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IoT Based Smart Interactive Office Automation

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Abstract - The word automation enables replacement of humans by machine. Proposed system enables us the control of any or all electrical devices in our office. This project illustrates and demonstrates the effective implementation of IoT (Internet of Things) used for monitoring and controlling office appliances through Internet. Additionally the system will also monitor number of visitors inside the office and accordingly control the electrical appliances to avoid excessive usage of electricity which results in less polluting and greener environment. Whenever the resources are consumed more than the visitors then either user can manage through Smartphone or System can manage the resources. Office automation provides sustainable workspace for the employees. The user here will interact directly with a mobile app. The raspberry pi acts as a controller which is connected to cloud through internet and other hardware are interfaced to raspberry pi to control electrical devices.

Key Words - Internet of Things (IoT), Raspberry pi 3 model B, Automation, Relay.

1. INTRODUCTION

In the last few years technology has progressed tremendously and it's still evolving at rapid base. New technology is emerging every day & and changing the way of living. Like how they Shop, how they watch movie, how they order food. We have 30 crores of Internet user in India 14 crores smartphone users changing the behaviour of all consumer and creating a massive opportunities. The people have information at their fingertips, even in small cities and towns, now the technology enables the people to control things like Garage Door, Home Appliances & Smart Vehicles etc. on their fingertips.

Home Automation is becoming popular and crucial part of our life with many aspect like comfort, ease of interaction and energy Conservation etc. Ahmed ElShafee et al. [1] implemented home automation system that uses Wi-Fi technology. When technologies like remote control, radio connection are used at that time, devices are need to be within particular range. Monika M Patel et al. [2] Proposed automation using raspberry pi as a controller and actions are coordinated by the home agent running on a PC. Pavithra D et al. [3] implemented home automation using Wi-Fi as communication protocol and raspberry pi as server system. Here user will interact will system through web-based interface over web and controls home appliances like lights, fan and door look with fire detection feature. Praveen Kumar et al. [4] proposed a home automation system with monitoring and controlling of home appliances with door permission system. Where Raspberry pi acts as server and user interacts with web interface.

There are various systems proposed for home automation with central controller based on Arduino or raspberry pi web based email based, Bluetooth-based, mobile-based, SMS based, ZigBee based , Dual Tone Multi Frequency-based, cloud-based [7]. Now a days every person is connected to each other using different means of communication, where most popular communication mean is Internet, So the Internet which connects persons can connect things too[6].

Proposed Office automation system is cloud based that control of various electrical devices in our office. By using Internet we can control devices also from long distance. When the devices are controlled through internet are considered as IoT. IoT is a technology in which we can control various electrical devices through internet. The real time information, data monitoring and energy consumption in office can be traced through IoT.

The system can be used for monitoring and control of various electrical devices in offices and home. The user can monitor status devices i.e. ON/OFF and controlling that devicesfrom any location. This paper will describe an approach in which we implement an office automation system based on IoT to control the variousdevices in offices/home.

2. SYSTEM OVERVIEW

The main objective of proposed system is make a cost effective systems for offices, hotels and other workspaces. If one forgot to switch OFF light and fan of particular room in the office so there is chance of waste of electricity. Some time there is no presence of any one in the room and still the electrical appliances left ON. Also sometimes very few peoples are present in the office and still all the lights and fans are kept ON. So in this case the proposed system will keep a track of Visitors in the office and manages the electrical resources effectively. This situation can either be handled by user or by system itself. Fig 1. Represents block diagram of system. The system is like a plug and play for the user with less complexity. The system can use Wi-Fi or Ethernet port to connect to internet.

