Design and Implementation of a Visualization Tool for the in-depth Analysis of the Domestic Electricity Consumption

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Abstract

In this poster, we present a visualization tool for the in-depth analysis of domestic electricity consumption. The web-interface allows users to visualize their electricity consumption, compare them with their own records or with the means of selected communities.

CCS Concepts

• ***Human-centered computing*** → *Information visualization;* • ***Hardware*** → *Sensors and actuators;*

1. Introduction

The advent of the so-called IoT gives the possibility to cater and analyze data coming from many different sources that were never imagined since a few years ago. Sensors are scattered all around our environment collecting information that can lead us in reflecting on our behavior and change them. We developed a visualization tool for the in-depth analysis of domestic electricity consumption, with the possibility for the users to compare their measurements with average values and other users' data. Our final interface is designed to be simple, easy to use but, at the same time, full of functionalities. In this poster we will describe the components of our project: from data collection to UI development. This work is part of the TDM project [CUS21], a collaboration between the UNICA and CRS4.

2. State of the art

Several works inspired us in realizing our project. We can mention, for the sake of synthesis just three studies. Two of them ([CES] and [TNT*18]) are correctly user-oriented but are limited solely to monitoring and analyzing single buildings. The third [Fos], instead, is a really complex system but it uses an interface cluttered of information, not accessible to ordinary users. Anyway, none of those works allow making a comparison between a large set of houses, that is the purpose of this project.

3. Data

The data used in this project are related to the consumption of some residential units. We organized the consumption in time series. This kind of data is useful for further elaboration and to give the user important statistics about its electrical consumptions. A sensor installed in each house provides the measurements. The device used to this purpose is Iotawatt [Iot]. It allows obtaining real-time electricity consumption. It could send data to a database using WiFi. At the development time of this project, the device was still in the prototyping phase. For this reason, we decided to use an external database to build our system (the Dataport [Dat] project DB). Residential units in Austin, Texas, have been chosen and analyzed.

4. Interface

We developed a web-based interface containing several plugins to provide various information to the final user. All plugins are easy to use and studied for good user experience. We use Grafana [Gra] to develop the UI. Grafana allows us to view data collected in temporal-sequence thought a dashboard containing plugins. Every plugin is set up with different queries, in order to extrapolate the data. In the following sections, a list of appropriately customized plugins (at source code level), and the related shown measures.

4.1. Singlestat

The first plugin we developed is *SingleStat* (figure 1).Grafana's Singlestat plugin permits to retrieve a value from a single query and to compare it with only static values. We change the plugin code to allow us to compare the main value with other dynamic data, both obtained from queries. We use this modified version to compare the own actual consumption with the personal average consumption and to compare the own average with the average of the other (anonymous) users in the system. The plugin is already available on GitHub: `github.com/cg3hci/GrafanaSinglestatTDM`.

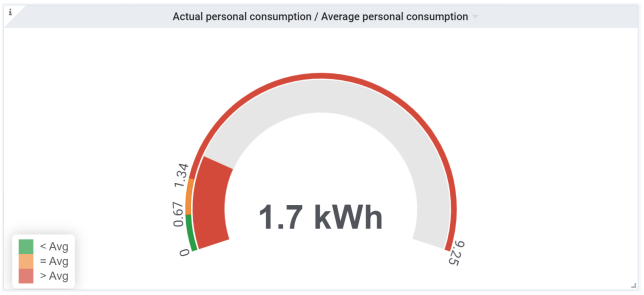

Figure 1: *The modified SingleStat plugin.*

4.2. Multistat

The second plugin we developed is the *MultiStat* (figure 2). This plugin too is already present in Grafana. In the original version, a single query provides the results for every vertical bar displayed in the histogram-like chart. With our changes, it is now possible to extract one measurement and draw a vertical bar for each column. This plugin is used to represent the own actual consumption of each appliance in the house compared with the average consumption. It is also used to show the average consumption of appliances compared to the average consumption of the other users. To do this, we modified the plugin and changed the way the information are retrieved. We also included the possibility of a second query for retrieving the mean value of each bar and to show it overlapped with the other measures. The plugin is already available on GitHub: `github.com/cg3hci/GrafanaMultistatTDM`.

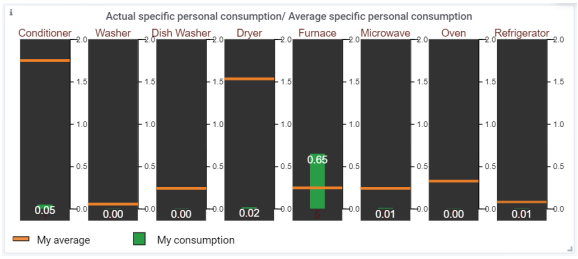

Figure 2: *The modified MultiStat plugin.*

4.3. Worldmap

The third plugin we developed is the *WorldMap* (figure 3). The original one works with geographic coordinates for the creation of meaningful circles overlapped to a map. With our changes, the map has selectable zones, and it became an input plugin. It is possible selecting a region and updating all the data presents in the dashboard according to the selection. A single query enables the association between houses and zones. The plugin is already available on GitHub: `github.com/cg3hci/GrafanaWorldmapTDM`.

5. Final remarks and future work

We developed a simple and accurate visualization dashboard suitable for any user (figure 4). The final result allows the citizens of a city to have a full awareness of their energy consumption, through continuous monitoring. In the future we plan to adapt the system with the Cagliari's real data, obtained via Iotawatt sensors. We intend to perform usability tests to improve the user experience and implement a login system to respect the privacy low requirements.

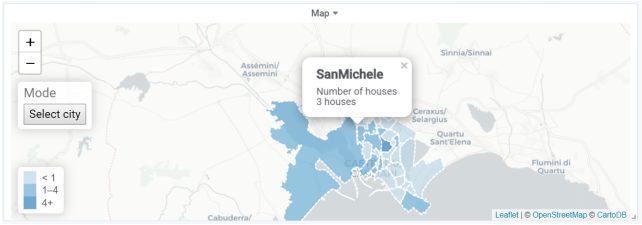

Figure 3: *The modified WorldMap plugin.*

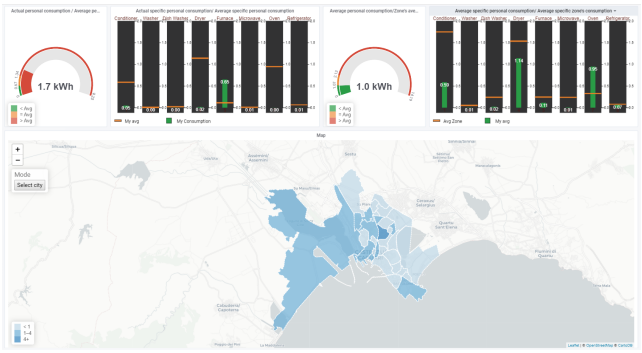

Figure 4: *The final dashboard.*

6. Acknowledgment

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