

## Advanced Home Automation by using Raspberry Pi

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**Article History:** Received: 11 January 2021; Revised: 12 February 2021; Accepted: 27 March 2021; Published online: 10 May 2021

**Abstract:** Now-a-days everyone is involved using their gadgets most of the day for the cause of office works, social involvement or as a hobby. In such era control over the most common domestic equipment's like lights, air conditioners coolers, washing machines, electronic entertainment equipment's needs an automation system. The main feature of such an automation system is to control the domestic appliances from anywhere using mobile phone for the purpose. It should be compatible with the mode, medium and convenience of the usage. Home automation now termed as the 'Smart Home' is a combination of most advanced technologies like Artificial Intelligence and Internet of Things. Having good control over common communicating equipment's this is most helpful for better decisions over optimizing resources usage. This Paper focus on an implementation of such system containing android application that controls devices remotely for switching on and off. The same functionality extended for using voice control also by converting voice command to text to send on network.

**Keywords:** Security, Artificial Intelligence, Internet of things, Machine Learning

### 1. Introduction

The recent technologies in Home Automation have well equipped with internet facility, wireless technologies built to control home appliances, others technologies like Bluetooth and GSM technologies. These can control the appliances locally only and not remotely. Hence, it is observed that such system has complex hardware, not much efficient to use and limits the range of Bluetooth making the appliance being controlled

Therefore, we extend the range by creating a network between the Application and Cloud; we can widen the range, so that the appliance can be controlled from anywhere anytime. On the click of button or voice command, a signal or status with On or Off is sent to the Raspberry Pi via Relay. Thus the status of the appliances is updated on the Cloud Database. The Android Application can be used only by authorized users, thus providing security by Fingerprint Authentication.

#### RASPBERRY PI:

The Raspberry Pi is a series of single motherboard device developed by Raspberry Pi foundation, invented in United Kingdom that aims to impart education to the people in computing technology. It is very low-cost device, very tiny device we can easily connect into computers or TV other appliances and uses standard keyboard and mouse. There is unique operating system runs named as a 'Raspbian'. It works on Debian Linux and very suitable for its hardware configuration. It supports user friendly GUI and it supports wide range of software's, like Python, Java and sonic pi.



**Figure 1.1** Circuit of Raspberry-pi

It supports a set of GPIO pins (general purpose input/output) that supports you to control electronic components for computation and to satisfy Internet of Things application.

**RELAY:**

Relay is acts like switch that use an electromagnet that causes transition in electronic circuit from one state to other state.



**Figure 1.2** Relay Diagram

The Benefits of using relay is that it consumes very small amount of power to control the relay coil. Relay coil suitable for computer type motherboard circuits to change relatively high range of voltages both “ON” and “OFF”, some relay switch is required to control it.

**2. Literature Survey:**

“Mobile based Home Automation using Internet of Things (IoT)”.

- In this paper the system uses Arduino Board instead of Raspberry Pi and an Android Application.
- The communication of the Android application and the Board is fulfilled using Bluetooth and Ethernet connection.

“Internet of Things based Home Automation System”.

- In this paper the system makes use of Raspberry Pi, Android Application.
- The communication of the Android application and the Raspberry Pi is fulfilled using internet.
- Android Application is used to control the Appliances.

“Security Analysis and Improvement of Fingerprint Authentication for Smartphone’s”.

- This paper discusses about the security provided by the Fingerprint Authentication for Smartphone’s.
- This paper discusses about various attacks used and the counter attacks for those attacks.

**3. Problem Definition:**

To design and develop a system to remotely control home appliances using voice commands on the Android Smartphone with fingerprint authentication. The system will be developed in 3 modules i.e. Android App, Hardware module and Cloud module.

**4. Existing System: Disadvantages**

- **Smart Electrical appliance control system**

The disadvantage of this system is they have used AC converter for power conversion. This increases the cost of the system.

- **Home Automation with Raspberry Pi & Bluetooth**

In this project they have included Bluetooth Connectivity to communicate with the Raspberry Pi, which has range limitations. Therefore, the user cannot access the system remotely.

- **An Internet of Things framework for automation and remote control of home appliances**

This project has Raspberry Pi which uses Wi-Fi adapter coupled to it and run over web server. This increases the number of hardware components and hence increases the cost of the system.

