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A PROPOSAL FOR AN OPEN WIRELESS SENSOR NETWORK ON-LINE COURSE

UNIVERSITAT POMPEU FABRA

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Introduction

It is a commonplace that the Internet is changing our lives. It is changing the way we learn and also the way we contribute to our communities and organize ourselves. In this course we will explore the bottom-up creation of a wireless sensor network that can be used to gather and share data. This gathering and sharing of data empowers the citizenship to monitor and interact with the environment.

We are interested in the bottom-up models. We use the terms peer-to-peer, do-it-ourselves and bottom-up interchangeably. The idea that we want to transmit with bottom-up is that the participant takes an active role and contributes to the community rather than being a mere consumer. For this reason, we teach the first simple steps to build, configure and program a sensor that uploads the gathered data to the Internet to make it publicly available to those that are interested in.

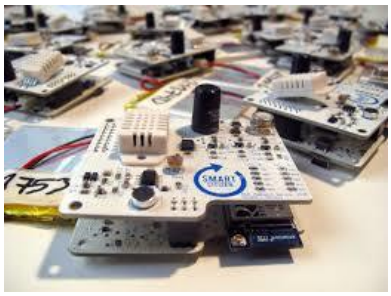

Figure 1: Smart Citizen Kit units. These are wireless nodes with multiple sensors.

Methodology

The course is organized in different units. Each of the units is a basic ingredient in the construction of a bottom-up wireless sensor networks. For each of the units, we will follow the same class dynamics.

Class dynamics

The course is divided into video lectures and written material, both published as the course goes on. Video content include: teaching lessons, interviews and additional instructions for the assignments (when necessary). While the written material is composed by assignments and quizzes. Further details are provided below.

Each unit starts with introductory video lessons in which the lecturer presents the different concepts, tools and examples that are going to be useful for both the assignments and quizzes. Starting from the necessary theory underlying each unit, the lecturer then guides the students through hands-on examples providing further insight on the subject.

After each unit's video lessons, assignments and quizzes are "unlocked" to the student. Assignments are composed of written (and photographic) material detailing instructions on how to build examples, which work as hints to complete the assignment itself.

After completing the assignments, students are provided with all that is required to successfully complete the end-of-unit quizzes. These in turn are composed of both theory and assignment-related multiple-choice questions.

Teachers will propose challenges on each assignment, often composed of alternative or advanced services that can be added at various stages with little (or none) additional work. Challenges are not graded, but set the ground for a final course project which students may submit in order to gain additional credentials and compensate for previous assignments.

Challenges may be completed by forming groups of students, in fact, collaboration among groups is encouraged. It is strongly believed that discussion and feedback provide more valuable results

and are considered as ways of effective learning in this platform.

In-class courses

Besides the online offering, the course will also offered in-class for students registered at Universitat Pompeu Fabra. Furthermore it will be possible to use the material for Summer Schools to promote the University and Bottom-up Initiatives.

Resources

The course will be offered in the P2P University course platform. The students will be offered with videos, a lab assignment guide with all the details of the different projects, and the discussion and feedback tools of the P2P University platform. The guide will be adapted from the current guide for the existing in-class course on wireless sensor networks.

Figure 2: The motto of the P2P University is "Learn Anything with Your Peers"

Additional Material

- Robert Faludi "Building Wireless Sensor Networks"
- Alejandro Andreu "Open Sensor Network"

Working Plan

1. Scripting of the course: preparation of the course structure including units segmentation, number/length of videos per unit, assignments and quiz dynamics and evaluation, feedback and collaboration management; and final project evaluation.
2. Preparation of the written guide: there is already a guide for the in-class course, therefore this new adapted guide should take advantage of on-line resources (video, comments, etc.).
3. Setting up the P2P University on-line platform: based on the course script, this task will configure the platform accordingly.
4. Shooting and producing the videos: this final task aims at shooting the videos according to what was designed in the course script and configured in the P2P University platform.

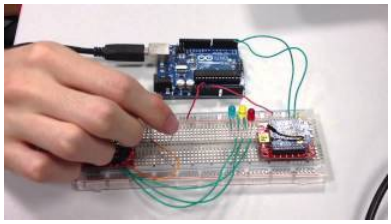

Figure 3: It is necessary to shoot videos with step-by-step instructions to build the pilots or complete the assignments.

