

Home Automation through E-Mail using Raspberry Pi

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ABSTRACT— In present days, as the technology improves day by day, every one seems to automate most of the possible things to take advantage in providing ease in life, secure and saving electricity. The main objective of this paper is to develop an interactive home automation system based on Raspberry Pi through reading the message body of E-mail which we are send. Here the message body of the received E-mail is read by the developed algorithm fed into Raspberry Pi and it will resend the acknowledgement to that mail_id, if it is successfully sent or not. This algorithm is developed in python language, which is default programming language provided by Raspberry Pi. Store these results in internet by creating new channel API in thingspeak, which is an IoT application.

Key words: Home automation, E-mail, Python, Raspberry Pi, WI-FI dongle, TV tuner card, Thingspeak.

I. INTRODUCTION

Today the technological world's centralized principle is to automate each conceivable thing for simplicity in life, providing security, saving electricity and time. In that home automation is one of the major things to automatically on and off the home appliances. Home automation can be characterized as a method for doing something without human inclusion. It may incorporate brought together to control of lighting, heating, ventilation, air-conditioning, machines, security door locking and different systems, to provide improved convenience, comfort, energy efficiency and security.

The idea of automate each appliances in home is done from many years ago, it started with connecting two electric wires to the battery and close the circuit by connecting load as a light. Later it can be developed by different organizations, creates its own automation systems with different devices like sensors, controllers, actuators, buses, and interfaces. There are few methods for controlling home automation systems. These can be separated into two main structures:

- i) Wireless systems and
- ii) Hardwired systems.

Wireless systems: With wireless routines, you can utilize distinctive media, like Bluetooth, infrared, or radio frequencies, to control the automation system.

Hardwired systems: With hardwired routines, you can utilize Ethernet links, like fiber optic links, electrical wirings,

telephone lines, and even coaxial links are normally utilized as a part of home security system. In present days most of the automation systems utilizes the combination of hardwired and wireless systems for control the appliances. It should have both equipment and programming set up for proficient systems.

The prevalence of home automation has been expanding incredibly because of much higher reasonableness and straightforwardness through Smartphone's and wireless networks. Internet of Things (IoT) is interlinked through these networks; because of the popularity of the home automation is improved by the quality of service provided by the devices. Different home automation systems are proposed by different authors for automatically on and off the appliances with different applications. In that, [1] "Design and Development of Activation and Controlling of HomeAutomationSystem throughSMS using Microcontroller". It predominantly concentrates on the control of home-appliances remotely when the person is far from the home. In this system GSM module is used for sending message, from throughout the world and 8051 microcontroller as a processing unit. Drawbacks: expensive architecture, reliability, cost. [2] "Bluetooth Remote HomeAutomation SystemUsing Android Application". The principle control system executes remote Bluetooth innovation to give remote access from PC/portable PC or advanced cell with design of low cost, user friendly -interface and installation is easy in manner. Drawbacks: Distance, flexible and security. [3] "Design and imple-entation of homeautomation system using raspberrypi". This paper is primarily concerned with the programmed control of light or whatever other home machines through internet using raspberry pi, microcontroller and sensors. Drawbacks: complex and expensive architecture and high cost. [4] "Control of Door and HomeSecurity by RaspberryPi through Internet". This paper intends to work a system is being created to join any entryway with the web, so that the entrance control that system can be controlled from anyplace on the planet. Drawbacks: highly expensive and difficult to operate. [5] "Android Based HomeAutomation Using RaspberryPi". This paper aims at controlling Home appliances through Android mobiles using Wi-Fi as communication protocol interfaces and Raspberry Pi as processing unit. The server is interfaced with relay board that controls the appliances which are running in the Home. Drawbacks: Expensive, flexibility.

II. PROPOSED SYSTEM

In order to overcome the drawbacks of previous methods, and improves the security, flexibility, efficiency, interactivensess, and provides easy life, saving electricity in accordance with the user needs, proposed these interactive home automation system by taking Raspberry Pi as a processing unit, TV tuner card is connected to view the display of instantaneous status and processing of raspberry pi, WI-FI dongle as internet connecting device to access and sending E-mails to user, key board and mouse is to operate the raspberry pi and relay board for the controlling and switching operations, the proposed system block diagram is shown in below figure.

