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Raspberry Pi Based Home Automation Using Wi-Fi, IOT & Android for Live Monitoring

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ABSTRACT

The project focuses on controlling the Electronic Devices with a Remote or a Smartphone. The major focus of this project is to provide the Ease of Access to handicapped people. A Live Monitoring System to get the fresh updates of what exactly the power consumption of a Room or a Hall is happening. We will also implement the Bill Calculation System from which one can compare it with the actual one. The system will be based on few Sensors, Detectors which will be embedded with the Raspberry Pi. There will be a Server where the updates will be stored in Database. We are using Python, Android and Web Application or Website. The website will be consisting of Login System and UI can be customized by the user as per the need with Device adding the feature.

If you are outside, you can check the temperature of your Home and according to it, you can turn on the AC from the website. We will provide an Easy and reliable GUI for the user so that anyone can learn it easily. It will also consist of User Authentication with an Administrative feature to handle the number of users and the Admin can grant access to some home appliances to a particular user. We have planned to implement it on a live room so that if one enters in the room motion detectors will send the signals to raspberry Pi to turn on the lights or fans. If someone wants how much electricity consumption has occurred, then he/she can get the result of every minute Monitored with the graph of electricity consumed versus time and what is the bill and can take preventive measures.

Keywords :— Raspberry Pi, Relays, Sensor, Detectors, Python; Android; Web Interface.

I.   INTRODUCTION

Our Future is in our Hand so let's make it better and proper. In this world of technology, we all have a very busy life and one can think of living in a comfort zone rather than getting it stressed. So why cannot we use technology to make things better. Home Automation is the first approach to this, which has become and will become a trend in 21st and the upcoming century.

Home Automation is a term used to describe the working of all household amenities and appliances together [1] and we are making it control from our daily use or things especially smartphones, tablets or a computer having Internet connectivity. According to the statistics report, it has been recorded that from 2005 to 2015 the increase in Internet users is been increased from 1,024 to 3,207 million and will increase more in the future. Mobile's smartphones and laptops are the means from which one can use the Internet at any time and from anywhere. So, if we will open a door that connects you to your various daily home appliances then we can control our home.

Many companies like Samsung, Control4, Crestron, AMX, ELAN Home Systems etc. are working for this system and to make it intelligent enough so that the system can communicate with humans which will be no longer far.

There are many projects regarding this topic using DTMF based, JAVA based, Android-based, Wi-Fi based, Bluetooth-based or by using Arduino UNO etc.

II.   LITERATURE SURVEY

1.   *Remote control Home Automation System using Bluetooth:*

Bluetooth technology is used widely across the globe because of its secure and reliable data transmission technique Bluetooth uses a short- range ratio to transmit data over a speed of up to 2.4GHz. Project's main focus is to control home appliances using Bluetooth. An AVR ATMEGA8 microcontroller is used for handling the process which is of 28 pin architecture. The Advantage of using Bluetooth is it is fast reliable cheap and easy to use and handle and has low energy

consumption rate. The components used in this project is as follows:

- ATmega8 micro-controller 1 unit.
- ULN2803 1 unit.
- SPDT 5v Relay 3 units.
- V-Reg 7805 & LM317 1 unit each.
- Terminal blocks 6 units.
- Breadboard 1unit.
- 5v Regulated Power Supply 1unit.
- HC-05 Bluetooth module 1 unit.
- Resistors, capacitors, diodes, etc.
- 16MHz crystal oscillator 1 unit.
- Some wires and jumper wires.
- An Android phone with BluControl v1.0 or above installed on it. [4]

This system has two major drawbacks firstly if the phone doesn't have Bluetooth the user cannot access the network and secondly the Bluetooth has small range of coverage area so it makes the user bounded and cannot be used outside the coverage area.

