

Controlling Home Appliances in IOT Environment

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Abstract

With increasing technology and decreasing amount of time in everyone's lives, the luxury of home automation is being deeply valued. This paper will provide an efficient solution for a reliable, economical and user friendly home automation system. In this system we will be using Raspberry pi to connect to the home network through which we can access the home appliances from across the globe. PHP Script has been used for creation of web portal through which the user can provide the inputs for controlling the appliances. Python program has been used in Raspberry pi which will turn devices on and off. Connection between PHP and Python has been maintained using My SQL Database.

Keywords: IOT, Raspberry pi, Web page, Database, Python and PHP, Relay controlled switch board.

1. Introduction

With busy schedules and late working hours, the need of simplifying our lives and having efficient energy systems at our house is being felt more than ever. Those days are gone, when home automation was a cumbersome process and was operated by only tech savy geeks and afforded by the rich people. With changing trends and newer technologies, home automation can be easily installed, operated and afforded by majority of people. There are many situations in our day to day life which we encounter and wish to automate them. Like, the air conditioner to be switched on by the time we return to our home after feeling the scorching heat outside. The coffee maker switch on itself by the time we wake up and get ready for the day. The outside gates would open up themselves on arrival of guests and to save the trouble of getting out of our car and opening the door of the garage. Switching of lights themselves off, when we are tucked inside the blanket at night. All of these wishes become true in the form of a single home automated system which will make sure our life is comfortable, easy and energy efficient. My first encounter with an home automated system left me spell bound, wonderstruck and made me appreciate the pace with which technology is making our lives more comfortable. It also made me wonder, what if people around me could afford this comfort as easily as the rich ones in our society. With the increasing popularity of energy conservation and increasing need of efficient energy utilization, a home automated system will fulfill our needs and wishes with great justice. In less than 50\$, you can purchase the hardware behind this magnificent piece of technology. Home automation results in a smarter home and is used to provide a higher & healthier standard of living. The beauty of a home automation system is that it is highly scalable, flexible and its capabilities are limited only by our imagination. With the IoT revolution just around the corner, it is high time we move towards widespread adoption of such a system. The Internet of Things (IoT) will be huge in several ways. The forces that are driving it and the benefits that are motivating it are

increasingly numerous, as more and more organizations, industries, and technologists catch the IoT bug. The number of connected devices on the IoT network will be huge. One estimate says that the number will be nearly 40 billion, which is approximately 30 devices for each and every active social network user in the world. That is actually a conservative estimate. Another analyst predicts that “trillions of sensors” will comprise the IoT.

2. Internet of Things

The Internet of things is a connection of objects such as automobiles, plants, animals or anything which we can think of. These things have ability to sense and communicate with each other with the help of network. This allows the control of physical world from devices like computer making a complete Cyber-physical System. Each device has a unique address through which you can identify the device and access data. IPV6 played an important role in providing address space for these things. Bluetooth low energy, rfid, wifi and many more are different ways to provide communication power to these things. IOT is gaining its popularity day by day. Even today there are billions of device already connected to internet. The quantity of data being collected and analyzed in and through the IoT will be huge. No one can predict this “ginormous data” volume reliably, but we frequently see articles that mention zettabytes, yottabytes, brontobytes, and even as high as geopbytes. For example: it is already true that sensors on a single Boeing aircraft jet engine can generate 20 terabytes of data per hour; the future astronomy optical telescope LSST (Large Synoptic Survey Telescope) will produce about 200 petabytes of data in its survey lifetime; and the future astronomy radio telescope ensemble SKA (Square Kilometer Array) will alone produce several exabytes per day as it senses the changes and behaviors of objects in the Universe. The Universe! – So, maybe we really are building the Internet of *everything* after all. Each of these examples corresponds to one single node out of the billions (or trillions) that will be collecting and delivering data through the IoT. Those are huge “devices”, whereas most devices on the IoT will be small (*e.g.*, your home thermostat, your car tires, your toaster oven, and everything else). The details of country wise IOT devices per 100 residents are published by OCED [3] in 2015 given in Table 1. According to experts estimate there will be more than 50 billion IOT devices online by 2020.

