura
Degree	527 - Master's in Electronic Engineering
ECTS	5.0
Year	1
Semester	First semester
Subject Type	Optional
Module	---

1.General information

1.1.Introduction

The subject forms the student in the techniques of electronic design of sensor networks in the field of intelligent environments and Internet of Things. It presents different types of protocols used in these applications as well as the different strategies of intelligent management of networks and their connectivity to the cloud. It presents embedded devices that integrate real-time systems and are the core of smart sensors with reduced energy consumption.

1.2.Recommendations to take this course

Taking into account the training acquired in the degrees that give access to the Master in Electronic Engineering, it is not necessary any previous previous knowledge to study this subject. Specific previous technical knowledge is necessary in digital electronics, electronic systems with microprocessors and programming in C.

1.3.Context and importance of this course in the degree

This subject is part of the Master in Electronic Engineering. It is a subject of 5 ECTS credits equal to 125 total hours of student work.
Within the context of Intelligent Environments and Internet of Things, context awareness is key. In this respect, knowledge of the technologies used to implement embedded electronic devices as well as the fundamentals of application sensor networks in intelligent environments is of great importance.
This knowledge will enable the student to design and develop electronic devices that are integrated in intelligent environments and able to monitor the environment.

1.4.Activities and key dates

The detailed calendar of the various activities to be developed will be established once the University and the Center have approved the academic calendar (which can be consulted on the website of the center):

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- Delivery of works: will be informed in class of the dates and conditions of delivery.
- Exam: there will be a 1st exam and another 2nd exam on the specific dates indicated by the center.

2.Learning goals

2.1.Learning goals

- To know the fundamentals of application sensor networks in the intelligent environments and Internet of Things.
- To know the main international standards and protocols used in sensor networks.
- To know the energetic implications associated with sensor networks.
- To continue to autonomously acquire new knowledge related to sensor networks.

2.2.Importance of learning goals

Within the realm of Smart Environments and Internet of Things, intelligent sensor networks are key. Its usefulness focuses not only on the ability to automate and adapt the environment, but also on improving aspects related to energy consumption. In this respect, it is very important to know the technologies used, and the emerging ones, to implement electronic sensors and actuators.
The knowledge, skills and abilities acquired through this subject, together with those of the rest of the Master, should allow the student to develop the above competences, as well as to approach with guarantees the realization of a doctoral thesis in the field of sensor networks , Or adequately carry out professional work in that area.

3.Aims of the course and competences

3.1.Aims of the course

The aim of the course is to train the student in the fundamentals of the electronic design of sensor networks, as well as familiarize himself with the appropriate laboratory instruments and some practical applications

1. The networks of sensors, their applications, relation with the environmental intelligence and Internet of Things
2. International standards and sensor network protocols.
3. Electronic design of sensor nodes

3.2.Competences

BASIC SKILLS:
CB6. Possess and understand knowledge that provides a basis or opportunity to be original in the development and / or application of ideas, often in a research context.
CB7. Know how to apply the acquired knowledge and their ability to solve problems in new or little known environments within broader (or multidisciplinary) contexts related to their area of study.
CB10. Learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.
GENERAL COMPETENCES:
CG1. Capacity for physical-mathematical modeling, calculation and simulation in technological and engineering centers, particularly in research, development and innovation tasks in areas related to Electronic Engineering and related multidisciplinary fields.
CG2. Ability to design and design products, processes and facilities in the field of Electronic Engineering.
CG4. Ability to approach with guarantees the accomplishment of a doctoral thesis in the field of Electronic Engineering.
SPECIFIC COMPETENCES:
EC1. Ability to analyze and design advanced analog systems for signal processing, intelligent electronic instrumentation and sensing systems.
EC2. Ability to design and develop advanced digital systems based on programmable devices, configurable logic devices and integrated circuits, with mastery of hardware description tools.
EC5. Ability to specify, characterize and design complex electronic components and systems in telecommunication and medical applications.
EC6. Ability to interpret and apply the regulations for the design, manufacture, homologation and commercialization of

electronic products, systems and services.