**5. Proposed Sestem:**

The system should require Raspberry-Pi, an Android phone, a relay circuit and appliances. The appliances are like Bulb, Fan, Refrigerator and other electronic appliances which are present in our home. We need to develop a mobile application that can be used to switch the appliances on or off by using the toggle buttons in application or

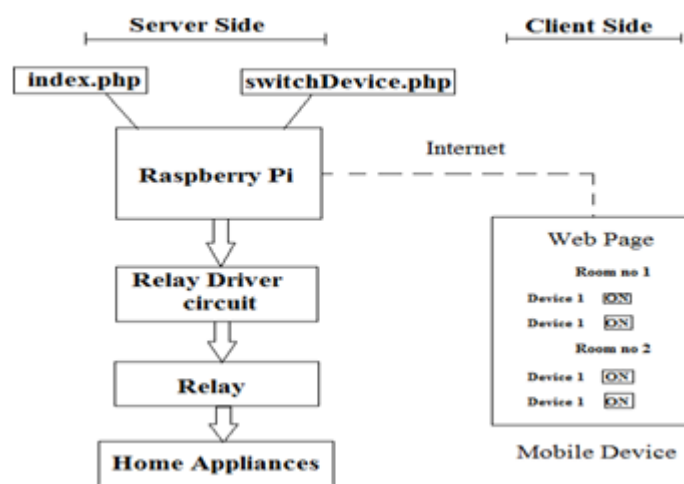
it can be operated by using voice command. Whenever user presses a button on android application it will send the status to the PHP

script on cloud which updates the database. The raspberry Pi has a python program that runs and keeps checking the database for updates. The relay circuit is act as a switch which can turn the appliances on and off with the input received from Raspberry-Pi.

**Advantages:**

- In our project we have used Relay circuit that requires only 5V to control the appliances. Main objective of our project is to reduce the costing structure than the existing one by reducing the hardware cost.
- Our project makes use of Wi-Fi, which can be used to communicate with the hardware locally or over the cloud, and can be operated, from any part of the world.
- Our project has inbuilt Wi-Fi on the Raspberry Pi and which can be used as a local server. The version of Raspberry Pi used in our project is the latest one which has all these additional functionalities.

**6. Design and methodology:**



**Block Diagram for methodology**

**Hardware implementation:**

To make the system hardware we insist below

block diagram. The entire model is categorized into parts; one is server side other one is user side (Client side). The system is implemented using Raspberry Pi, Relay circuit and Android Application. When the user logs into the system using the Fingerprint Authentication implemented in the Android application, the user has an option to send commands to the Raspberry Pi using voice based commands or click of a but- ton. The server side is completely controlled by Raspberry Pi, Server is controlled by using Raspberry pi with the aid of (Apache,mysql,php). When the voice command is sent to process, the string is accepted in the Php script and the string is checked for commands like “on”, “off”, “both”, “fan”, “bulb”, we can always include more patterns, these words determine whether the appliances have to be switched on or off, and further commands are written to change the appliance status in the database.

The Raspberry Pi is connected to the relay circuit which is attached between the KAB and the appliance and acts like a switch. The GPIO pins on the Raspberry Pi are connected to the GPIO pins present on the relay circuit, which in turn is connected to the KAB as well as the appliances.

A Python program is present in the Raspberry Pi, which is run and this program keeps checking the status that is present in the database, if the status of the appliance is 0, then a LOW signal is sent from the Raspberry Pi to the relay circuit, which in turns keeps the switch disconnected. When the status of the appliance is changed to 1, a HIGH signal is sent from the Raspberry Pi to the relay circuit, which closes the switch and the appliance is switched ON.

**Software implementation:**

Our proposed system is divided among three modules. Android studio part is implemented by using Java & XML Programming languages. Authentication is developed by using this module. The hardware module will be implemented by using Raspberry-pi, instructions are written by using Python Programming Language.

The Communication module is developed on cloud using php. On the user request Php script

will be run on the client side and status of the devices will updated at the database. and the Python program will be continuously running on Raspberry Pi keeps on checking the status of all the appliances and if there are any changes, signal will be sent accordingly.

**Module Descriptions and working:**

The System will be developed in 3 modules

**The Android App:**

The android app will be developed using Java and XML programming languages and it will convert voice command to text and send it to the Hardware module, the module can be used only by authorized person. The authentication will be performed using fingerprint scanner of the mobile. There is an alternative to voice command that is, using the toggle buttons to switch on and off the appliances. The user can use any of these to control the appliances.

**The Hardware Module**

The hardware module will be implemented on the Raspberry Pi using Python programming language. The appliances (Bulb and Fan) will be connected to the raspberry pi via the relay. The relay acts as a switch or mediator that controls the 230V current passing through it and it is connected in between the appliances and the main switch for it to act as a switch. The Raspberry Pi sends a 5V signal every time the user switches on the appliance, making the switch complete and switching on the appliance by completing the connection and when the user gives a command to switch the appliance off, a 0V signal is sent from the Raspberry Pi to the relay which is connected via the GPIO pins and the connection is open and the appliance is switched off.