Rank	Country	Devices online
1	Korea	37.9
2	Denmark	32.7
3	Switzerland	29.0
4	United States	24.9
5	Netherlands	24.7
6	Germany	22.4
7	Sweden	21.9
8	Spain	19.9
9	France	17.6
10	Portugal	16.2
11	Belgium	15.6
12	United Kingdom	13.0
13	Canada	11.6

Rank	Country	Devices online
14	Italy	10.2
15	Brazil	9.2
16	Japan	8.2
17	Australia	7.9
18	Mexico	6.8
19	Poland	6.3
20	China	6.2
21	Colombia	6.1
22	Russia	4.9
23	Turkey	2.3
24	India	0.6

Table 1. IOT Devices per 100 Inhabitants

3. Related Work

For a smart home networking it is significant to implement an automation system. CAN (controller area network) for recognition of fire work is given by Lee *et al.* which is a research work held for BACNet low level analysis in smart homes. Large usage of CAN protocols is due to less cost and simple application [11]. Another work is floated by Zhang *et al.* through which technology enhancement in energy line communication to connect entire network and other networking devices is achieved. When we talk about wireless communication networking bandwidth should be considered properly such as for radio frequency, ZigBee and Wi-Fi communication frequency is exact 433 Mhz. With the development of technologies worldwide we ensure that latest technology and its aspect can be implemented and one of them evolving technology is use of wireless sensors with IoT. Internet of Things can be described in one word a technology where human intervention is not involved *i.e.* a technological device can monitor the data and after analyzing that data device is capable of taking decision in its own and that is what I have found and got motivation from different works and articles. We have found and got motivation from different works and articles. To develop background data and to arrange amenities to users by regulating wireless network actuators for home networking, they used wireless sensor networks for the same [12]. Lots of research works has been done on smart home networking by ZigBee.

4. System Overview

A. Raspberry Pi-

Raspberry Pi is a credit-card sized computer manufactured and designed in the United Kingdom by the Raspberry Pi foundation. The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC), which includes an ARM-S 900 MHz processor, Video Core IV GPU and was originally shipped with 256 megabytes of RAM, later upgraded (Model B Model B+) to 1024 MB. It does not include a built-in hard disk or solid-state drive, but it uses an SD card for booting and persistent storage, with the Model B+ using a MicroSD. The Foundation provides Debian and Arch Linux ARM distributions for download. Tools are available for Python as the main programming language.

Web Server and PHP Code
Python Script for I/O Ports
My SQL Database for control

Table 2.Raspberry Pi Contents



Figure 1. Raspberry Pi

It has abilities to execute programs in various programming language like python and PHP. It is capable to do anything which a normal computer can do from coding to internet access. It can also connect to a network by Ethernet or wifi. In this paper Raspberry pi is used to create a web server for the client, where it is continuously executing the python script to control the appliances with the help of database as shown in table 2.

B. PHP Program-

Controlling of appliances is done with integrated Wi-Fi module connected via web page.



Figure 2. Web Page for User for Controlling the Devices

On the web page, we can toggle the buttons and their output is being reflected in the data base of that web page. The database is a MySQL database. The php file is used for making the web page consisting of four buttons. These four buttons refer to the four pins of raspberry pi. The database consists of 2 columns. The first column refers to the four pins connected and their corresponding values are stored in the second column. The web page could easily be accessed through mobile/tablet/PC. A web page is created with the help of PHP as shown in Figure 2, It consists of several buttons. When a button is clicked, the corresponding value gets changed in the database with respect to its I/O pin. This web page is hosted on Raspberry pi on port-80. It can be accessed anywhere on the globe with the help of IP address of the network and the Raspberry pi.

C. Python Script-

The python script is connected to My SQL database. It reads pin number and value from the database. The voltage on the pin gets high or low with the help of General-purpose input/output (**GPIO**) library as shown in Figure 3, The python program keeps running periodically on Raspberry pi after the interval of five seconds.



Figure 3. GPIO Pins

D. Database-

My SQL database is created as shown in Figure 4, It consists of two rows- pin number and value. Database act as a bridge between web page and python script. We need to create the database only once. This helps in making the system reliable and consistent. The entries of the database get updated corresponding to any event on the web page. The updated values then read by python script making the device on and off.

