

LUIS SANABRIA ET AL.

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.

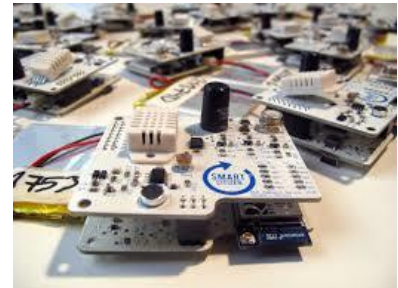


Figure 1: Smart Citizen Kit units.
These are wireless nodes with multiple sensors.

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 participants will watch a motivation video and a video tutorial. The tutorial will describe how to complete a simple project and will be complemented. Then, the participants have to collaborate to solve a challenge. The teachers offer a suggested challenge, but the participants are free to take other challenges that are relevant to them and to the course. Finally, the participants have to carefully document their works so that it can be evaluated, reproduced and discussed by the other participants.

The first and the last unit are slightly different. In the first unit there is no project as the focus is on the presentation of the participants, the course itself and the discussion of the expectations on the course. The last unit is also special because the participants design, plan, execute and document their own project. The courses finishes with an exhibition of the personal projects.

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 the 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.

Additional Material

- Robert Faludi “Building Wireless Sensor Networks”
- Alejandro Andreu “Open Sensor Network”



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

Team

- 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)
 - Michel Bauwens (P2P Foundation)
 - 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 3: Luis Sanabria-Russo currently teaches a course on Wireless Sensor Networks at Universitat Pompeu Fabra

Results and Impact

This course builds upon successful experiences. There is already an existing course that received very good feedback from the students. There is also a degree thesis by one of the students that was presented in Battlemesh, Aalborg University, and attracted the attention of the P2P Foundation.

The idea of bottom-up smart cities implemented by Smart Citizen was applauded in kick starter and received over \$60,000 in crowd-funding. The hardware used in the course is the XBee that was also used in the best-selling book by Rober Faludi *Building Wireless Sensor Networks*. 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 be do the first steps in programming, electronics, and sensing projects.

People that have taken the course will be able to contribute to the creation of bottom-up smart cities.

Figures

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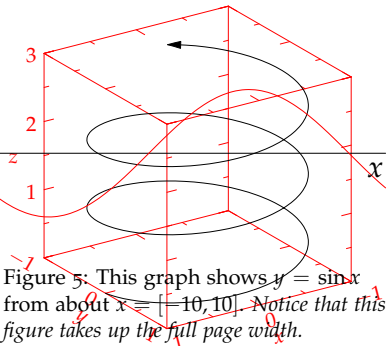
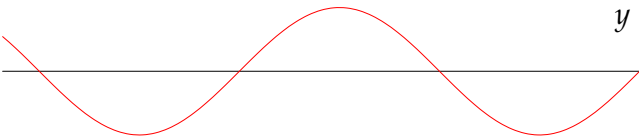


Figure 5: This graph shows $y = \sin x$ from about $x = [-10, 10]$. Notice that this figure takes up the full page width.

Tables

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| Strain | Growth Media | | | | |
|--------------|--------------|-------|-------|-------|-------|
| | 1 | 2 | 3 | 4 | 5 |
| GDS1002 | 0.962 | 0.821 | 0.356 | 0.682 | 0.801 |
| NWN652 | 0.981 | 0.891 | 0.527 | 0.574 | 0.984 |
| PPD234 | 0.915 | 0.936 | 0.491 | 0.276 | 0.965 |
| JSB126 | 0.828 | 0.827 | 0.528 | 0.518 | 0.926 |
| JSB724 | 0.916 | 0.933 | 0.482 | 0.644 | 0.937 |
| Average Rate | 0.920 | 0.882 | 0.477 | 0.539 | 0.923 |

Figure 4: This is a margin figure. The helix is defined by $x = \cos(2\pi z)$, $y = \sin(2\pi z)$, and $z = [0, 2.7]$. The figure was drawn using Asymptote (<http://asymptote.sf.net/>).
This is a random margin note. Notice that there isn't a number preceding the note, and there is no number in the main text where this note was written. Use `sidenote` to use a number.

Table 1: Table caption text

Chapter 1 Title

Section 1 - Fullwidth Environment Example

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Chapter 2 Title

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