2. *DTMF based Home Automation System:*

DTMF is an abbreviation for Dual Tone Multiple Frequency technology which focuses on the keypad usage of a phone for data communication. It creates a signal on pressing a key on a keypad. Two or more frequency is mixed [4] and the tone we get is called Dual tone. A cell phone is connected using aux wire to a DTMF decoder MT8890 IC. Every key creates and output of 4 digit and a table is prepared. Based on table different home appliances are controlled [5]. Components used in this project is as follows:

- MT8870 DTMF Decoder one unit.
- Relay 5 volt three units.
- Bulb with holder or LED three units.
- Bread board two units.
- Aux Wire one unit.
- 330K resistor one unit.
- 22 pF cap two units.
- Mobile phone one unit.
- LEDs three units.

This system also has drawback that only limited number of devices can be connected to the system as there are only 12 combinations used in a dial pad for making the digital tone. We cannot access this technology from the outside of the coverage area as that of Bluetooth based home automation.

3. *Raspberry Pi Based Home Automation System using internet of things:*

This project's main focus is for security and to monitor the flow of water using raspberry pi sensors MSP430 microcontroller. Raspberry pi plays a role to handle the execution of code and to process it. The Raspberry pi here is connected to internet via a Modulator Demodulator (MODEM) to handle or access various emails sent to the customer. The device (home appliances) to control is been integrated with the circuit using a Relay channel due to high voltage ratings of home appliances. To view the updates this project make use of display connected to the Raspberry pi. [6]

Fig. 1 Block Diagram of the proposed system for security purpose and to control the flow of water.

4. *Home Automation System using Arduino Micro-controller:*

To control the heavy data communication, we need to have a base i.e. microprocessor or a microcontroller which can handle or control the data processing of the project. This system uses the Arduino which is a microcontroller for controlling various data handling of home automation. This system makes use of PIR sensors motion sensors for detecting the objects around us with the help of heat radiation. This system also makes use of OTP (One Time Password) that can be used as an entry password for the users.

The data which is been send is processed with the help of Arduino. As all the system has its drawbacks this too lags in processing heavy data when multiple devices are connected together.

5. *Smart Home Automation control using Bluetooth and GSM:*

This project majorly focusses on how the Bluetooth module and GSM module get to work in parallel so that user can control household appliances. A mobile phones Bluetooth and SMS facility is used so that any fellow user having the mobile phone can access their home appliances. Bluetooth was a target for accessing home appliances within the home i.e. indoor and GSM for accessing from outdoor. With the help of the GSM user can easily control by giving commands written in SMS from outside. An Android application with C program is used in this project. Eclipse IDE was used for making android application and MP lab software to write and burn code in microcontroller. Android app was tested in many different mobiles and different activities were recorded.

The drawback of using Bluetooth is that it limits its usage due to its low range. On the other hand, the systems working would decline due to some network errors.

III. PROPOSED SYSTEM

We have used Raspberry-pi as the main base of our project for processing data. Our aim is to build a fully workable and controllable home appliance on circuit switch board directly. The user interface would be created for desktops or laptops and applications for mobiles and tablets. The additional new feature would be live monitoring system having graph showing statistical analysis of watts/sec used. Also, we would add bill calculation system which would make the user aware of watt consumption.

Our system would also hold features to detect temperature and humidity. A control would be provided to the members of the family with an administrative feature. Moreover, guest access and family parental control would also be implemented.

6. *Architecture:*

The system architecture comprises of a smart phone with Android Operating System, Web application, a database server as their main components. The main base component of our project is the Raspberry Pi handling the data processing between various modules. We will connect the Raspberry Pi with the 8 connected Relay channel using the GPIO (General Purpose Input Output) pins on Raspberry Pi. We will try to connect the bulbs and DC motor fans just to test that it is working properly or not. We will add the temperature and humidity sensor to get information about the room temperature and the humidity of that particular room.

