

Intelligent Home Appliances Operates Through Email Using Raspberry PI

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Abstract:-- Due to rapid development in home automation technology people are demanding for smart home in which the home automation system is implemented or home appliances work automatically and by remotely. The existing system such as Zigbee and Bluetooth module are having several drawbacks. They are limited range of access, less secure and expensive Putting all these things in mind proposed system is designed which consists of control system based on Raspberry pi with WIFI module. This system uses WIFI module to read mails, matches the subject of mail and perform the particular action. Python script is used for writing the control algorithm which is generic and flexible.

Index Terms:—Raspberry Pi, WIFI module, Relay, Dimmer Circuit.

I. INTRODUCTION

Home automation is controlling basic home function and features automatically and sometime remotely. An automated home is called smart home[1]. This home automation system make tasks more convenient as turning ON/OFF devices remotely, save energy, increases the security. There are several reasons for proceeding home automation system. Major reason is electricity loss because inability to access and control the appliances from remote location. As new technologies arriving quality and performance of home automation system increases. People are also giving preferences for automated houses. With the help of Zigbee and Bluetooth module, home appliances can be accessed remotely .Due to limited range of both module, it will create problem for long term distance. Many modules are available in market for home automation system. Using different technologies like Bluetooth, GSM module, Zigbee Module, Microcontroller, automation systems can be implemented. This home automation system is implemented using raspberry pi. Raspberry pi is heart of this system .It is low cost, credit card sized single-board computer. And also controlled by Debian Linux optimized for the ARM architecture. The Raspberry pi has Broadcom system on a chip (soc). Some of raspberry pi has two USB port and some of them consist four USB port which is called USB hub. In Raspberry pi 1, three model as model A, B,B+. Raspberry pi2 model B is present. For different type of raspberry pi model used different type Broadcom. As in raspberry pi 1 Broadcom BCM2835 and for raspberry pi 2 Broadcom BCM2836 system on chip used RAM is provided bottom of this raspberry pi. This model requires micro SD card which is at bottom of raspberry pi. This SD card is used to store the

operating system and program memory.10/100 BaseT [2]
Ethernet socket is provided on this raspberry pi board.



Figure 1 Raspberry pi 2 model B

II. RELATED WORK

There are several existing system for controlling home which helps to elderly and physically handicap people. Using GSM system home appliances are controlled by sending SMS to other GSM module which is at receiver side. For this type of automation system every time you need to send SMS to control home appliances. And after sending SMS, it will not give the assurance of delivery of SMS as early as possible and device is switch ON/OFF. Speed is slow due to delivery issues. Cost is high due to SMS charges [3]. Email Interactive home automation systems using microcontrollerLPC2148.Using this controller connect unlimited appliances. Main disadvantage of this system is that it requires PC [4].In Bluetooth Remote HAS (home

**International Journal of Engineering Research in Electronics and Communication
Engineering (IJERECE)
Vol 3, Issue 12, December 2016**

automation system) using android is low cost project. This system is user friendly, easy to implement. But it operates up to limited range as we know Bluetooth range is 10m. This system couldn't operate beyond 10m.[5]. Using Zigbee technology, control home appliance like switch ON/OFF devices. This system can monitor and accessed remotely by user via SMS or Email. This system requires two hardware as Home server and controller board. The home server is high end PC that controls the algorithm that enables the user to access home appliances. It communicates receiver side Zigbee which is connected to microcontroller. Disadvantages of this system is limited range of Zigbee which is indoor 10 m and outdoor 30m. so we couldn't operate this system beyond 30m [6].

III. PROPOSED SYSTEM

The architecture of the system mainly consists of Raspberry pi module. The overview of proposed system is as shown in the fig2. The block diagram mainly consist Raspberry pi, Display, Mouse, Keyboard, WIFI module, Dimmer Circuit, Relay, Motor Driver, web-cam, light, motor, fan, pushbutton etc. Main heart of this system is Raspberry pi, which is interfacing with number of devices like light, fan, motor and button. These blocks are on left side of block diagram. Using USB hub of raspberry pi mouse, keyboard, and WIFI module connected to raspberry pi. Mouse and keyboard both are input to raspberry pi. Those are used to operate the raspberry pi, so it's easily help do the programming and make changes easily. The raspberry pi module is having HDMI connector option so using HDMI to VGA cable. Due to this cable monitor current status of the home appliances and also to check the updates of raspberry pi. WIFI module is used to access incoming and outgoing E-mail services. Dimmer circuit used to make brightness of light high, medium and low. Relay is an electrically controllable switch which is used in industrial relative simplicity, long life and proven high reliability. The control signals use +5V logic levels and is of TTL compatible.

