IoT based home automation using Raspberry Pi

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ABSTRACT

IoT (Internet of Things) is a new way of connecting and controlling the electronic devices over the internet and it is going to used it to convert a normal home into a smart home whose appliances can be controlled via the internet from anywhere around the world. Also, voice control is going to be implemented into the Smart home that uses simple speech to control the devices.

Keywords— *Raspberry, Python, Relay*

1. INTRODUCTION

The Internet of Things is a very popular way of connecting the electronic devices over the internet and it can be used to adjust various parameters of those devices using the internet. The IoT is basically a network of interconnected electronic devices and various embedded devices and controllers and sensors that all communicate with each other over the internet in order to perform the desired tasks required by the user.

IoT is used to connect various non-internet devices to the internet and have absolute control over them.

In this Project, the Raspberry Pi is going to be used which is a simple mini computer that can perform various complex operations even though it is very small in size. It has become greatly popular in the computer market and it is even being considered as the third most popular computer ever in just 6 years of being released. This was greatly due to its size and its various uses that the DIY computer community was able to use it for. The main reason for this was their GPIO Pins that allowed various third-party modules that could be connected to it.

Just like the Raspberry Pi Home Automation is also something that is growing in popularity recently due to the rise of various smart devices. But that route is a very expensive one and the goal of this goal is to achieve an inexpensive but effective way of implementing IoT on the standard home appliances. The Raspberry Pi is going to be used to connect the standard home appliances to the internet and control them from anywhere in the world. This will allow total control over the lights, fans, air conditioners and various other devices over the internet by using an online IoT server.

Now the Raspberry Pi can also be used to integrate voice commands into the project. So the Pi can also be controlled by using Voice commands by using a simple Voice control software. This is more useful when the user is at home and can control their appliances directly using voice commands.

2. PREREQUISITE

This is not a very complex project even if it may seem so at the beginning. There is no need to have a lot of knowledge in order to execute this project. This project requires some basic knowledge of electronic devices like Resistors, Relays, Connection Blocks, LEDs and how to connect a basic electronic circuit is enough for this project.

On the software side, some knowledge of python is required as the Raspberry Pi uses Python in its command line interface. Some knowledge of the interconnections of the Raspberry Pi and about its GPIO Pins is necessary since those Pins are the most important part of the project as all the sensors viz. Temperature Sensor (DS18B20), Humidity Sensor (DHT11), PIR Sensor (HC-SR501) and the Light Bulb are all going to be connected to these Pins.
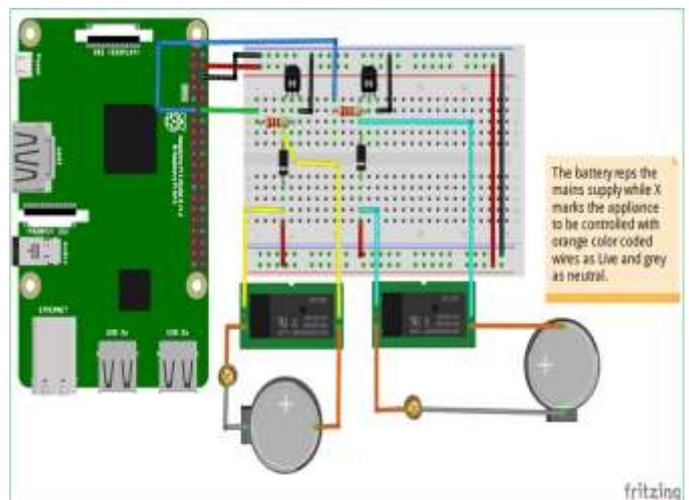
3. CIRCUIT DIAGRAM

