

FluctuS - Intelligent Sensor System, and the IoTPrise Community

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Abstract

This document attempts to provide an overview about the IoTPrise project and the Community that is being developed around, especially the FluctuS Intelligent Sensor System platform, that allows creating and managing Wireless Sensor Networks in the Internet of Things context.

1. Introduction and motivation

The Internet of Things (IoT) is one of the most important areas of the Future Internet with a high potential to positively impact European economy and society.

In the Internet of Things (IoT) paradigm, many of the objects that surround us will be on the network in one form or another. Radio Frequency Identification (RFID) and sensor network technologies will rise to meet this new challenge, in which information and communication systems are invisibly embedded in the environment around us. This results in the generation of enormous amounts of data which have to be stored, processed and presented in a seamless, efficient, and easily interpretable form.

Together with the infrastructure of the Internet and mobile networks, these objects can communicate with humans and enable us to monitor and control them anytime, anywhere and enjoy their intelligent service, making the idea of a "Smart Planet" a dream come true. Ubiquitous sensing enabled by Wireless Sensor Network (WSN) technologies cuts across many areas of modern day living: this offers the ability to measure, infer and understand environmental indicators, from delicate ecologies and natural resources to urban environments.

In this context the IoTPrise project has been developed thanks to the support of the Ministero dell'Economia e dello Sviluppo (Ministry of Economic Development). It is carried out by Cubit in partnership with the

University of Pisa and aims to increase and consolidate the process of transferring the research results to SMEs in the field of the IoT through integrated actions such as: analysis of the skills and needs of SMEs, diffusion of knowledge and technologies, services for the management of intellectual property, support in the various stages of business plan creation, aggregation of business associations and local organizations engaged in similar or complementary activities.

The IoTPrise project aims to build a Community whose members (Enterprises, University Departments and Research Groups) can share common tools and technologies to develop products, services and applications. This aspect is important for the creation of a technological competence center in Tuscany, in the IoT context.

The use of common tools and technologies could build and strengthen the Community.

Currently, two hardware platforms have been identified for this purpose: FluctuS and Udo.

FluctuS is an Intelligent Sensor System for the creation and management of Wireless Sensor Networks.

Udo is a mini PC that can run either Android or Linux, with an embedded Arduino-compatible board.

This paper aims to describe FluctuS features.

2. Scientific and technical description

FluctuS is an Intelligent Sensor System for the creation and management of Wireless Sensor Networks. It provides a fully engineered, open hardware and open software platform for the Internet of Things and Smart Cities applications.

FluctuS came as the result of a decade of Research and Development in Wireless technologies, carried out by Cubit (University of Pisa and Polo Tecnologico di Navacchio-Technological Park) and by the FluctuS project partners, with the aim of transferring innovative technologies to the market.

FluctuS is a set of hardware modules that retrieve data from a variety of sensors (i.e. Methane, CO, NOx, SOx

- Air quality, Air Temperature, Humidity, Air Pressure, Video cameras, etc.) and transmit them to a dedicated Cloud Platform by means of different technologies (UMTS/ GPRS/ Wi-Fi/ ZigBee/ Bluetooth /Ethernet). FluctuS ensures high performance in terms of stability of radio communications and interoperability. The Cloud is totally customizable, according to the various monitoring and remote detection needs of Smart Cities and of any other specific Internet of Things application. FluctuS is halfway from optimized full custom product and general purpose experimental board.

As custom product its features are:

- on-board power supply unit with planned power distribution path;
- CPU internal peripherals dedicated to the control of expansion modules, on-board sensors and memories;
- mechanically stable;
- API functions for management of all FluctuS peripherals.

As experimental board its features are:

- General purpose Expansion port (with software macros for the configuration of I/O signals);
- Users can create their own modules on RF PORT or WAN PORT;
- Hardware configuration jumpers and testing connectors.

Furthermore FluctuS has CE marking of Mother-Board (Figure 1) and expansion Modules, and CE marking of some end-product configurations (i.e. Box + MB + RF433 module + GPRS + backup battery).

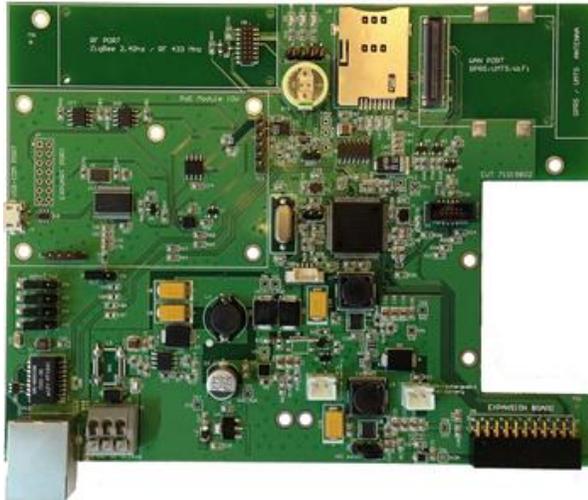


Figure 1 – FluctuS Mother Board

The FluctuS Mother Board represents the "heart" of the entire FluctuS system as it is able to manage all the devices and FluctuS expansion modules.