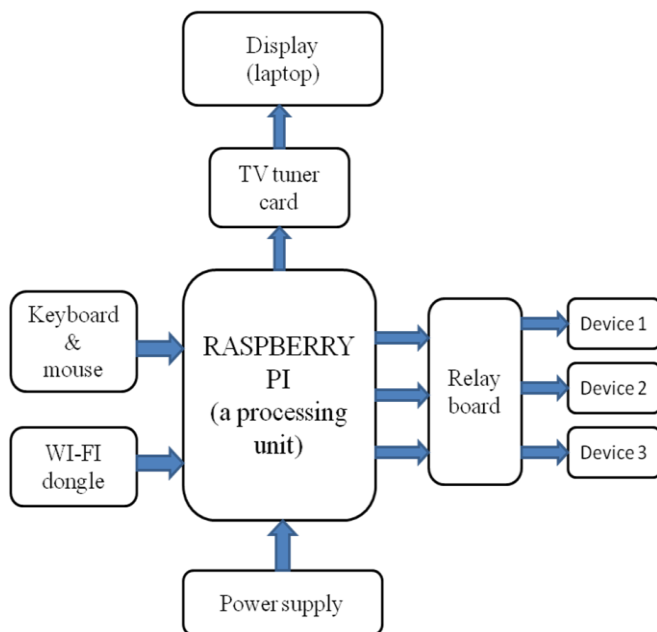


Figure1: Proposed system block diagram.

III. IMPLEMENTATION

A. COMPONENTS DESCRIPTION:

The implementation of the proposed system consists of following major components.

- [i] Raspberry Pi
- [ii] WI-FI dongle
- [iii] TV tuner card
- [iv] Relay board
- [v] Key board and mouse

[i] Raspberry Pi:

Raspberry Pi is a processing unit, developed by Raspberry Pi foundation in UK is of size equal to the debit card. It has Broadcom BCM2835 System on Chip (SoC) module with ARM1176JZF-S processor. It having internal storage of 512 MB, 1- ethernet port, 2-USB ports, 26 GPIO pins for peripheral connections supported by raspberry pi, external storage supported upto 32 GB, DSI display connector, CSI camera connector, HDMI connector for display, RCA video and audio jacks as shown in the below figure.

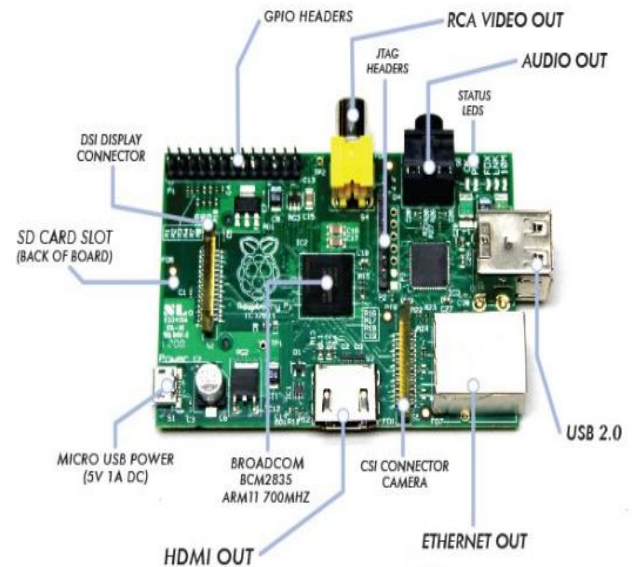


Figure2: Raspberry Pi model-B board

The Raspberry Pi model-B CPU is of ARM 11 family, operates at 700 MHz. The GPU having broadcom Video core-IV, open GLES 2.0, 1080p30, H.264/MPEG-4, AVC high profile decoder and capable of 1Gpixel/s, 1.5 Gtexel/s (or) 24 GFLOPs of general-purpose (GPIO) compute. It operates, 1mA at 5V power supply. The GPIO pin configuration is shown in below figure.