Fig. 1: Circuit diagram
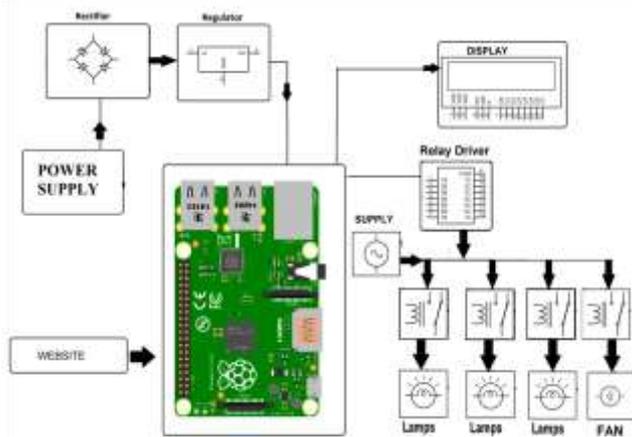
4. BLOCK DIAGRAM

Fig. 2: Block diagram

5. METHODOLOGY

As shown in the block diagram and the circuit diagram above the project is mostly about implementing home automation using the Raspberry Pi as our centrepiece. The Pi will be the actual hub that will take the commands from the user via the internet and then pass them along to the respective appliance.

At first, it is important to set up the Raspberry Pi so that it can accept the user commands and for that to happen it needs to have an O.S. installed in it. In this project, the Raspbian O.S. is used, which is freely available over the internet and can be installed directly on an 8 or 16 GB Memory card. This O.S. provides a user-friendly interface to pass commands on to the Pi and also install other software that will be required later. Then the Pi needs to be updated using the CLI (Command Line Interface) that is available in the O.S.

Now the components can be connected as shown in the circuit diagram. These connections need to be made precisely because any loose connection can result in failure of the system.

Now it is time to set up the IoT server. This server will be made and stored on the Raspberry Pi's memory. This will be a web server that will be used to control the states of certain pins of the Raspberry Pi and to get the data from various sensors that are connected to the Raspberry Pi. The goal is to receive this data over the internet and to control the devices connected to the Pi. In order to do this, there is a certain web server application that needs to be installed on the Pi called Apache Web Server. This is a popular web server application that can be used to server the web pages. The server can contain web pages that are creating using HTML, for a static webpage or PHP for a dynamic webpage. After installing Apache on the Raspberry Pi the web server needs to be tested, this can be done simply by opening a web browser on the Pi and enter the IP address of the Raspberry Pi. This will open the Default webpage for Apache that is a Demo page that has some instructions in it and it also explains what Apache is all about. This default page is the one that has to be replaced with our own web page.

The webpage will be built using HTML and that HTML web page will contain few buttons that will be used to turn the LEDs on and off. This webpage will be calling few Python code files that will contain a code to change the GPIO pinout state. This webpage will also show the data that is being sent by the various sensors that are connected to the Raspberry Pi on the GUI. This Data is variable so the PHP can be used to display this information like temperature, PIR sensor data, etc. This web page can now be accessed by using the browser on the Pi and

entering the IP address of the Pi. This, however, only works in a closed network or devices that are connected in the same network. This means that a computer or mobile can use this web page to connect to the web server over Wi-Fi only. However, this is not the goal of the project, the goal of the project is to connect to the Pi over the internet.

For that, another package needs to be installed which is called as the remote, its package which is an internet server that lets us connect to the Pi over the internet and access the GUI using the desired method. The remot3.it is an online service that allows the user to register and control up to 1000 Raspberry Pi's all at once. In this project, we are using the service that allows connecting to the port 80 of the Raspberry Pi since this is the same port that is used by the Apache web server. This will allow us to connect to the web server that we had previously built. In order to connect the Raspberry Pi to the remot3.it services an account on the website is required which will be required at the time of the installation of the service. The installer will automatically connect the Raspberry Pi to the server and then by logging into your account in the remot3.it website the Raspberry Pi can be controlled remotely directly over the internet. Now the web server that has been created on the Raspberry Pi previously can be connected to using this website and the GUI that was stored in the Apache folder. Now by using this Gui the Bulb can be turned on or off by the click of a button. After the button is clicked the data will be sent to the Raspberry Pi over the Internet and change the state of the assigned GPIO pin to HIGH. This will turn the 5V relay on and then the bulb will be on, the GUI can then be used to control all the other devices connected to the Raspberry Pi. This Gui also displays the data from the various sensors and now this data can also be received over the internet using remot3.it.