An Android device is the second major component used to access those things which are connected to 8 connected Relay channel. Android platform gives a good inbuilt architecture having Snapdragon or any smartphone processor with up to 2GB of RAM and a display panel to view the outputs. It is a way good stuff with which we can use to process the data connectivity between itself and the different devices. (here Raspberry Pi).
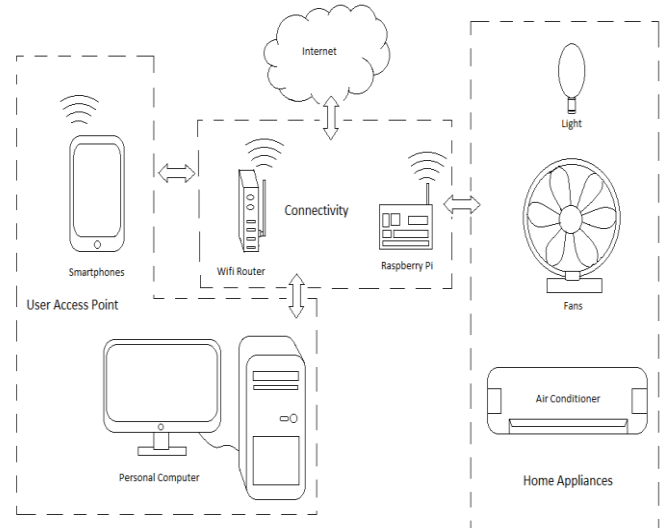

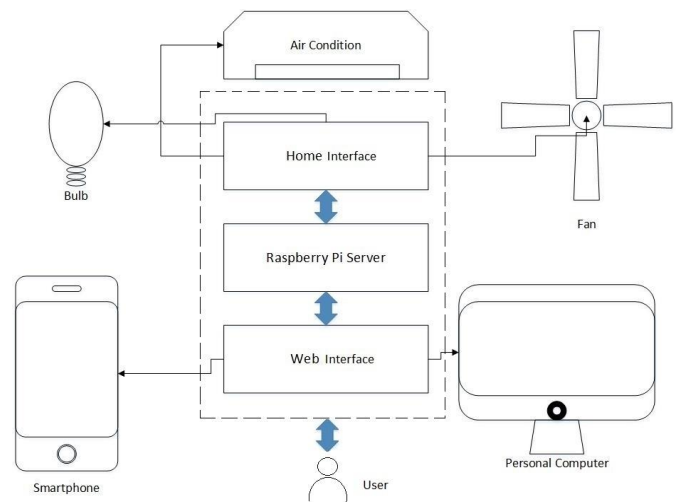Fig. 1 Basic architecture of the system.

Fig. 3 Server architecture of the system.

Any personal working laptop with internet connectivity can be used to gain access to our home appliances. In short, we would say that any electronic device no matter it is a PC or a laptop or a tablet or a palmtop or smart TV or a smartphone etc. can be used to control your switches of your home's fans

or tube light. We have opened a door of your switches and connected it to the internet.

IV. WORKING, TEST CASES AND RESULTS

1) *Setting up of environment:*

Download and install packages like Python, Django framework, MATPLOT Library, Numpy, RPi Package, GPIO modules, etc. which is basic necessity of our project. Before installation we must check whether the environment variables are set or not After completing the package installation, one must Open up the Terminal or command prompt and go to that folder which consist of the project folder, make a super user by typing the following command as:

Code:

```
python manage.py createsuperuser
```

After doing so insert superuser username, password and email ID. This information will be of home superior (home admin) which will have the administrative features of adding, deleting and suspending member of home. After becoming superuser the user has to log in to the website using his superuser username and password, He can then add user and delete user according to his wish. The members can now be able to access the home appliances.

2) *Test cases:*

Testing phase is divided into two main categories which is Hardware Testing and Software Testing. Hardware Testing is done manually as all the components used in our project was new and was tested by company. In Hardware Testing, LEDs were used so that to ensure the working is fine or not, LEDs indicating the hardware circuitry is active and fine.

Software Testing methodology we used in our project is White Box Testing methodology. We have made our test cases as per our knowledge.

Test case: Software Testing include validation and verification and flow of correct data from database to the output. The validation is provided by the Django form and field validation module embedded inside Django framework.

Verification is done using the Django database embedded which is safe and very secure and powerful it has powerful password verification with similar username notification and weak password notification.

