Power Strip Automation with Internet of Things

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***Abstract*—The concept of the internet of things (IoT) achieves through its applications more and more space in the technological, commercial and academic fields. One of the most obvious applications is the smart homes. Living in smart homes, or having systems turned to them, is already a reality for many people. This article presents a proof of concept of IoT with a residential automation application from a power strip to control electronic devices in rooms.**

***Keywords* — Internet of Things, Smart Homes, Microcontrollers, Automation.**

I. INTRODUCTION

The Internet of Things is the latest evolution of the web [1], since the concept of internet of things arises by connecting objects to each other, communicating by the internet [2]. In this context, heterogeneous devices are involved, such as wireless sensor networks, Radio-frequency identification (RFID) and actuators, communication technologies that aim to acquire data from a physical medium, processing them to provide services of interest to users [3].

We are still far from a truly connected world, as there are still challenges, such as patterns of sharing and infrastructure, control and data security, [4] however, it is estimated that $ 6.4 billion in IoT devices were in use in 2016 (30 percent more than in 2015), and this number will grow by 20.8 billion by 2020.

A. Smart Homes

Soon, it is estimated that at least 90 million people will live in smart homes [5]. Once the Internet concept of things is introduced to run the implementation of a smart home, traditional smart homes go out of fashion [6]. Residential automation systems can monitor and configure indoor environments and activities at the time the home is empty or occupied [5]. From residential automation, it is possible to provide convenience, comfort, energy efficiency and security for homes. Thus, home automation provides a better quality of life for people who are old or debilitated and require special care in their homes [7].

B. Intel Galileo Development Board

The development of applications for Smart Homes can be done according to different technologies, these being able to involve microcontrollers, mobile applications and computerized systems [8]. The Intel Galileo microcontroller can be considered as a development board based purely on the Intel x86 architecture, focusing on projects aimed at smart homes, providing interface for connection of various sensors.

The Galileo board has software compatible with the Arduino IDE, as well as its ports have similarity to the Arduino microcontroller. The main differences between this board and the conventional Arduino are some built-in components, such as an Ethernet port with a range between 10 and 100 MBps, RS-232 serial connection and a Flash SPI for reading SD cards with 8 MB legacy for firmware reservation And reading the latest recorded applications.

The advantages of using the Intel Galileo microcontroller are revealed when considering compatibility with Arduino Shields, real-time Clock, that improves the internet connection, and an embedded Linux distribution, allowing the installation of Python and node.js compilers [9].

II. METHODS AND RESULTS

The Application development was performed according to the diagram in Fig. 1:

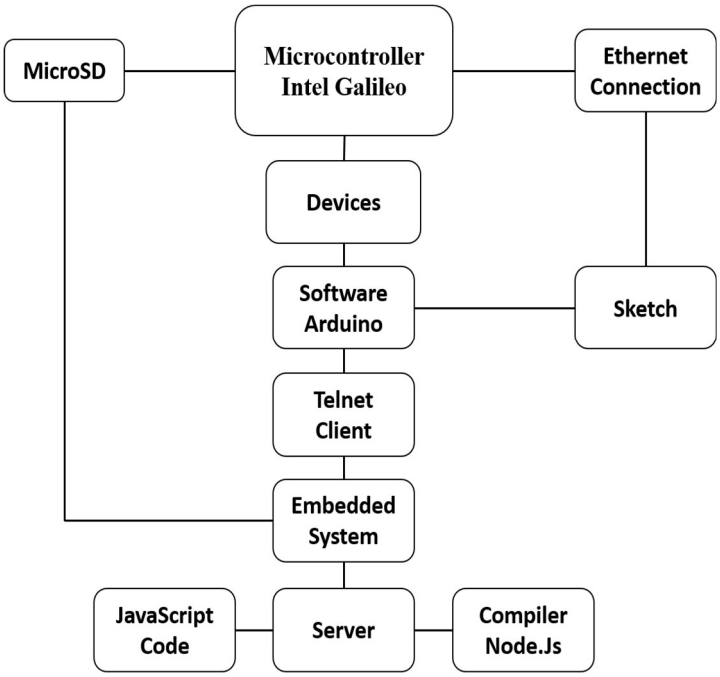

Fig.1. Application Diagram.

