Book Review

10 (ten) projects Internet of Things. Author: Radu Pietraru

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The Internet of Things (IoT) is an increasingly widely used term lately, as people use smart devices to take advantage of advanced features and their connectivity. At the same time, however, given the multitude of devices, the Internet of Things also raises the issue of security risks, for example as regards access to the local equipment or network to which they belong, i.e. the collection of users' personal data.

Generically speaking, the Internet of Things includes any device that can communicate with other devices over the Internet. From the point of view of the field of use we identify two major areas for the Internet of Things: the industrial field and the living space. The main difference between the two areas is the implementation scale.

The book **10 (ten) Internet of Things projects** is aimed at those who want to take the first steps in the world of the Internet of Things. Over the course of 233 pages, the author aims to provide readers with knowledge and skills in this fascinating field through the realization of attractive projects, a total of ten in number. Each of these projects is designed to highlight the implementation of various aspects of the Internet of Things domain. We will review the ten chapters of the book, insisting on the main ideas brought by each project. The book is structured in ten chapters, with the author allocating a separate chapter for each of the ten projects under discussion.

In the first chapter, "Internet of Flowers" is described the realization of a project for an Internet monitoring system of environmental conditions (soil moisture and ambient temperature) for houseplants – flower pots or other decorative plants. Even if the intended purpose for this project is limited to houseplants, it can be easily extended to plant greenhouses or outdoor gardens.

The system includes data acquisition modules that measure soil moisture and ambient temperature parameters and radio the measured values to a base module that allows the logging of measurements in the *io.adafruit* cloud system. Internet logging then allows the user to remotely track measurements and receive alerts through specific mechanisms (e.g., email). Access to the data is recorded on the *io.adafruit* server can be made from any station or mobile system connected to the Internet via a web client. The stages of the project are presented logically and clearly. Project development and improvement directions are also suggested, going as far as transforming it from a simple purchasing system into an automatic drive and/or adjustment system.

A second project, “Internet of Events” proposes to implement a simple mechanism for monitoring events produced on the Internet. Typically, the user interacts with these events through computer, laptop, tablet or smartphone equipment connected to the Internet. Usually, these terminals do not allow the complete separation of the sources available online: in other words, open the terminal to check if you have received an email and notice that you have a message from a social network, finish the message and then an advertisement attracts you to visit an online store with amazing discounts, etc. As a result, the user is constantly manipulated by the flow of information from the online environment and unwittingly becomes the prisoner of their events. Discipline of online activity is a difficult thing to do, even for an experienced user. This is exactly what the project aims to do – building a device that only announces the occurrence of major events, without deceiving the user in the universe of Internet temptations. The operation of the project is based on two online platforms: *IFTTT* (online service to monitor the occurrence of events generated by various Internet applications) and *data.sparkfun.com*.

The “Internet of Weather Stations” project addresses the realization of a weather station system in two implementation variants. Both solutions allow remote reporting over the Internet. The creation of a weather station system connected to the Internet is an interesting challenge from a technical point of view and involves the appropriation of important concepts related to the acquisition and processing of data from the environment but is also useful, such a system can be used as a daily tool for reporting the weather. Weather station systems vary widely in complexity (number of parameters purchased, operating environment, power supply) and purpose (reporting, prediction, integration into a larger collection and prediction system). This is why this project details two implementation variants, trying to cover as many techniques used in the design and realization of this kind of systems. The two variants of weather stations are: *WiFi weather station* and *GPRS weather station* respectively.

The first variant of implementation, *WiFi weather station*, is a data acquisition system for the following parameters: air temperature and humidity, atmospheric pressure and intensity of solar radiation; the system has no user interface, and information acquired from the environment will be reported to the IoT *ThingPeak* service and can be accessed over the Internet from anywhere and from any system. The station connects to the Internet via a WiFi network connection; hence the result is the limitation of the urban use of the WiFi weather station.

GPRS weather station, is a slightly more complex system, with possibilities of operating in isolated environments. The GPRS weather station can acquire the following parameters from the environment: wind speed and direction, amount of precipitation, air temperature and humidity, atmospheric pressure and ultraviolet radiation factor. The purchased information will be made remotely to the *Weather Underground* independent weather prediction service.

This service allows forecasts based on information from a personal weather station. The *Weather Underground* service complements the functionality of the weather station with the history and prediction of the weather evolution and will also be how the user will be able to view the information provided by the weather station. The system is based on Internet communication via GSM 2G – GPRS mobile networks and can be located wherever there is coverage of such a network – even in an isolated area. Autonomous operation in an isolated area can be sustained by a battery-based rechargeable battery through a solar energy capture system using a photovoltaic panel.

The “Internet of Solar Cells” project describes the development of a system for monitoring the production capacity of electricity for photovoltaic panels. Monitoring elements, measuring stations, are autonomous and will communicate wirelessly with a central station – the *Emoncms* gateway station. The role of the central gateway station is to retrieve data from all measuring stations and forward it via the Internet network to the *emoncms.org* server, a dedicated server that provides specialized IoT services to monitor the production, consumption and exchange of electricity. The user can then track from a smart mobile station or device connected to the Internet the power generated by each photovoltaic panel, thus being able to accurately assess the operating efficiency, the state of operation and the quality of the location for each photovoltaic panel. The user has access to the stored data and reports generated by *Emoncms* through a web browser or through the *Android Emoncms Open Energy Monitor Tools* mobile app. The radio communication structure between the measuring stations and the central gateway station has been chosen in such a way as to ensure long-range reporting capacity, through the possibility of retransmitting information from one station to another to the central station with low consumption – thus ensuring a long range of measurement stations.