3.3V	1	2	5V
I2C1 SDA	3	4	5V
I2C1 SCL	5	6	GROUND
GPIO4	7	8	UART TXD
GROUND		10	UART RXD
GPIO 17	11	12	GPIO 18
GPIO 27	13	14	GROUND
GPIO 22	15	16	GPIO 23
3.3V	17	18	GPIO 24
SP10 MOSI	19	20	GROUND
SP10 MISO	21	22	GPIO 25
SP10 SCLK	23	24	SP10 CE0 N
GROUND	25	26	SP10 CE1 N

Figure3: pin configuration of Raspberry Pi

- 8 --- GPIO pins for external periperal connections supported by raspberry pi.
- 2 --- UART, 2 --- I2C, 5 --- SPI Bus pins for transmitting and receiving data from one source to another source.
- 2 --- 3.3V, 2 --- 5V pins for power supply connected to the external devices.

Python is a default programming language for the raspberry pi with support of BBC BASIC, C, C++, Java, Perl and Ruby. We are considering Python as a main

Programming language, for its benefits and features. It is suitable for real world applications with the addition of NumPy, SciPy, Matplotlib, IPython, and PyLab.

[ii] WI-FI dongle:

In order to access the internet in the raspberry pi board we are using Wireless-n USB 2.0 Adapter. It is 5 times faster than traditional Wireless-g and Wireless-b networks. It allows all the high-speed features of Wireless-n networks. It is having data rates of 150Mbps for transmitting and receiving and it supports 20MHz/40 MHz frequency bandwidths. It is simple and easy to setup.

[iii] TV tuner card:

A TV tuner card is a device, that allows Tele-Vision signals to be received by the computer. The card contains a tuner and an analog to digital converter along with demodulation and interface logic. The video port of the raspberry pi is connected to TV tuner card and TV tuner card USB port is connected to laptop to view the display of the raspberry pi working operation.

[iv] Relay board:

Relay is an electrically controllable switch widely used in industrial controls, automobiles and appliances. Here we are using 8-channel relay for switching and controlling the devices, having 8 independently-controlled SPDT relays. The Control signals use +5V logic levels and is of TTL compatible.

[v] Key board and mouse:

Key board and mouse are used to operate the Raspberry Pi, just like our normal computer (PC).

B. INTERFACING:

[1] First write the Raspbian OS in to a SD card by using “Win32Disk Imager”, and put it on Raspberry Pi board, and then give power to the Raspberry Pi.

[2] Connect TV tuner card to the laptop to view the display of the Raspberry Pi operation, and it will show like below figure.

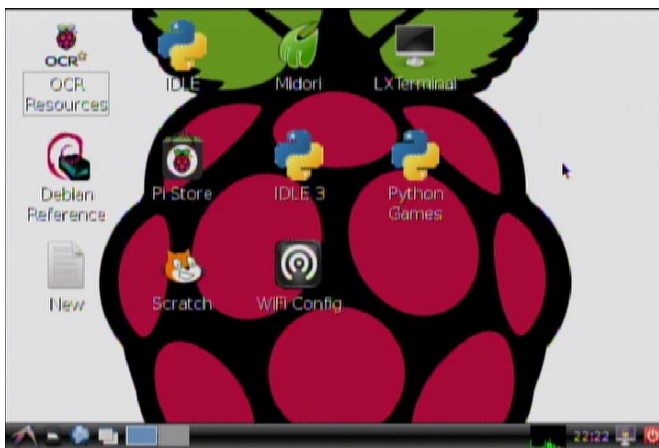


Figure4: Desktop of Raspberry Pi

[3] connect key board and mouse to the Raspberry Pi USB ports for operating the rasperr pi and change the keyboard settings by typing “sudo nano /etc/default/keyboard” on LX terminal from ‘UK’ to ‘US’, then reboot it by “sudo reboot”.

[4] Configure the Raspberry Pi with the command “raspi-config” according to need of the project requirements, then reboot it.

[5] Connect WI-FI dongle to one of the Raspberry Pi USB port for internet access and sending mails. Then configure that dongle to support the Raspberry Pi

[6] write the code for corresponding application in python IDLE. The flow chart of reading BODY of E-mail is shown below.