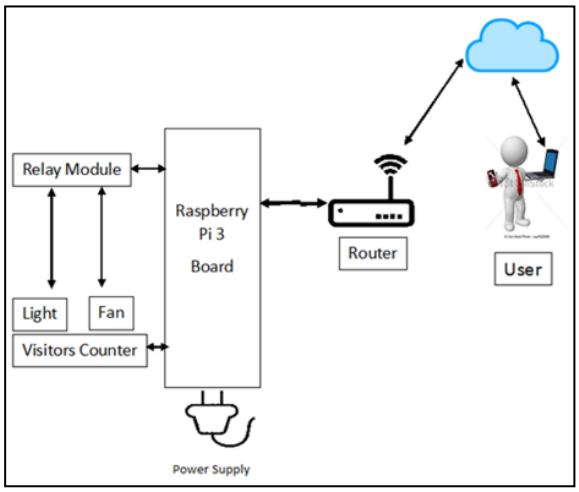

Fig. 1. Block Diagram Of System

This IoT based smart office automation system is a combination of different components as follows:-

A. Raspberry pi 3 model B
B. Relay circuit
C. Sensors interfacing
D. Application interface

A. Raspberry Pi 3 Model B

This board is used for multiple purpose due to its usefulness. This board consist of Broadcom BCM 2837 ARM cortex A53 quad core 1.2 GHz processor. This chip also consist of 1 GB RAM, 40 pin GPIO header, 10/100 Ethernet port, Broadcom videocore lV GPU, Bluetooth 4.1, microSD storage. Fig 2. Represents Raspberry pi 3 model B. This chip is easily available in market. Its processing speed is higher as compared to earlier Raspberry pi models.

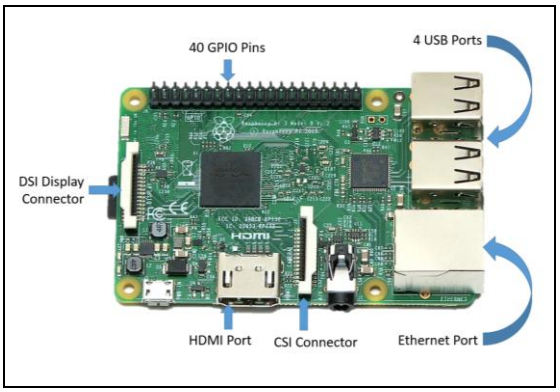

Fig.2. Raspberry Pi 3 Model B

B. Relay circuit

A relay is electrically operated switches which allows low power circuit to switch a relatively high voltage or current ON/OFF. In our system we use 4 channel relay which is operated on 12V. It is equipped with high current relay 7A @250VAC / 10A @24VDC. It can be used to control both AC & DC appliances such as solenoids, motors, lights, fans, etc. High quality screw terminals (terminal block) provides (C, NC, and No) for easy and quick connection. Fig 3. Represents 4 channel Relay module.

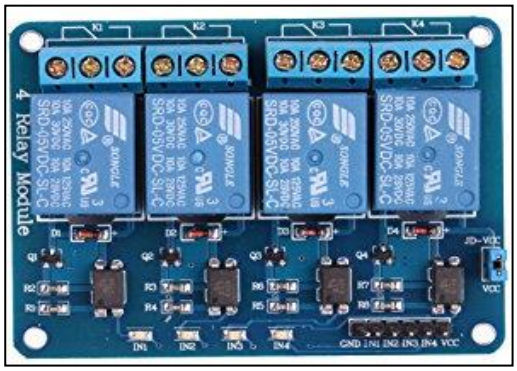

Fig. 3. Relay Module (4 Channel)

C. Sensors Interfacing

IR sensors are used to detect infrared light, which is used to turn ON/OFF of lights. We used PIR (Passive Infra-Red) sensor which is used to detect human being at time, when he/she comes in contact with it. A camera is attached to see number of peoples present in particularroom and it will also broadcast live video to user. Fig 4. Represents PIR sensor.

Fig 4. PIR sensor

D. User Interface

User interface is everything to see and control the raspberry pi. To operate the raspberry pi we made a Universal Windows Application. Mobile application is built in Visual Basic by using language C# for logical design and XAML for UI design. Mobile application provides ON/OFF of electrical appliances, sensing camera information, etc. As Visual Basic is also product of Microsoft there is a less complexity of compatibility with server due to homogeneity of technologies. Fig 5. Represents Mobile application UI.