Pin	Value
22	0
23	1
24	1
25	1

Figure 4. Database

5. Flow Diagram of the System

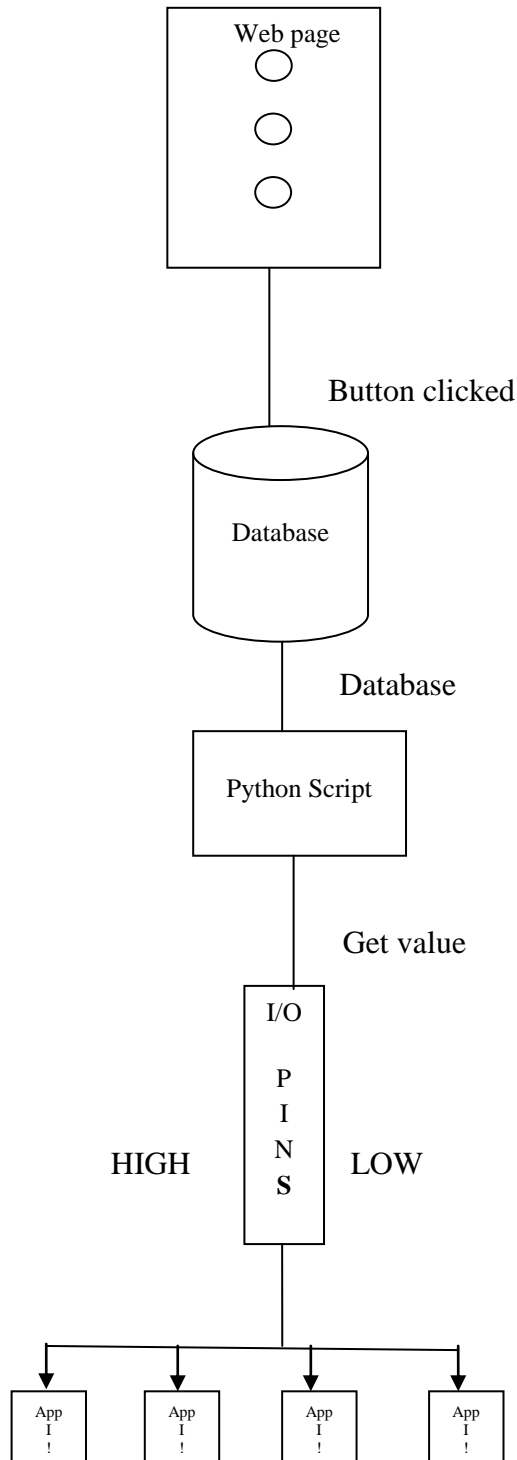


Figure 6. Flow Chart of the Complete System

E. Hardware-

The hardware consists of a relay controlled circuit as shown in Figure 5 & 6, In this circuit, one end of relay board is connected to Raspberry pi and the other end to the main AC supply.