**The Communication Module**

The communication module will be implemented on Cloud using Php. On the user command a Php script will be run and the status of the appliances will be updated on the Cloud Database and the Python program will be continuously running on Raspberry Pi keeps on checking the status of all the appliances and if there are any changes, signal will be sent accordingly.

**7. Results and comparison:**

**Authentication Process:**



**Figure 7.1** Login

In the above figure the user needs to place his fingertip on the scanner, if the user is authorized, the user can then login.

Main Page:



Figure 7.2 Main Screen

In the above figure the user can select the voice command button and give a speech command which in turn is converted into text and when the 'Go' button is clicked, the command is sent to the Php script on the cloud. The user can use the toggle buttons instead of the voice command to operate the appliances.



Figure 7.3 Putty Software

This software is used for remote access of the Raspberry Pi. The host name is the IP address of the Raspberry Pi, which shows the contents inside the Raspberry Pi after getting connected with the hotspot of the Raspberry Pi to the laptop.



Figure 7.4 Login to Raspberry Pi

The Raspberry Pi has to be logged in with its ID and password before getting the details of the Pi.

```
pi@raspberrypi:~/ashwini
login as: pi
pi@192.168.5.5's password:

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Mon May  6 10:42:52 2019 from 192.168.5.46
pi@raspberrypi:~$ ls
ashwini  disha  industry  rodents  sunday
cashew  fahaem  prateek  sumati  test
pi@raspberrypi:~$ cd ashwini/
pi@raspberrypi:~/ashwini$ ls
project.py
pi@raspberrypi:~/ashwini$ sudo python project.py
```

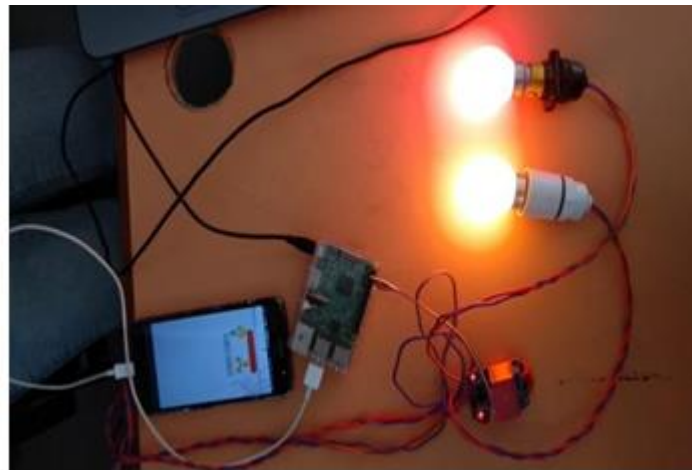
Figure 7.5 Contents in Raspberry Pi

This Figure shows the contents present in the Raspberry Pi, using simple UNIX commands we have to reach to our program files which we want to run.

```
pi@raspberrypi:~/ashwini$ sudo python project.py
Bulb : 0   Fan : 0
Bulb : 0   Fan : 0
Bulb : 0   Fan : 0
Bulb : 0   Fan : 0
Bulb : 0   Fan : 0
Bulb : 0   Fan : 0
Bulb : 0   Fan : 0
Bulb : 1   Fan : 1
Bulb : 1   Fan : 1
Bulb : 1   Fan : 1
Bulb : 1   Fan : 1
Bulb : 1   Fan : 0
Bulb : 1   Fan : 0
Bulb : 1   Fan : 0
Bulb : 0   Fan : 0
Bulb : 0   Fan : 0
```

Figure 7.6 Running the program on Raspberry Pi

After navigating to the required program and when we run the Python file, we get the bulb and fan status from the database, the initial status of both the appliances are 0 and are off. When we try to operate the appliances through the mobile application, the status of the application is changed in the database and hence the values of the appliances change to 1.



**Figure 7.7** The connection of the appliances

This figure shows the connection of two bulbs with the Raspberry Pi and the Relay circuit. The figure even shows the mobile application which is used to give commands to the appliances.