4.Assessment (1st and 2nd call)

4.1.Assessment tasks (description of tasks, marking system and assessment criteria)

E1 Assistance and evaluation of practices
Practices will be used to initiate and orient the student in the accomplishment of the practical work. The work done in the laboratory sessions will be evaluated within the practical work. In addition, attendance is considered mandatory because it is a fundamental part of learning. The students will have to submit the corresponding reports to each of the practical blocks.
This activity will be scored from 0 to 10 points and will represent 40% of the student's grade in the subject.
E2 Project of subject
A practical group work activity will be proposed to apply the different concepts and contents seen in the theoretical classes. This learning method is an approximation to the professional activity and a style of learning more autonomous, more efficient and that allows the student to acquire those professional skills that will be more useful in their professional practice.
The work will be done in groups of students. An initial job specification will be proposed. This specification is provided in a document along with an index of chapters that the group must complete. In the initial phase, the group has to decide how to do it and the distribution of tasks. This will be included in the working document and has to be approved by the teacher to continue the realization. Final delivery will include;

- Presentation of the prototype.
- Oral presentation of the work done.
- Workbook with a complete description of the work done, distribution of tasks, calculations made, work diary and any documentation considered necessary to document the work.

This activity will be graded from 0 to 10 points and will represent 30% of the student's grade in the subject.
E3 Research and presentation article
Related to the theoretical contents of the course, the student must write an article that presents the innovation of his work. You should also make a presentation of your work in class.
This activity will be graded from 0 to 10 points and will represent 30% of the student's grade in the subject.
Overall rating: The subject is evaluated in the global assessment modality with the above activities.

5.Methodology, learning tasks, syllabus and resources

5.1.Methodological overview

The methodology followed in this course is oriented towards achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as

- Lectures, where the theoretical basis of sensor networks in Internet of things applications will be presented.
- Laboratory sessions, in which small groups of students will solve representative problems, designs and practical assemblies with sensor networks.
- A project where the student will be responsible for developing the work and the teacher will supervise it.
- The teacher will define different areas of research for students to carry out their research articles and their presentations.

Students are expected to participate actively in the class throughout the semester.

5.2.Learning tasks

The course includes the following learning tasks:

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Classroom activities (1.96 ECTS: 49 hours):

- A01 **Lectures** (10 hours). The fundamental contents of the course will be presented and a set of representative problems will be made. This activity will take place in the classroom. The materials will be available on the virtual platform.
- A03 **Laboratory sessions** (20 hours). Lab sessions are structured in 9 tasks. The detail of the tasks will be available on the virtual platform.
- A06 **Tutorials** (15 hours). Supervision of the project.
- A08 **Assessment tests** (4 hours). It includes the examination, and the review of the test mark and project mark.

Autonomous work (3.04 ECTS: 76 hours)

- A06 **Project** (50 hours). Activity related to the lab sessions and it will be done in pairs.
- A07 **Study** (26 hours). This activity includes personal study aimed at monitoring the learning process, conducting lab sessions, exam preparation and tutorials.

5.3.Syllabus

The course will address the following topics:

Theory

1. Introduction to sensor networks. Applications.
2. Communication protocols in sensor networks. Synchronization. Interoperability. Internet connectivity.
3. RF nodes design, energy considerations.
4. Embedded intelligence and performance metrics.

Laboratory sessions

1. Microcontroller:
   - Task 1: Understanding the environment - Basic I/O, Timing, UART and ADC
   - Task 2: Interrupts, PWM and RTCC (Real Time Clock Calendar)
   - Task 3: Reat time operating system. FreeRTOS
2. WIFI:
   - Task 4: WiFi networking, Exchange TCP data
   - Task 5: HTTP send and receive data
   - Task 6: Internet connectivity
   - Task 7: Low Power
3. ZigBee:
   - Task 8: Zigbee Networking
   - Task 9: Zigbee + WIFI

5.4.Course planning and calendar

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course, will be provided on the first day of class or please refer to the EINA website.

5.5.Bibliography and recommended resources

It will be available on http://moodle2.unizar.es:

- Lecture presentations.
- Task instructions.
- Supplementary teaching materials: a set of useful materials for the course: catalogs of manufacturers, component data sheets, manuals laboratory instrumentation, etc.

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