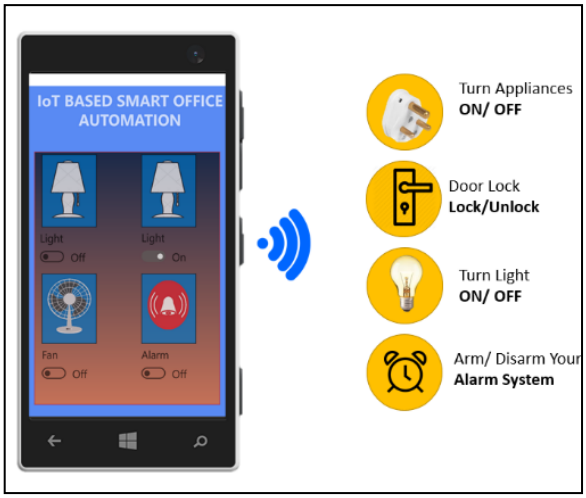

Fig. 5. Mobile Application UI

3. IMPLEMENTATION DETAILS

Implementation consist of connection of devices with relay, Raspberry pi setup, developing app for mobile, connection of Raspberry pi and mobile app with cloud services etc. as follows:

3.1 System Architecture

The physical layer consists of the devices which are to be controlledthat is the lowest layer of the stack. On top of which we have a controlling device which responsible for controlling the appliances. These controlling devices are connected to cloud services Internet. Fig 6. Represents architecture of IoT.

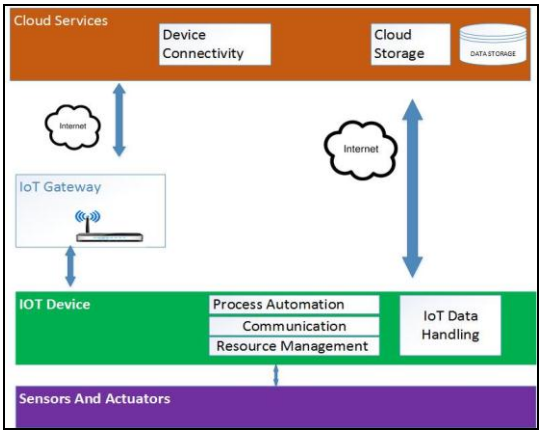

Fig.6. Architecture of IoT

The user command first goes to cloud services these commands from cloud is fetched by controlling devices to control the appliances. This is real-time system just takes fraction of seconds to perform ant action.

3.2. System Design

As we are implementing visitor counter system we need two pir sensors. The entire setup of visitor counter is shown in Fig. 7. To implement it we placed two sensors across door serially. The logic behind it is when outsides sensor(PIR 2) is cut followed by inside sensor(PIR 1) cut it indicates that someone enters into room and when inside sensor(PIR 1) is cut followed by outsides sensor(PIR 2) cut indicates someone leaves room. When someone enters into room counter increases and when someone's leaves room counter decreases. The time to time status of counter will be supplied to user whenever he/she requested. Fig. 7. Represents visitor counter implementation.

The logic of cutting sensors is given below:-.

```
If (PIR1)
{
        If (PIR2)
        {
        Counter-- ;
        }
}
 Else if (PIR2)
{
        If (PIR1)
        {
        Counter++;
        }
}
```

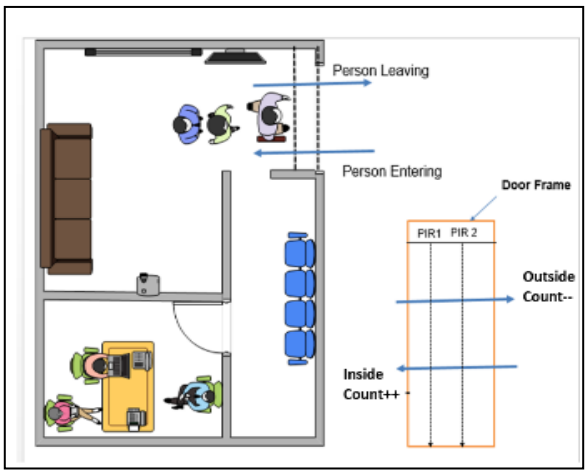

Fig. 7. Visitors Counter

3.3 Connections

First step is setup of Raspberry pi, which consists of loading of OS and other setup. For our project we selected Microsoft Windows 10 IoT operating system which is developed by Microsoft especially for IoT based applications. After loading OS we need to do various configuration setting like password for default user, language, username, command line etc. As we know Raspberry pi don't have any storage so we required microSD card to store OS.