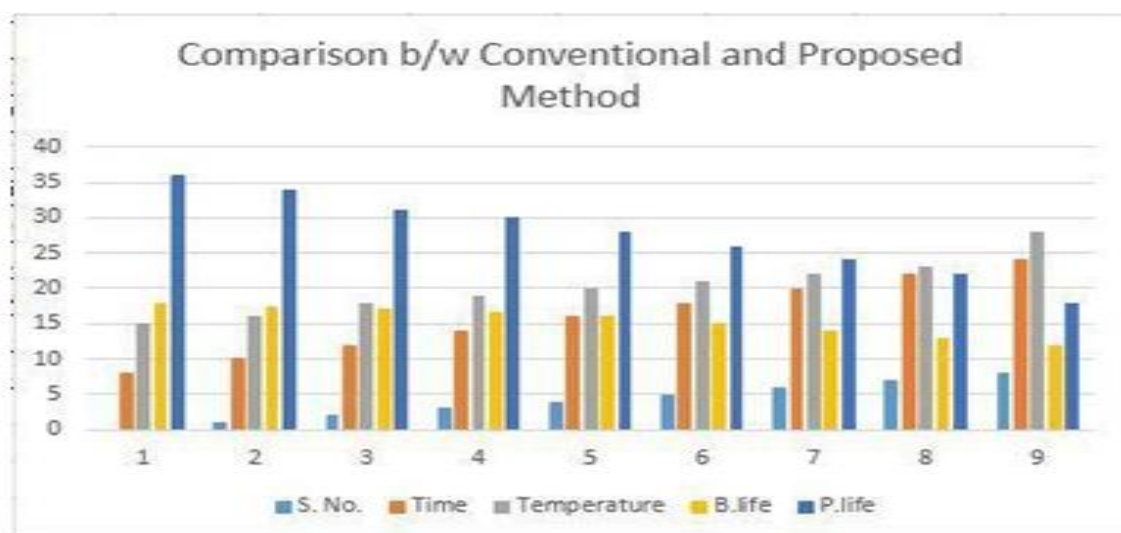
**8. Comparison of Proposed System Under different scenarios:**

In view of comparison in between existing system and proposed system, we are considering three parameters time, temperature, and Battery life.

sl.no	Time	Temperature	Existing battery	Proposed .Battery
1	8	15	18	36
2	10	16	17.5	34
3	12	18	17	31
4	14	19	16.5	30
5	16	20	16	28
6	18	21	15	26
7	20	22	14	24

**Table 8.1** comparison

The below graph shows proposed method is better than conventional method in all manner.



**Fig 8.2** graph between both systems 9.CONCLUSION:

This system provides ease to the users to operate any appliance which operates on 230V by the use of Android application, which everybody now days possess. The security to the system is added by introducing Fingerprint authentication, which can be accessed only by the authorized person.

The Hardware requirements of the system is the Raspberry Pi and relay circuits, which when compared with the existing system is cost efficient and the price can still be bought down with the opting for previous versions of Raspberry Pi. The system takes a maximum time of 5 seconds to switch the system on or off, which means its time efficient as well. This system even consists of voice based commands which can be used to switch the appliances on off. This is efficient for the blind people to use.

### References

1. S. M. Anamul Haque, S. M. Kamruzzaman and Md. Ashrafur Islam1 “A System for Smart-Home Control of Appliances Based on Timer and Speech Interaction” Proceedings of the 4th International Conference on Electrical Engineering & 2nd Annual Paper Meet 26-28
2. , pp. 128-131, January, 2006
3. Tam Van Nguyen, Dong Gun Lee, Yong Ho Seol, Myung Hwan Yu, Deokjai Choi, “Ubiquitous Access to Home Appliance Control System using Infrared Ray and Power Line Communication”, ICI 2007, 3rd IEEE/IFIP International Conference in Central Asia, Tashkent, Uzbekistan, vol 1, pp1-4,26-28 Sept.2007
4. Malik Sikandar Hayat Khiyal, Aihab Khan, and Erum Shehzadi “SMS Based Wireless Home Appliance Control System (HACS) for Automating Appliances and Security”. Issue in Information Science and Information Technology Vol 6,, Pp 887-894, 2009.
5. Kumar Mandula, Ramu Parupalli,
6. CH.A.S.Murty, E.Magesh, Rutul Lunagariya “Mobile based Home Automation using
7. Internet of Things(IoT)”Centre for Development of Advanced Computing(C- DAC), 2015 International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT)
8. Soumya S, Malini Chavali, Shuchi Gupta, Niharika Rao“Internet of Things based Home Automation System”
9. IEEE International Conference On Recent Trends In Electronics Information
10. Communication Technology, May 20- 21, 2016, India
11. Young-Hoo Jo, 1 Seong-Yun Jeon, 2 Jong-Hyuk Im, 2 and Mun-Kyu Lee 2
12. “Security Analysis and Improvement of Fingerprint Authentication for Smartphones” Electronics and Telecommunications Research Institute, Daejeon 34129, Republic of Korea Department of Computer and Information Engineering, Inha University, Incheon 22212, Republic of Korea.
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