Features:

- CPU ARM Cortex-M3 32bit
- Flash 256KByte - SRAM 96KByte
- Real Time Clock
- EEPROM for data/software Backup
- USB, ETH, etc.
- Power Supply: 9 to 24 Vdc or POE

The Sensor Board (Figure 2) is provided with Temperature, Humidity and Atmospheric Pressure sensors, two MQ series Gas Sensors (PG, Alcohol, CH4, CO, Air Quality), Led and Beeper.



Figure 2 – FluctuS Sensor Board (front view)



Figure 2 – FluctuS Sensor Board (back view)

Power over Ethernet (PoE) module allows powering FluctuS Board via Ethernet (Figure 3).

Features:

- Input voltages from 21Vdc to 48Vdc
- IEEE Standard 802.3af.
- Integrated protection against reverse polarity
- Output voltage of 5.2Vdc 2A (10W)
- Isolated 5.2Vdc output power.



Figure 3 – PoE Module

FluctuS addresses a professional target: system integrators, design consultants in the IoT and Smart Cities sector. It wants to be a virtual place where the

stakeholders and the web community could share innovative technological assets and their FluctuS based applications.

3. Implementation and use

With the FluctuS platform it is possible to develop Smart Cities, domotic and Sensor Network applications.

Just to give an idea, it is possible to develop Smart Parking application to monitor spots status in the city center, or Intelligent Transport System to monitor weather conditions, accidents or traffic congestion, both in urban and extraurban roads. Thanks to the FluctuS Sensor Board we can develop applications to monitor Air Pollution (CO, CO₂, NO_x, SO_x emission), Noise Pollution or Art Preservation.

Thanks to this platform the Community can develop application in any sector:

- Smart Lighting application - intelligent lighting networks, allowing the implementation of internet services to citizens;
- Smart Water - quality control of water in the sea and rivers in order to monitor its chemical composition for suitability for fauna and drinkable use; monitoring of water level in rivers, dams and reservoirs;
- Smart Logistics - monitoring of the quality of goods during transportation (openings, vibrations, strokes or cold chain interruption), tracking of goods;
- Agriculture - monitoring of micro-climate conditions to improve both quality and quantity of production of fruits and vegetables. Weather station Networks to forecast weather events (rain, ice, snow, drought);
- Photovoltaic Panels - monitoring and optimization of energy production in solar power plants;
- Industrial Monitoring - Indoor control of air quality. Self-diagnosis of machinery. Temperature monitoring of perishable products. RFID tracking of stocked goods.

The main goal of FluctuS platform is to build a Community where all developers can use common tools and technologies to develop products, services and applications in Internet of Things context.

Indeed FluctuS uses only Open Source web application (Wordpress CMS for the website and the community / forum) and the portal contains information about the main applications and will contribute to implement

further use of the platform and new solutions implemented by members of the Community.

Furthermore, FluctuS Cloud is the Cloud SaaS platform for monitoring, managing and provisioning. It collects information from each FluctuS module and organizes all the related activities through a programmable workflow.

Thanks to a precise differentiation of roles and to the definition of different levels of access, FluctuS Cloud allows the complete information security and offers maximum reliability, as it is hosted in the cloud infrastructure owned by third parties.

FluctuS Cloud needs neither local hardware/software installation, nor specific technological know-how, with the result of speeding up, with a considerable reduction of time and costs, the start-up phase of a project. The Dashboard allows the graphic visualization of FluctuS sensors survey in real-time and the graphic comparison between different sensors. The Sensors Control Box allows the visualization of sensors settings and the control of possible issues through alert messages.

4. Conclusions and future developments

Today the Internet of Things refers to the general idea of things, including everyday objects, which are readable, recognizable, locatable, addressable and/or controllable via the Internet. In this context the IoTPrise project has been developed with the aim to build a Community where all the actors can work together with the purpose to develop products, services and applications in the IoT sector.

For this reason FluctuS Intelligent Sensor System has been identified as a platform that can help this Community to grow up and enhance useful applications that can make our life better. FluctuS is a virtual place where the stakeholders and the web community can share innovative technological assets and their FluctuS based applications in a collaborative, open and interoperating way.