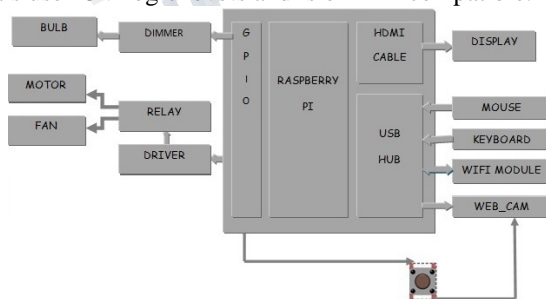


Figure 2 Proposed system Configuration

Motor driver is used to drive a motor, automobiles and home appliances. Push button is also interfaced with Raspberry pi as shown in block diagram. By pressing this button it will capture the image from USB camera and getting mail on user ID. This entire algorithm can be controlled by Python script. It is interpreting language it means it does not require any compiler this is the main advantage of this coding. In other language the program will first compile then it will execute. Python code is written on raspberry pi module to perform particular action. Python version 2.7 is used to write the program.

A. Raspberry pi model

In proposed system Raspberry pi2 model B is used which has 6 times processing capacity as previous model. Broadcom BCM2836 used which is powerful ARM cortex A7 based quad-core processor. It runs at 900MHz frequency and memory capacity is up to 1GB [14]. Raspberry pi module consists micro power supply socket which provide 5V power supply to PI and operating current is 2A. Raspberry pi model B is as shown in fig 1. Forty GPIO pins are provided to this raspberry pi2. GPIO pin layout is shown in fig 3.

| Pin# | NAME | NAME | Pin# |
|------|-----------------------|-----------------------|------|
| 01 | 3.3v DC Power | DC Power 5v | 02 |
| 03 | GPIO02 (SDA1 , I2C) | DC Power 5v | 04 |
| 05 | GPIO03 (SCL1 , I2C) | Ground | 06 |
| 07 | GPIO04 (GPIO_GCLK) | (TXD0) GPIO14 | 08 |
| 09 | Ground | (RXD0) GPIO15 | 10 |
| 11 | GPIO17 (GPIO_GEN0) | (GPIO_GEN1) GPIO18 | 12 |
| 13 | GPIO27 (GPIO_GEN2) | Ground | 14 |
| 15 | GPIO22 (GPIO_GEN3) | (GPIO_GEN4) GPIO23 | 16 |
| 17 | 3.3v DC Power | (GPIO_GEN5) GPIO24 | 18 |
| 19 | GPIO10 (SPI_MOSI) | Ground | 20 |
| 21 | GPIO09 (SPI_MISO) | (GPIO_GEN6) GPIO25 | 22 |
| 23 | GPIO11 (SPI_CLK) | (SPI_CE0_N) GPIO08 | 24 |
| 25 | Ground | (SPI_CE1_N) GPIO07 | 26 |
| 27 | ID_SD (I2C ID EEPROM) | (I2C ID EEPROM) ID_SC | 28 |
| 29 | GPIO05 | Ground | 30 |
| 31 | GPIO06 | GPIO12 | 32 |
| 33 | GPIO13 | Ground | 34 |
| 35 | GPIO19 | GPIO16 | 36 |
| 37 | GPIO26 | GPIO20 | 38 |
| 39 | Ground | GPIO21 | 40 |

Figure 3 GPIO Pinouts of Raspberry pi

B. Relay Circuit

5V relay is used to control Fan and Motor.

C. Motor Driver

Motor driver is used to drive current to control Fan and Motor

D. Push button

By pressing this button it will capture the image from USB camera and getting mail on user ID.

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)
Vol 3, Issue 12, December 2016

E. Dimmer Circuit

Dimmer circuit is used to increase and decrease brightness of light (Bulb)

F. Flow chart of control Algorithm

Fig 4 Shows Flow chart of control algorithm. Two flow charts are shown in fig 4. First flow chart is of interfacing devices with raspberry pi as light, fan, motor. Second flow chart is of interfacing push button with raspberry pi.

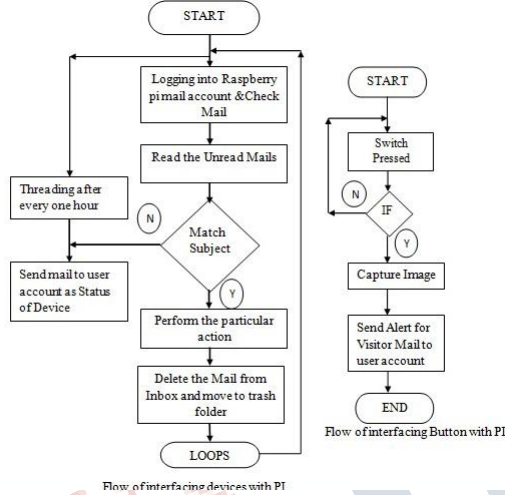


Figure 4. Flow chart of control Algorithm

G. Hardware interface board

The hardware interface as shown in Fig 5. As raspberry pi 2 model b is used Relay is used to control devices as Fan and motor which is connected to GPIO pins of raspberry pi. Dimmer circuit which is used to control the brightness of light and is also connected GPIO pin of Pi. USB camera is connected to capture image.



