ALLARD
Estelle
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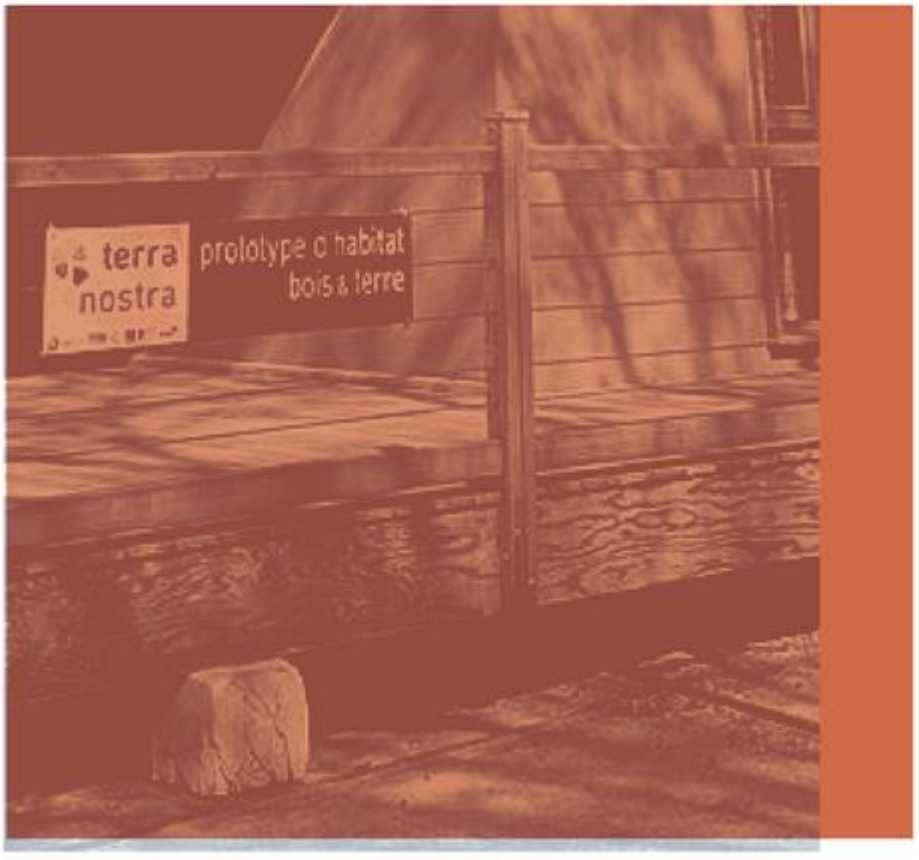
PROJECT REPORT
IOT PLATFORM



Project 2016-2017
RICM 4

UNIVERSITÉ Grenoble Alpes
POLYTECH GRENOBLE

TABLE DES MATIERES

I- GENERAL ASPECT

1. CONTEXT

Our project was about the development of a platform IoT used by Terra Nostra house.

What is Terra Nostra ?

The Terra Nostra project is in line with the objectives of the new Flaubert eco-neighbourhood, a project built on constructive innovation, the use of healthy, bio-sourced materials, energy efficiency and attention to quality, indoor air. This prototype was rebuilt last November on a site near to the Bifurk, by the team of people who had previously disassembled it from the exhibition of Lyon Confluence.

Terra Nostra is a prototype of a five stages building which is composed of 10 flats and some practice work rooms upstairs, create for families and working students.

[Photography of Terra Nostra in Grenoble]

2. PRODUCT DESCRIPTION

The scope of our product is to provide a phone application/generic platform which is able to analyze IoT data from the connected house (Terra Nostra). Users of the application will be able to choose the type of analyses they want to make, to know results : temperature average, energy

consumption … Our application can receive not only house's information (from sensors) but also externals information such as weather.

The plateform should make possible to :

- select data sources
- display data visualization in dashboards
- compute custom statistics

Users of the plateform will be :

- Students working on IOT (for example, students from IUT1 working on Terra Nostra project)
- Owners of the objects, once they are setup
- Territorial authorities could also be interested in some data

Design a plateform that is :

- easy to adapt to new sources of data
- enough powerful to compute complex statistics
- easy of use

3. PRODUCT PURPOSE

The goals of our product is to analyse the consumption of the house, and predict the best way to use energy : period of time, intensity etc. Indeed the analyses of the several sensors are able to show us when the house is more using some energy. The purpose is to be more efficient and energy friendly.