1) Test 1: We worked with the database and tried adding up to 4 users and accessed the appliances from different places to get the database connectivity and fast workflow of our

project. It was recorded that there were some minor glitches while accessing and controlling the lights from the website

2) Test 2: Second test mainly focused on internal logics and connectivity range. The internal logic code was cross verified with different data inputs like running the test.py file in python interpreter and giving different inputs. GPIO package were also tested by implementing it on breadboard and running the code from test.py file. The interface graph design was tested in three different PC and three different mobile phones in three different software and hardware configuration which worked fine but took time to load on PC and mobiles with low specification.

Connectivity Range was as similar to the Wi-Fi range for the device connected to same Wi-Fi router, but if maximum number of users are connected then there might be a chance of getting our system to lag and even hang. We recorded only maximum of 8 users connected to Wi-Fi providing 1MBPS internet surfing speed were able to use the project in a fluency, but when one more device is connected small glitches occurred.

3) *Test 3:* Administrative testing, testing of admin features with controlling, suspending and getting updates are essential. We tried controlling one light with two different users and was able to control by both of them and tried to suspend one of the user for 2 mins so that only one user can handle the switch. After two mins, we got a notification that the suspended user is able to control the light again.

We repeated the suspending task for same two users with more time of suspend, this time it was half an hour, after 15 mins we were able to cancel the suspension of that particular user and that user was able to control the lights again.

3. *Results:*

We were able to successfully control the lights and fans of a room. We saw the updates on the website about the light or fans getting on and off with live updates to admin. The Dashboard has number of users connected to the system and who has the access privilege to a particular switch. The Home automation was successful in showing the unit Bill and the amount of voltage consumed by a particular user. The Live Graphical representation of Number of user connected versus time, Voltage versus time, Amount of bill till now versus time.

Tasker is working correctly. Three task with different dates and time were spotted working on given time. Last date and time of use of particular switch was recorded and displayed on website at the time of testing.

4. Drawback:

• No one is perfect and thus we too, our system is dependent on internet and the Wi-Fi range. Once the raspberry pi is disconnected or taken out of the Wi-Fi coverage website access is stopped.

• Our project is dependent on the electricity supply so one cannot access home appliances if the targeted home does not have power or electricity supply.

• Without admin creation, no one can add delete or suspend users, our system is admin dependable.

• More period of time can make the Raspberry pi hot leading to several damage problems, but a heat sink will be good to keep it cool in that case the project will be heat sink dependent.

• Raspberry Pi needs at least 2 hours to update itself till then nothing can be controlled.

V. CONCLUSION

The project focusses on helping hand to the needful people like handicapped and the patients in hospital and in home. Technology should be used in betterment of the people lifestyle. We can add n number of features to make our life a beautiful and wonderful with technological environment.

Lights and fans are the subjective elements in a common in low class or middle class room. Due to this maximum number of the people will get a good and a user-friendly environment with controls of light fans and any appliances in your smart phone or website. As smartphones, have become the crazy trending and fastest growing technology worldwide and there is a smartphone in each and every pocket.

Giving access of their home in their pockets or in their hands is a challenging task that completes our objective and motto of this project. By doing so the rate of internet access and IoT will increase, people will get a good exposure to the new emerging technology and will get a curiosity to know about what technology can change the lifestyle and the problems faced by the human.

VI.   FUTURE WORK

• A call on user's smart-phone when someone rings the doorbell.

• NFC based room waking or NFC tags based profiles. Based on NFC we just need to tap our phone on smart NFC tags according to which the desire function will be done like opening the garage door or some user customized functionality.

• Chat rooms or chat conference with other smart homes using home to home communication protocols i.e. IEEE 802.15.4. This protocol is being used by Threads Network, ZigBee etc. We can add All Room MIC and Speakers and can even convert it to video conferencing using a surveillance camera all embedded on 4 to 5 raspberry pi. These pi's will communicate with each other through IoT.

• Internet calling, GPS location getting location of nearest restaurants or hotels.

• Google search engine embedded with all Google maps and different APIs.t.

• Intelligent Personal assistant which can answer all sets of questions.

• Intelligent Music playing system that plays music on different vacations or parties units.

• Gesture based stop and start or command recognition and customization.

• Speech recognition and biometric key unlocking system for security.

• And many more features would be added up as the project work proceeds.

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