A Linux software distribution called Yocto is installed on a MicroSD and the main devices that perform the simulation are a power strip and a relay module. The relation between the number of inputs to be used in the relay module is directly related to the number of sockets present in the power strip. In this simulation, four inputs and four sockets were used, that means, up to four electrical and electronic devices could be connected and controlled. Fig. 2 shows the connection scheme used in the simulation.

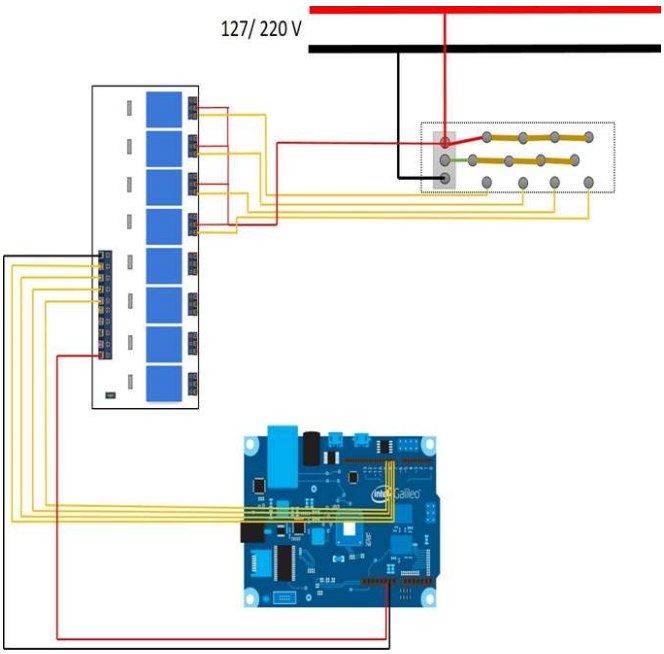

Fig.2. Simulation Schematics. [10]

There are three files that have the codes for the application. The first one is a sketch that enables the recognition of the IP address coming from the Ethernet cable, which is assigned to the Intel Galileo board. This file runs in the Arduino IDE and enables the Telnet Client on PuTTY application. Through the Telnet Client on PuTTY application, with the IP address assigned to the board it's possible to access the Linux embedded distribution, which will act as a server for connecting the application with web browsers.

The second file is also a sketch that runs in the Arduino IDE, but is related to the configuration of the relay module and the power strip. The third file is a JavaScript, that configures the server to execute the trigger commands of the connected electronic devices in the power strip. This third file runs by a compiler node.js, within the Linux embedded distribution.

Once the three files are running, is possible to control the devices that will be connected in the power strip through the address bar of any web browser, through the path specified for each command, which works according to the commands entered in the sketch that configured the relay module and the power strip. In this simulation, commands such as "On1" and "Off1", for example, were used respectively to switch on or off the first power strip socket. The general form of the path was denoted as: "IP / command".

The power strip control can be performed through a personal computer or through any device connected to the internet, working as a smart power strip. Other more improved forms of power strip control can be developed by setting up a web page or a mobile application.

III. CONCLUSIONS

In this article, it was possible to perform a proof of concept in Internet of Things through the simulation of a smart power strip. Combining the Intel Galileo microcontroller with relay modules and a four-outlet power strip, it was verified the possibility of controlling four electronic devices through commands over the internet, using an embedded system who works as a server to provide connectivity.

The concept of a smart power strip can be applied in rooms of a home from the moment it acts as a single point of connections of the devices in the place, thus being turned on or off remotely anywhere, providing intelligence to the environment.

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