Now it is time to implement voice control over the home which is helpful to make it more streamlined. For this, a software called Voice Control for the Pi needs to be installed directly and it is a simple Voice control software that was developed by Steven Hickson. This software uses Google's Voice and Speech API in order to convert the audio input it receives to text.

So this software when installed uses the Mic that has been connected to the Pi to take the voice commands from the user and converts it to text and then sends it to the Pi for further processing. The Pi then receives the text command from the software but it does not know what to do with that command. So, a code needs to be written in the Pi so that it works as desired. This code will make the Pi do certain things depending on the command it has received. After this, the Pi will be ready to receive commands from the software and then execute the command as desired.

6. ADVANTAGES

- A Smart Home is more convenient than a standard home as it can be controlled from anywhere in the world. The only requirement is that an internet connection is required which nowadays is easily available.
- There is also the flexibility factor that makes a smart home more efficient as new appliances can be easily introduced into the system just by making some minor changes.
- A Smart Home is indirectly a secure home as it can accommodate sensors that detect the presence of a human and security cameras and smart locks can also be implemented in it.
- The energy efficiency is also higher as compared to a conventional home as the appliances can be turned off or on

from anywhere and if a person forgets to turn some of their appliances off while leaving their house they can do that using the internet.
- The ability to check the status of any device in the house and to be able to monitor the usage hours of every device in order to reduce the power consumption is critical.

7. CONCLUSION

In this paper, we studied the drawback of a standard home and how a smart home is a more reliable and efficient solution. The Smart home is also more future proof as the popularity of IoT increases and it becomes more mainstream.

8. REFERENCES

[1] Vamsikrishna Patchava, Hari Babu Kandala and P Ravi Babu et al. "A Smart Home Automation technique with Raspberry Pi using IoT" International Conference on Smart Sensors and Systems (IC-SSS), 2015 International Conference on IEEE, 2015.

[2] Alaa Alhamoud, Arun Asokan Nair, Christian Gottron, Doreen Böhnstedt and Ralf Steinmetz et al. "Presence detection, identification and tracking in smart homes utilizing Bluetooth enabled smartphones" 39th Annual IEEE Conference on Local Computer Networks Workshops, 2014, International Conference on. IEEE, 2014.

[3] Basim Hafidh, Hussein Al Osman, Juan Sebastian Arteaga-Falconi, Haiwei Dong and Abdulmotaleb El Saddik et al. "SITE: The Simple Internet of Things Enabler for Smart Homes", IEEE Access (Volume: 5), 2015, IEEE Access, 2015.

[4] Arun Cyril Jose, Reza Malekian and Ning Ye et al. "Improving Home Automation Security; Integrating Device Fingerprinting Into Smart Home", IEEE Access (Volume: 4), 2016, IEEE Access, 2016.

[5] Murad Khan, Bhagya Nathali Silva, and Kijun Han et al. "Internet of Things Based Energy Aware Smart Home Control System", IEEE Access (Volume: 4), 2016, IEEE Access, 2016.

[6] F. A. Qayyum, M. Naeem, A. S. Khwaja, A. Anpalagan, L. Guan and B. Venkatesh et al. "Appliance Scheduling Optimization in Smart Home Networks", IEEE Access(Volume: 3), 2015, IEEE Access, 2015.

[7] Odunlade Emmanuel -"IoT based Web Controlled Home Automation using Raspberry Pi" Oct 23, 2017, Circuit Digest.

[8] Arvind Sanjeev - "How to Automate Your Home With Raspberry Pi and IBM Cloud" June 25, 2015 Maker.Pro.