Figure 5. Hardware interface

H. Software requirement for PI2

1. Raspbian OS
2. Python 2.7

IV. EXPERIMENTAL RESULT

The proposed system controls three devices as light, fan and motor. The email account of Raspberry pi as shown in fig 6. As shown in fig 6 list of mails with the subject of devices as ON or OFF. These subject of Emails will be read by the raspberry pi and perform the particular action. After reading the subject of Email the raspberry pi send the mail to trash folder.

As shown in fig 2 a push button is connected to GPIO pin 7. When this button is pressed USB camera captures the image and Raspberry Pi's Gmail account sends a mail with the image to user account. The subject of this mail is as "Alert for Visitor". The screenshot of this mail is as shown in fig.7

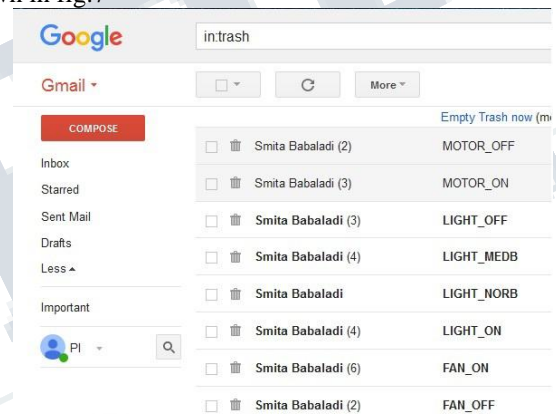


Figure 6. Snapshot of Trash of Raspberry pi

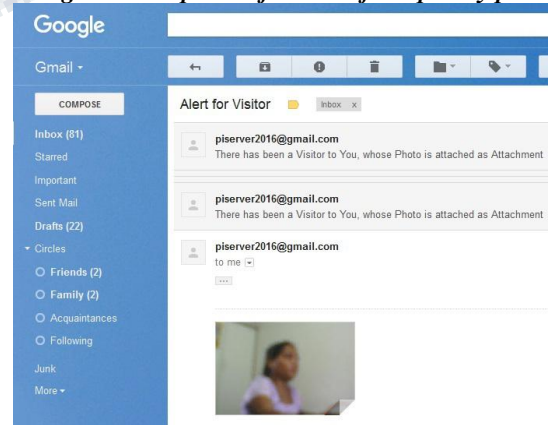


Figure 7. Snapshot of Alert For Visitor

V. PERFORMANCE ANALYSIS OF RASPBERRY PI2

The difference between PI2 with ESP8266EXX as given in table1.

**International Journal of Engineering Research in Electronics and Communication
Engineering (IJERECE)
Vol 3, Issue 12, December 2016**

| PARAMETERS | MODULE | |
|---------------------------------|---|---|
| | RASPBERRY PI 2 | ESP8266EXX |
| OPERATING VOLTAGE | 3.5 to 5 v | 3 to 3.5v |
| OS | OS is provided | OS is not provided |
| PROGRAMMING LANGUAGES SUPPORTED | all(python, HTML,c,c++,java) | only c and c++ |
| RAM SIZE | 1GB | <36KB |
| EXECUTION TIME | Less | more |
| GPIO PINS | 40 | up to 17 |
| USB CONNECTOR | USB connector is provided up to 4 USB port | USB port is not provided, can add externally |
| ETHERNET PORT | Provided | Not provided |
| CAMERA | USB camera is also connected and separate connector is provided | Can't connect USB camera and not provided separate connector for camera |
| MICRO SD CARD SLOT | Provided | Not provided but can add externally |

Table 1 comparison of Pi 2 with ESP8266EXX

VI. CONCLUSION AND FUTURE SCOPE

As per experimental result number of devices can be controlled using raspberry pi through Email. Raspberry pi proves secure, economic, and efficient platform for implementing this intelligent home automation system. This low cost system is designed to improve standard of living at home. It consumes less power. Python script is written on raspberry pi which is easy to understand and system makes user friendly. Using Gas sensor, it is easy to protect room. In raspberry pi more number of GPIO pins are available, so

many number of devices can be controlled like gas sensor, temperature sensor and so on elaborating the applications. Surveillance system can be implemented using this raspberry pi.

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