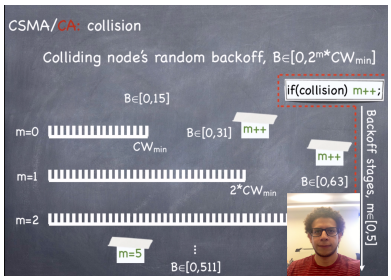

Figure 4: Most video lessons will show the teacher's face over supporting slides.

Results and Impact

This course builds upon successful experiences. There is already an existing course that received very good feedback from the students. Also, there is a degree thesis by one of the students that was presented in Battlemesh, Aalborg University, and caught the attention of the P2P Foundation. Furthermore, the idea of bottom-up smart cities implemented by Smart Citizen was applauded in Kickstarter and received over $60,000 in crowdfunding.

The hardware used in the course is the Digi XBee, that was also used in the best-selling book by Rober Faludi "Building Wireless Sensor Networks"; and the Arduino. More than one million Arduino have been sold, confirming the success of their open business model.

The main goal of this course is to strengthen the community by teaching very basic skills to a large audience. After completing the course, the participants will be able to continue on their own with more advanced projects.

It is a basic digital education for everyone. People with no or little background in technology will make their first steps into programming, electronics, and sensing projects.

Students successfully completing this course will posses the basic tools to contribute to the creation of bottom-up smart cities.

Teaching Plan

Concepts and competences acquired in the course:

- Bottom-up, peer-to-peer and community-oriented collaboration models
- Sensors, actuators, sensor networks, open data, smart cities
- Very basic electronics
- Very basic microprocessor programming
- Configuration of Digi XBee
- ZigBee communication

Weekly organization:

1. Presentation of the participants, presentation of the course, motivation to take the course, dream about a personal project.
2. Introduction to Arduino. Arduino IDE. Input/output.
   Lab assignment: Blinking LED project.
3. Introduction to XBee. Basic configuration of AT mode.
   Lab assignment: ZigBee chat project.
4. Basic interaction. Make a measurement and react.
   Lab assignment: Wireless Sunset Sensor project.
5. Open data. The importance of sharing the data. Open data platforms.
   Lab assignment: Taking measures with a sensor and uploading them to the Internet.

Motivating videos:

- Do-it-ourselves, Bottom-up, Sensors, Smart Cities: Laia Albo, Michel Bauwens, Tiberius Brastaviceanu, Tomas Diez
- Arduino (Blinking LED): Massimo, (Jaume)

- XBee (Chat): Robert Faludi (Luis)
- Interaction design (Sunset Sensor): Alex Posada (Luis)
- Open Data, Open Data platforms (Internet thermometer): Albert Domingo, Manuel Palacin, (Alejandro Andreu)

Team

Figure 5: Luis Sanabria-Russo

- Lead teacher: Luis Sanabria-Russo (Universitat Pompeu Fabra)
- Other members of the team:
  - Laia Albo (Universitat Pompeu Fabra)
  - Alejandro Andreu (Universitat Pompeu Fabra)
  - Massimo Banzi (Arduino)
  - Jaume Barcelo (Universitat Pompeu Fabra): He is a lecturer at Universitat Pompeu Fabra where he takes part in the Wireless Sensor Network course. He has also taught at Universidad Carlos III de Madrid were he took part in the opencourseware experience that published the class materials online. Together with Luis Sanabria, he has prepared the basic laboratory guide for the WSN course that has been shared with the community in GitHub. Jaume has taught more than 20 courses at the graduate and undergraduate level at two universities.
  - Michel Bauwens (P2P Foudation)
  - Tiberius Brastaviceanu (Sensorica)
  - Tomas Diez (FabLab Barcelona)
  - Albert Domingo (Universitat Pompeu Fabra)
  - Robert Faludi (Digi International)
  - Manuel Palacin (Universitat Pompeu Fabra)
  - Alex Posada (Media Interaction Design Lab)

Figure 6: Jaume Barcelo

Bibliography