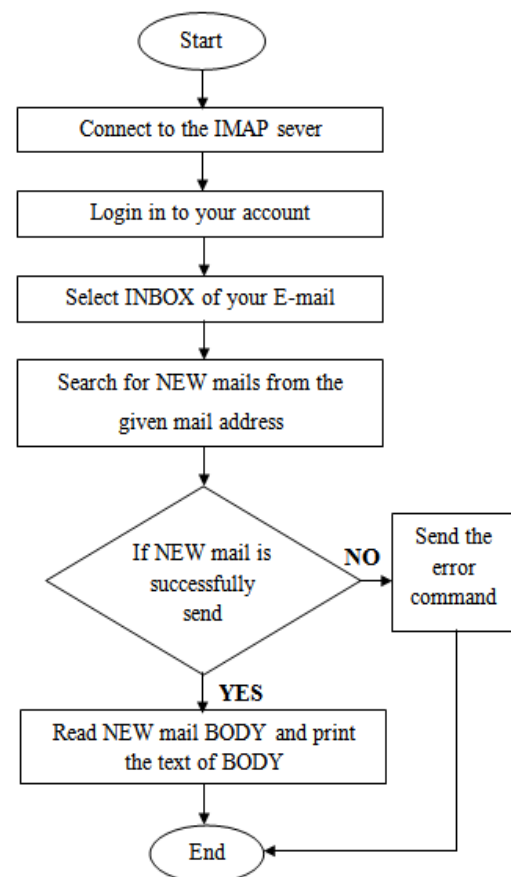


Figure5: Flow chat of How to read the messageBODY of E-mail

[7] For the purpose of storing the results in the internet we are using thingspeak as an IoT application. We are creating a new channel and interface to the code for storing our results.

C. PERFORMANCE EVOLUTION:

In order to verify the proposed algorithm in practically, LED’s were taken as switching indicators of the interfaced devices. We have to take three LED’s (devices) for testing the results, and connected to three GPIO pins of the Raspberry Pi accordingly.

If the mail is received to Raspberry Pi, first it initialize the system whether the Raspberry Pi, GPIO pins are properly connected or not and then start the process of reading the message BODY of received new mail. Check the syntax which is written in the proposed algorithm, whether the device is ON or OFF. Based up on the ON and OFF conditions, which are in the message BODY of our send mail, the GPIO pins are activate and deactivate. At what time and date the devices are ON and OFF are store in our thingspeak channel. After activating and deactivating, the raspberry pi send the acknowledgement whether the mail is successfully send or not and the work is done or not to that mail id. In case the mail is not send due to network problems or the command which we are send is wrong, it will send the acknowledgement as mail is not send or invalid command. The loop is continuously running after every 30 seconds. After 30 seconds it will check for new mail, if the new mail is received then it start the process of reading, if not, it will go on running up to the receiving of new mail.

Flowchart of proposed system:

