Course guide
300267 - ARASM - Augmented Reality & Smart Objects

Last modified: 22/01/2024

Unit in charge: Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit: 701 - DAC - Department of Computer Architecture.

Degree: MASTER'S DEGREE IN APPLIED TELECOMMUNICATIONS AND ENGINEERING MANAGEMENT (MASTEAM) (Syllabus 2015). (Optional subject).

Academic year: 2023 **ECTS Credits:** 3.0 **Languages:** English

LECTURER

Coordinating lecturer: Royo Vallés, M. Dolores

Others: Royo Vallés, M. Dolores

PRIOR SKILLS

Solid computer programming skills

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Generical:
03 DIS. (ENG) Diseñar aplicaciones de alto valor añadido basadas en las Tecnologías de la Información y las Comunicaciones (TIC), aplicadas a cualquier ámbito de la sociedad.
06 RES. (ENG) Resolver problemas y mejorar procesos en cualquier ámbito social a partir de la aplicación de las TIC, integrando conocimientos de diversos ámbitos y aplicando ingeniería de alto nivel tecnológico.

Transversal:
03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

Basic:
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.
CB9. Students will be able to communicate their conclusions and the knowledge and ultimate reasons that support them to specialized and non-specialized audiences in a clear and unambiguous manner.

TEACHING METHODOLOGY

The subject combines a small number of lectures, several guided lab sessions and an small project that combines Augmented reality and Smart Objects technologies

LEARNING OBJECTIVES OF THE SUBJECT

In this course, students will learn to:
1. What is and what does Augmented Reality consist of, as well as its applications.
2. To create intelligent objects with Arduino.
3. To program Augmented Reality applications for mobile platforms that use image processing and GPS location techniques.
3. To program Applications for mobile platforms that include information of intelligent objects.

STUDY LOAD

Type	Hours	Percentage
Self study	48,0	64.00
Hours small group	27,0	36.00

Total learning time: 75 h

CONTENTS

Introduction

Description:
General introduction to the course:
1. Introduction to the content of the subject where are presented a detailed breakdown of what topics will be explored during the academic sessions: Augmented Reality and Smart Objects.
2. Materials and work tools: books, documents, programming frameworks
3. Course evaluation
4. Students have to answer a programming level test

Full-or-part-time: 2h
Laboratory classes: 2h

Unity 3D framework

Description:
The work tool of this course is Unity 3D framework. Throughout the course you can see how this framework allows access to the sensors of mobile devices (GPS, camera ...) and how they can be used to create applications for mobile devices (Android), applications that can access smart objects and can combine virtual objects with the real world (Augmented Reality Applications)

Full-or-part-time: 6h
Practical classes: 2h 30m
Self study : 3h 30m

Augmented Reality

Description:
This part of the course will teach you the basics of developing mobile applications using Augmented Reality technology. Through small guided projects, you'll learn practical techniques to rapidly and easily prototype applications for Android devices.

Specific objectives:
Objectives:
. Students will learn the basics of Augmented Reality technology
. Students will be able to prototype applications for Android devices that use this technology

Related activities:
Activities:
1. Augmented Reality Introduction
2. Unity 3D introdction. My firs Augmented Reality app.
3. Augmented Reality based on GPS location
4. Theoretical assessment
5. Project

Full-or-part-time: 40h 20m
Laboratory classes: 13h 30m
Self study : 26h 50m

Smart Objects

Description:
This part of the course, through small guided projects, will teach how to desing and build a smart object based on Arduino and CoAp protocol (server side), also the basics of developing mobile applications to access this smart object (client side).

Specific objectives:
Objectives:
1. Students will learn how to build simple smart objects based on Arduino and CoAp communication protocol.
2. Students will learn to buil prototype applications to get smart object's sensor values

Related activities:
Activities:
1. Introduction to Smart Objects
2. Server side. Build a Arduino smart object based on CoAp protocol.
3. Client side. How to access to the smart object through an Android app

Full-or-part-time: 26h 40m
Laboratory classes: 9h
Self study : 17h 40m

ACTIVITIES

Introduction

Description:
General introduction to the course:
1. Introduction to the content of the subject where are presented a detailed breakdown of what topics will be explored during the academic sessions: Augmented Reality and Smart Objects.
2. Materials and work tools: books, documents, programming frameworks
3. Course evaluation
4. Students have to answer a programming level test

Full-or-part-time: 2h
Laboratory classes: 2h

Augmented Reality. Introduction

Description:
A master class that introduces the basics of Augmented Reality Technology:
1. History
2. Augmented Reality applications
a. Display technology
b. Tracking and Register technologies
c. Interaction technologies
3. Present-day mobile AR applications
4. Conclusions

Full-or-part-time: 2h
Laboratory classes: 2h

Augmented Reality. Introduction to Unity 3D framework. My first App

Description:
In this activity, after an introduction to Unity3D platform, the students complete a guided practice where a simple augmented reality based on image processing is prototyped.