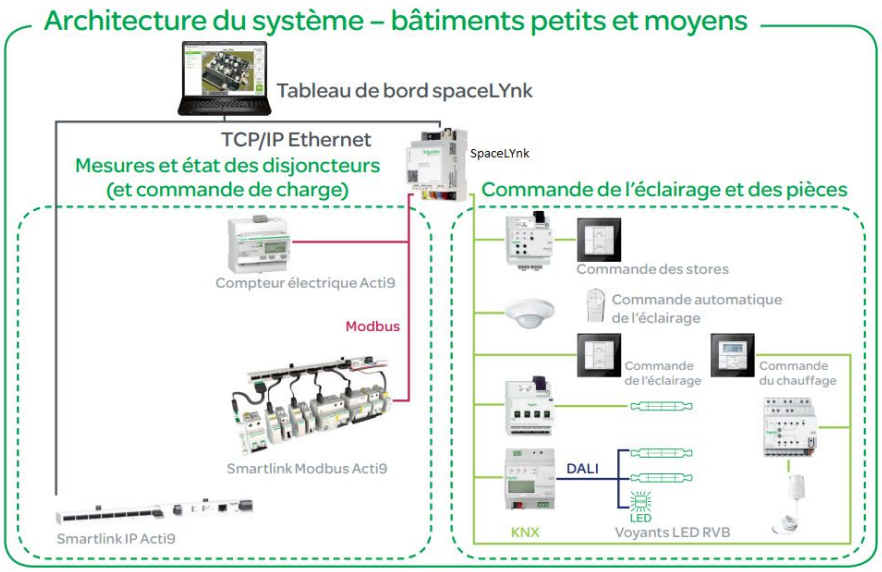
The other aim of our platform is to be able, after all, to add many other connected products as greenhouse (which is another 2016-2017 project of RICM4 class) or connected car for example.

II- TERRA NOSTRA DATA RECOVERY.

1. THEORY

Terra Nostra house is equipped with several sensors that indicate the state of the house : temperature, energy consumption, lamps in operation, air quality, etc

Most of the sensors are connected with the KNX bus. KNX is a standardized communication protocol for smart buildings. Some other sensors use another protocol called EnOcean because they use radio waves to communicate. Fortunately, an equipment called spaceLYnk connects all these sensors together in order to facilitate communication with them.



2. IMPLEMENTATION

The spaceLYnk contains an http server which, when configured to do so, exposes an API that makes possible to collect data measured by sensors. We need to be connected on the same local area network as the spaceLYnk to query it.

In order to collect all data from sensors, we first query the spaceLYnk with http://remote:remote@10.0.2.3/scada-remote?m=json&r=objects in order to get a Json object that lists the sensors. We parse this object to get the addresses of each sensor and then for each address we make a query to get the value measured by the sensor.

The queries are made with a Node-RED flow which reads the data and store them in the influxDB database.

We executed queries every 5 minutes during one hour but during this short time, most of the values measured by the sensors didn't change except for data about energy consumption.

If we wanted to collect data on the long term, we could make a LUA script running on the spaceLYNk or we could have a Raspberry Pi that stays permanently in the house to perform the queries. Maybe it is also possible to make the API accessible remotely. As it was very difficult to find the API documentation we first tried to make a LUA script on the spaceLYnk, but it was difficult (lack of documentation and examples) so we abandoned when we finally found the API documentation.

III- DATA VISUALISATION AND ANALYSIS PLATFORM.

1. TOOLS USED FOR THE PLATFORM

InfluxDB

InfluxDB is an open-source time series database that we use to store the data collected by Terra Nostra house sensors. These data are stored as points that contain at least a timestamp (with precision in nanoseconds) and a value. The differents points that come from one sensors are stored together as one measurement. InfluxDB can be managed using its http api accessible through port 8086.

Grafana :

Grafana is an open platform for beautiful analytics and monitoring. It makes possible to display interactive time graphs that can be zoomed or resized easily. Moreover it is especially designed to be easily connected to an influxDB database. Grafana can be configured using its graphical interface but is also provides an http api that we use to create dashboard dynamically depending on the database content.

Node-RED :

Node-RED is a programming tool for wiring together devices, APIs and online services. We use Node-RED to configure and link together influxDB and Grafana and make the http queries that collect data from the house. Node-RED provides several nodes that facilitate the access to online services such as meteo and it is possible to write custom nodes in javascript.

Docker :

Docker is an open-source project that automates the deployment of applications inside software containers. As we use several different technologies that can be tedious to install and configure on our own devices, we chose to use this technology. We use the official images of Grafana and influxDB available on dockerHub. Concerning node-RED, we built our own image based on node-RED official image because we had to install extra nodes (for influxDB, meteo services, etc). Our image is described in a dockerfile on github and it is built automatically on dockerhub when a change is detected in our dockerfile.

In order to start easily these different images together we use docker-compose.

2. FUNCTIONALITIES OF THE PLATFORM

The platform allows to create the database and to fill it with Terra Nostra house data using Node-RED flows. Then it configures grafana to show graphs of the data. We show the most relevant data that we collected : power and energy consumption.