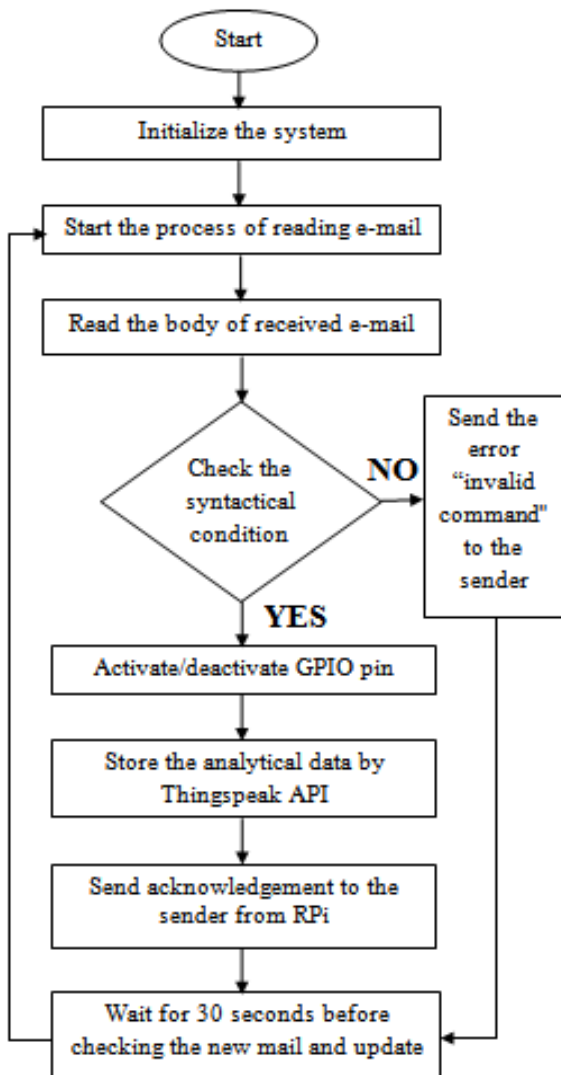


Figure6: Flowchart of proposed system

If the power to the raspberry pi is OFF, after giving power, the loop is automatically run and the device is in the previous state only. After testing, finally connect the relay board to corresponding devices, for automatically ON and OFF the appliances.

IV. RESULTS

I) For our convenience, give names for the devices as ‘fan’, ‘light’ and ‘ac’.

Case 1: ‘ON’ and ‘OFF’ all the devices at a time or individually.

i) fan on/off light on/off AC on/off --- all the devices are activated/deactivated accordingly, and send acknowledgement as ‘your mail is read and done successfully’.

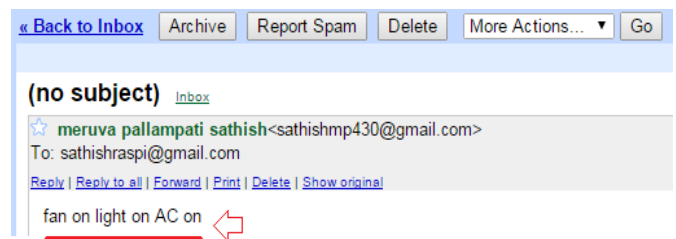


Figure7: INBOX of received mail-id.

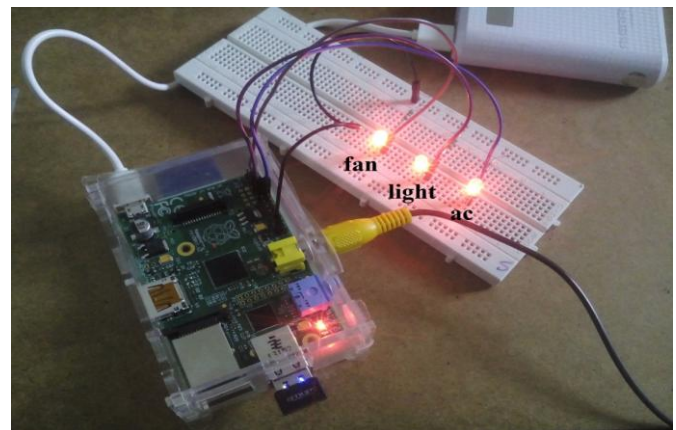


Figure8: Activated according to the received mail.

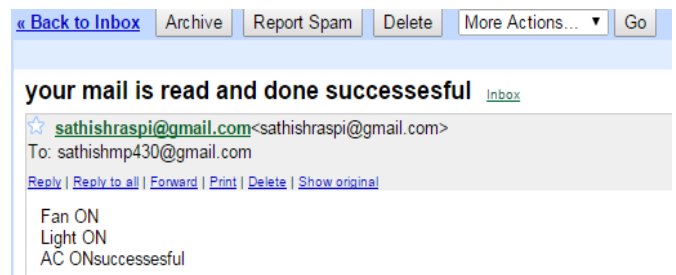


Figure9: Acknowledgement of the corresponding received Email.

ii) fan on/off --- that particular device only activated/deactivated, remaining two devices are in the previous state only i.e. no reaction for the other devices, and send acknowledgement as ‘your mail is read and done successfully. No command receives from light and ac’.

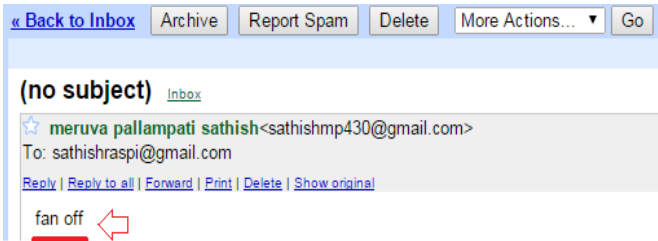


Figure10: INBOX of received mail-id.