The experimental hardware setup of the proposed system is as shown in fig. 5. The following set is done with DC devices, the system

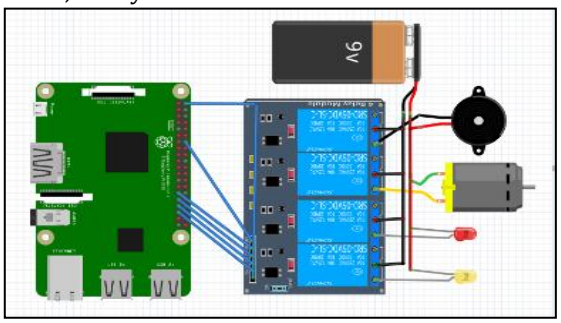

Fig. 8. Connection of Components

Will behave same for AC devices powered with AC current as acts in case of DC. The setup mainly focused on the interfacing of various hardware devices. Fig 8. Represents connection of components.

Next step is electrical devices are connected to relay circuit, for each device each channel is required. In our system we take 4 channel relay circuit to control multiple devices. Relay circuit is connected to Raspberry pi through GPIO pins of Raspberry pi.

Next step is connection of Raspberry pi and mobile app with cloud services. Mobile app is easily connected with cloud through internet. In our system we use Microsoft's azure cloud services for cloud connection. The server side programming is done in language .NET and xml.

The last step is developing mobile app to control Raspberry pi. App is Windows mobile app which is developed by using visual studio. In app we provide necessary access like ON/OFF appliances, sensing parameters like temperature, intensity of light, camera etc. Programming languages used to develope mobile app are c# and .NET.

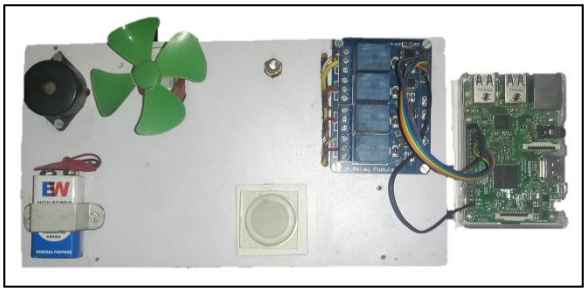
Fig. 9. Hardware Implementation

Step by step Working:-

1. User switch ON/OFF the radio button on mobile app.
2. Mobile sends this request to server through Internet.
3. This request is stores in server.
4. As our Raspberry pi is connected to Internet, it always listens the server.
5. So when request comes in server, Raspberry pi listens it and start execution.
6. Raspberry pi executes it and gives instruction to relay.
7. According to instruction relay ON/OFF the appliances.

4. RESULT

The office automation system is control through mobile. We have developed a mobile app which provides interface to control appliances. This method makes comfortable and easy access to a particular appliances from mobile. The ownercan also interact with the visitors without reaching to the door.

Fig. 4. Represents UI of mobile. UI provides ON/OFF switch for light, fan, alarm and visitors counter. There is a login page which requires the user id and password for authentication of user. This system prevents unauthorized access of smart office system. The system is plug and play type system, where user just need to turn ON the system and wait for couple of seconds to boot up the system and then can start the action. The user have a flexibility of adding or removing the Electrical appliances. The application can be installed on any desktop, laptop, tablet or Smartphone which

runs on Windows operating system. So the user will have a choices for using the application as per their preference.

5. CONCLUSION

This paper present a low cost and flexible solution to the smart office. Various appliances in offices are directly controlled through mobile. Office automation system is developed using Raspberry pi and IoT technology. The system allows control of appliances, real time monitoring, camera sensing, etc. The system reduces human effort for controlling and monitoring of the appliances as well as handling of the visitor counter. This system reduces consumption of electricity in the offices by proper scheduling and monitoring of the appliances. The system response is good and sustainable for long time operation. This system may employed in many places likes Banks, homes, hospitals, labs, etc. For saving energy.

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