The “Internet of Lonely Cars” project examines the possibility of remote surveillance of parked cars using LoRa long-range radio communications and details a simple and efficient way of monitoring cars that stay in the parking lot for long periods. Given the likely large distance between the parking space and a central monitoring station, the project uses a 433MHz LoRa (Long Range) ISM band radio transmission. Reporting of information from the machine module is done to a basic module that is intended to forward via the Internet to an IoT service the data received. Due to the technical characteristics of the LoRa module, the radio transmission may have a coverage of several kilometers (up to 20 km). Thanks to integration with the IoT service, information from the machine module can be viewed by the user from anywhere via a web browser or mobile app. As with other projects, the operation of the IoT system is based on two online data collection platforms: *DeviceHub.net* and *SmartLiving*.

The “Internet of Sunsets” project presents an automatic solution for shooting and saving sunset images in the cloud. Among the most sought after photos by all the beautiful aficionados are those that capture the sunset. Obviously, choosing the perfect moment can make the difference between a spectacular photo and a banal one. And how is it usually a gamble to capture the exact moment when the sun casts the last rays before sunset by reddening the sky and coloring the clouds what if we can do this automatically? Not just once, but every day. It's exactly the goal of the “Internet of Sunsets” project – to photograph every day sunset and save photography to the cloud and on a social network. It's an Internet-connected video camera that's able to calculate every day what time the sun goes down, take

a snapshot, and save that photo on *Dropbox*. From *Dropbox* the photo will be automatically transferred to the Facebook social network via the online service *IFTTT*.

The chapter “Internet of Homes” describes a project detailing the realization of a home automation system made using the *OpenHab* platform, the Raspberry Pi development board and wireless devices that allow temperature regulation, maintaining environmental parameters (temperature and humidity) in certain ranges of values, controlling alternative energy production (solar, wind energy), controlling and efficiency of electricity consumption, and so on. The control interface can be accessed both from the local Raspberry Pi development card network and via the Internet network using the *myopenHAB* cloud service.

An extremely interesting problem is that it explores the universe of artificial intelligence, explored within the project “Internet of Talking Robots”, in which various solutions are proposed to implement automatic conversation mechanisms. Automated conversation apps are tools that are increasingly common on the Internet. Whether it's automated customer support apps or just recreational apps, they're becoming increasingly complex and become extremely important elements of Internet applications by introducing artificial intelligence algorithms into their own operation. Naturally more and more devices such as mobile robots or mobile communication devices acquire the ability to interact through natural language with users and, moreover, become able to respond intelligently to their requests so that this example is a reference one.

The “Internet of Wheels” project is studying the possibility of creating a mobile robotic platform controlled by natural language (voice) using the IBM Bluemix cloud service. The project involves several phases of development: the realization of the mobile platform, the programming of the engine control card, the use of the IBM Bluemix service to implement the voice command.

Last but not least, the “Internet of Things” project presents a LoRaWAN radio network solution based on *The Things Network* platform. The project is of great interest, the field of LoRaWAN networks being a very current topic. It is worth noting in particular that LoRa modulation allows the transmission of data by radio waves at distances of kilometers or tens of kilometers with very low energy consumption. Moreover, LoRaWAN specifications enable the creation of networks of standardized electronic devices that communicate with the Internet network via LoRa modulation (LoRa RF LoRaWAN), the LoRaWAN architecture involving radio network nodes (acquisition or drive systems), gateway systems (concentrators) linking the radio network to the Internet and software platforms for network management and information flow. In addition to the construction of the purchasing system and the gateway system, the project will use the *TTN* and *IFTTT* services as management software platforms. Note also that all communications within a LoRaWAN network are encrypted ensuring a high level of security to network data.

The book **10 (ten) Internet of Things projects** is a true plea for a reality in which one can identify an increasing trend of interconnection of objects from anywhere in a global network of devices accessible over the Internet. The ten chapters of the book, one per each project discussed, have a clear and unified structure. Sub-chapters are present in each chapter such as: presentation of the components necessary for the realization of the project, description of the project, presentation of the architectures of possible data acquisition modules and the basic module, configuration of possible additional services, presentation of possible developments of the project, bibliographic resources.

Given the clarity of the presentation of ideas, the wealth of the bibliographic resources made available, and the multitude of examples used as support for the ideas discussed in the ten chapters of the book reviewed, I believe this book will be of real use to anyone who wants to learn more about the IoT field and either has average technical knowledge or is even new to the field but has a desire to learn.

About the author

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Mr. Radu Pietraru is a graduate of the Faculty of Automatics and Computers, specializing in “Systems Engineering”, Class of 2000. He graduated from the in-depth study cycle “Open Architecture Systems” in 2001. He has been a doctor in the field of Systems Engineering since 2009 and is a professor in the Department of Automatics and Industrial Informatics, Polytechnic University of Bucharest, since 2000 he has held the undergraduate courses “Integrated Microprocessor Systems”, “Microprocessor Systems” and “Performing Computer Architects”.

He has published 7 books in the Romanian language of CNCSIS-recognized publishers and more than 20 scientific papers. He is a member of the Romanian Society of Automatics and Technical Informatics and is part of the editorial staff of the international magazine “Journal of Control Engineering and Applied Informatics”. He has been the leader of more than 100 diploma and dissertation papers in the last 10 years. The main areas of research are Internet of Things systems, Low Power Wide Area Network communication systems and hazard management.