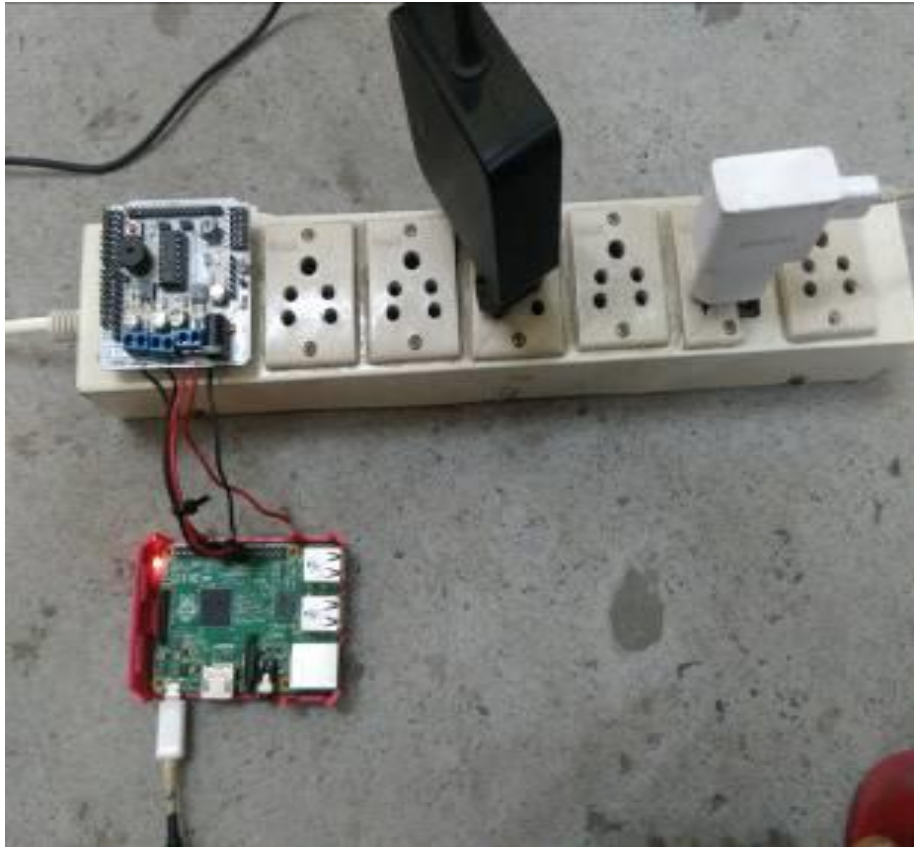


Figure 5. Working Prototype

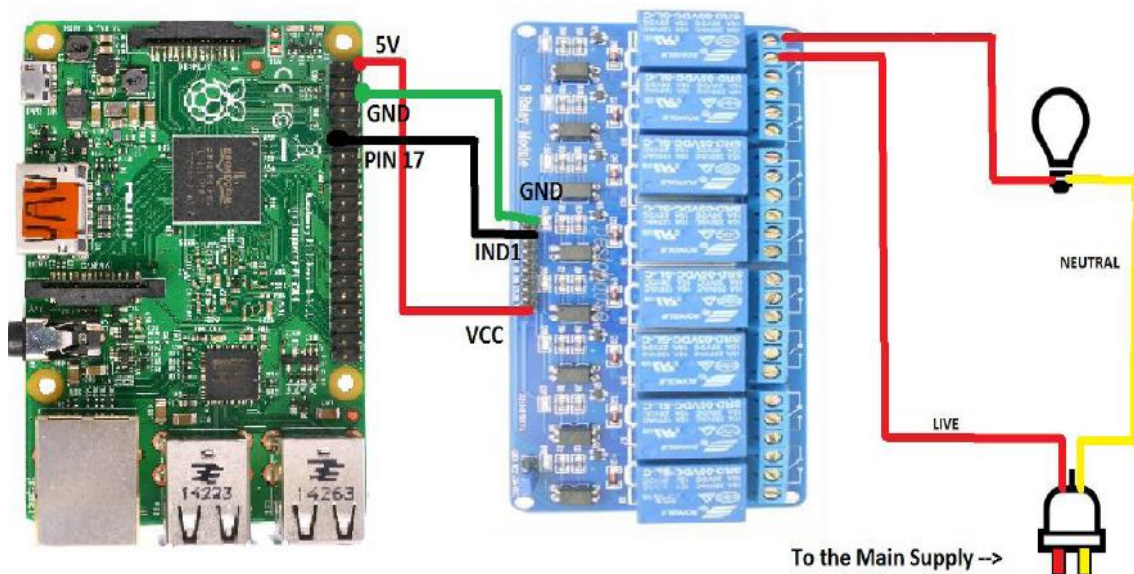


Figure 6. Connection Diagram of the Circuit

When output pin gets high, the circuit gets connected and the appliance gets turned on. When output pin gets low, the appliance does not get any input voltage, thus turning it off. The relay switch works on the principle of electromagnetism. IC-L293D is used to convert output voltage of Raspberry pi that is 3.3V to 12V which is require for the working of relay switch. In the final circuit we have

connected four electric bulbs in series connection and various the python script is running in background. The raspberry pi is getting input from the buttons available on the webpage.

6. Conclusion

Home networking and architecture design are very important for a smart home automation system. With the development of advanced networking technologies, a wireless approach not only can replace wire harnesses in implementation of a smart home automation system, but also is very suitable for an appliance joining in and withdrawing from a control network system. After constructing a smart home control system, a vital goal of the future is to manage all various appliances and optimize the appliances operations. We have designed a complete home automation system with the help of Raspberry pi which costs less than \$50. This system is quite reliable, cost effective and efficient. This IOT based design is much simpler than other designs and will ensure that all your automation needs are met easily on a single web page. The simple design makes it user friendly and very easy to operate.

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