Specific objectives:
The activity has three objectives:
1. Download and set up Unity 3D framework.
2. Program a very simple Augemented Reality application and run it in their laptops.
3. Programming image processing Augmented Reality applications

Material:
Materials:
. Document describing the activity
. Unity 3D framework
. Laptop

Delivery:
The work done during the sessión. At the end of the session

Full-or-part-time: 9h
Laboratory classes: 1h
Guided activities: 4h
Self study: 4h

Augmented Reality. GPS localtion

Description:
After an introduction to the Unity 3D's location service the students complete a guided practice where GPS sensor is managed. They learn how to obtain user's location and how can be obtained distances between user and real and virtual objects.

Specific objectives:
During this activity the students will learn:
a. How can obtain mobile gps sensor values from Unity 3D. User geolocation
b. Geolocalize virtual information
c. Calculate distances between two geolocalized objects

Material:
Materials:
. Document describing the activity
. Unity 3D framework.
. Android device

Delivery:
At the end of the session is presented the work done.

Full-or-part-time: 13h
Practical classes: 1h
Guided activities: 4h
Self study: 4h
Self study: 4h

Augmented Reality assessment

Description:
After all work done in Augmented Reality block, this activity consists in reading some papers related to Augmented Reality and answer a test.

Material:
Materials:
. a list of papers to read
. Questionary

Delivery:
At the end of the session the students deliver the questionary answers

Full-or-part-time: 2h
Practical classes: 2h

Smart Objects. CoAp Server side

Description:
After an introduction to Smart objects. This activity consists in designinig and build a smart Object based on Arduino and CoAp protocol.

Material:
Materials:
. Document describing the activity.
. Arduino board
. Sensors: ligt, temperature and led
. Computer running Arduino Uno
. Copper (Browser CoAp client)
. unity 3D framework for developing the app

Delivery:
At the end of the session is presented the work done.

Full-or-part-time: 8h
Laboratory classes: 1h
Guided activities: 3h 30m
Self study: 3h 30m

Smart Object. CoAp Client side

Description:
In this guided activity the students will learn how to protoype an application for Android devices that can get the sensor values of the smart object designed and builded in the previous activity, using Unity 3D framework

Material:
Materials:
. Document describing the activity
. Unity 3D framework and Californium plugin
. Smart object designed in previous activity

Delivery:
At the end of the session is presented the work done.

Full-or-part-time: 11h 30m
Laboratory classes: 1h
Guided activities: 3h 30m
Self study: 3h 30m
Self study: 3h 30m

Project. Design

Description:
During this activity the students will work with the design of their projects. They will define the architecture to identify the modules they need to implement it. During the activity the teacher will identify if it is necessary to explain anything else like: databases, mapping geolocated virtual objects in a map, concurrency, JSON formats etc...

Delivery:
A document describing their Augmented Reality projec, that should contain:
. A brief description of the Augmented Reality application
. the technologies they want to use: Augmented Reality based on image processing, Augmented Reality based on GPS location or both
. The Data Model the application will manage and if the app will use an external database.
. How the smart object will be included in their project or not

In case that smart object information will not be included in the Augmented Reality app. A brief description of the application that will use smart object information.

Full-or-part-time: 6h
Laboratory classes: 2h
Self study: 4h

Project. Design and implementation

Description:
This activity consists in designing and implementing a Project where all technologies studied along the course are used. The student can program only one project which includes augmented reality and smart objects tecnologies or two different projects, one that uses Augemented Reality and one that uses Smart object information.
The students will design and implement the applications for Android devices.

Material:
Materials:
Unity 3D and Vuforia frameworks
Smart object designed in class (Arduino board, CoAp protocol, temperture sensor and/or light sensor)

Delivery:
They will present the project at the end of the course to the rest of the class.
They must explain the project and argument the added values of using Augmented Reality and Smart Object technologies in their apps.

Full-or-part-time: 29h
Guided activities: 5h
Self study: 24h

GRADING SYSTEM

Qualification System.
45% Augmented Reality and Smart Object evaluation concepts. Oral and written evaluation of the knowledge acquired regarding basic concepts of these technologies and what added value they can offer with respect to other technologies (web applications for example)
45% Project evaluation. Quality of the apps presented in terms of functionality, usability and complexity.
10% Subjective evaluation

BIBLIOGRAPHY

Basic:
- R. Azuma ; Y. Baillot ; R. Behringer ; S. Feiner ; S. Julier ; B. MacIntyre. "Recent Advances in Augmented Reality". IEEE computer graphics and applications. New York: IEEE, 1981.
- Tomás Sánchez López, Damith C. Ranasinghe, Mark Harrison, Duncan McFarlane. "Using Smart Objects to build the Internet Of things". IEEE internet computing. New York: IEEE Computer Society, 1997-.

Complementary:
- Dimitris Chatzopoulos ; Carlos Bermejo ; Zhanpeng Huang ; Pan Hui. "Mobile Augmented Reality Survey: From Where We Are to Where We Go". IEEE Access [on line]. https://ieeexplore.ieee.org/document/7912316/ [Consultation: 26/07/2022]. Available on: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7912316.- Thad Starner , Steve Mann , Bradley Rhodes , Jeffrey Levine ,. "Augmen ted Reality Through Wearable Computing". Presence: Teleoperators and Virtual Environments [on line]. [Consultation: 06/06/2018]. Available on: https://www.cc.gatech.edu/fac/Thad.Starner/p/journal/augmented-reality-through-wearable-computing.pdf.