As we didn't have very interesting information for statistical analysis, we also created a local server that is accessible via http queries and that simulates a thermometer inside the house. The temperature returned is based on the weather forecast, adding a shift (because the house has good isolation), a smoothing and random perturbations.

Then we fill the database with the data returned by this simulated thermometer and the meteo forecasts from OpenWeatherMap. Then we can visualize them in Grafana and also calculate a correlation between them. In this way we can compute the shift between the weather and in-house temperature.

IV- FINAL RESULTS

The result of our project isn't really a friendly-user application essentially because it is not deployed on a server and we didn't build any graphical interface on top of grafana and node-red. It is more like the kernel of an application that is able to collect data, configure influxDB and grafana and access web-services such as meteo services. The use of docker should makes relatively easy to deploy this project on a server.

Moreover, the data analysis part is not very developed because we did not have many relevant data. We wrote a javascript function to compute correlation but the use of R would be better in order to offer various statistics functions.

Also, we didn't collect data from any other equipment than Terra Nostra house because it was already difficult to collect these one. Nonetheless, it should not be very hard to connect to another device with a few modifications on the Node-RED flow in order to adapt queries to the API of the device. The difficulty is more to find a device that is remotely accessible and that offers a convenient API.

VI- FEEDBACK

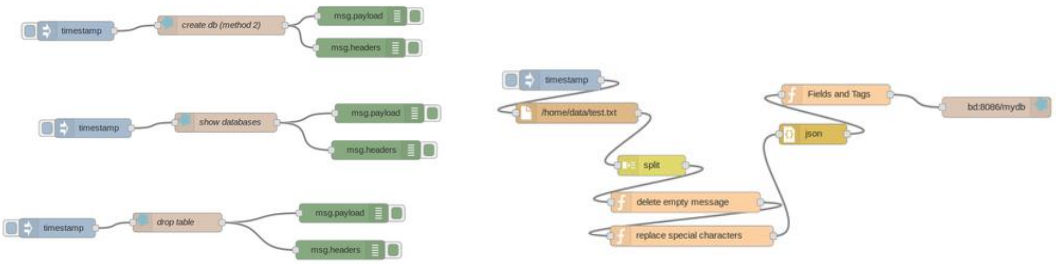
As we can notice just above this part, the final result was not the one whose expected. Indeed, our platform is not using R to analyse data. Moreover it has no other data from other devices as the greenhouse. However, our platform is working for the house data and is able to visualize all of the sensors data. Our project help us to discover many tools as Grafana, Openhab (even if we did not use it for the project), Docker and Node Red.
This project provides us some abilities to search and find information about thing that we did not know at first. Furthermore, it has force us to test, innovate, fail and persevere in order to succeed and create something we want.

We think that our Air page, tutorials and information in it can be very useful for the futures projects on this subject and that our platform can be easily used again and being improve for other connected objects.

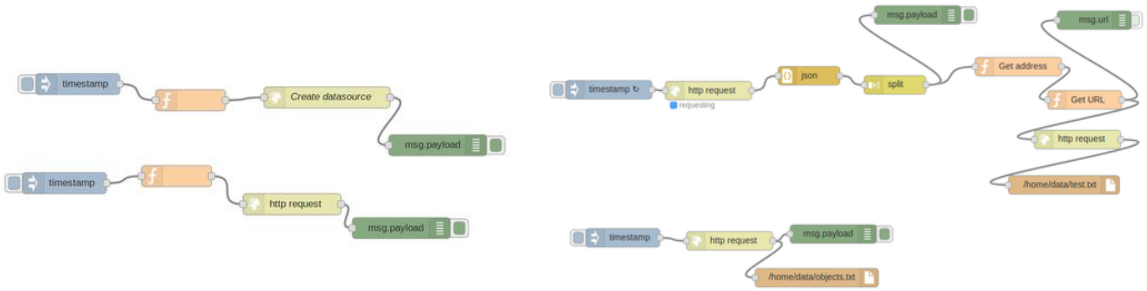
The other interesting part was to collaborate with other students from other studies (GEII). It was very interessant and rewarding to go to the Terra Nostra site and in the laboratory of the GEII department on the campus.
Testing directly the material in the practice room and in Terra Nostra house was very helpful for our project advancement.

To conclude, this project led us to meet very interesting people such as teachers, workers and students; to use many new devices; to work in pairs and to be able to manage a project during 2 or 3 months.

V- ANNEXES



[Database creation]



[Extracting data from the house]

[Spacelynk – Schneider Electric device]

THANKS TO

03

OUR TEACHERS WHO WERE THERE TO ANSWER ANY TIME

Palix Nicolas
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Richard Olivier

02

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Bergerand Jean-Louis

02

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Ducruet Clément
Trognon Nassim

40

CLASSMATES

who help us to use and discover some new devices, and had no problem to share information