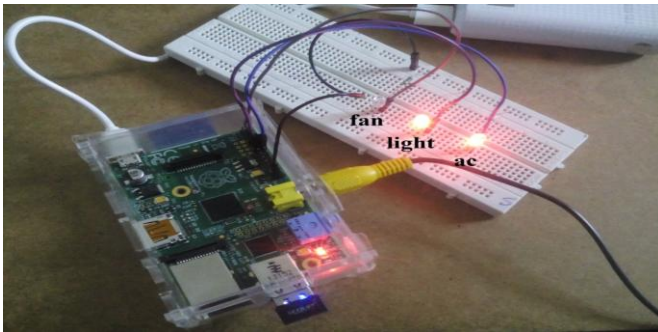


Figure11: Activated according to the received mail.

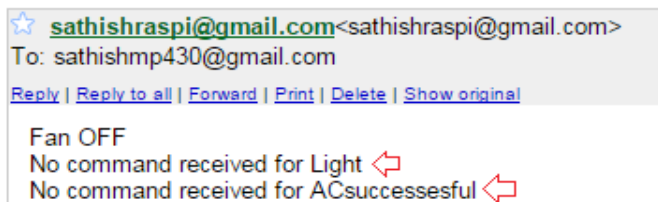


Figure12: Acknowledgement of the corresponding received Email.

Case 2: If the device name is entered wrongly i.e. in the place of 'light', entered as 'liht' --- at that time it will not respond that particular device only. Remaining device actions are done accordingly and send acknowledgement as 'no command receive for light'.

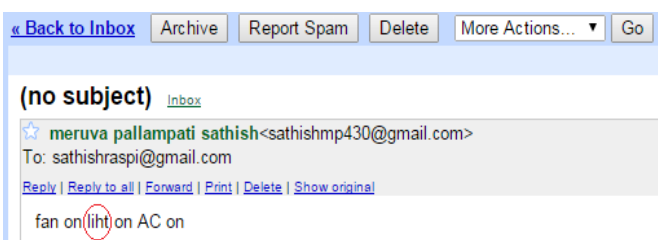


Figure13: INBOX of received mail-id.

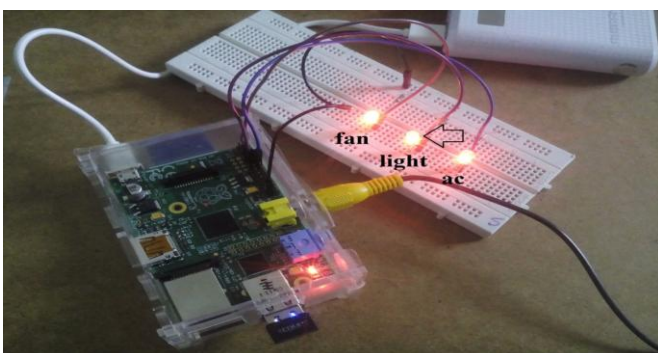


Figure14: Activated according to the received mail.

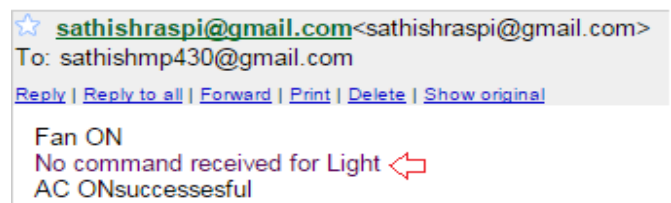


Figure15: Acknowledgement of the corresponding received Email.

Case 3: If the mail is not sending due to the network problems --- there is no reaction in the devices, the loop is continuously going. After the network is connecting, then it will react accordingly.

Case 4: If the power is OFF to the Raspberry Pi, after giving power, the loop is continuously run automatically and devices are in the previous states.

II) We have to store these results in internet by using thingspeak API with respect to date and time of that particular device respectively. By observing these thingspeak charts we can identify that, at what time and date the device is ON and OFF. So that we can decrease the power consumption of each device with respect to user need. Here 0 – OFF, 1- ON, 2 – error state, 3—no receiving of new mail.

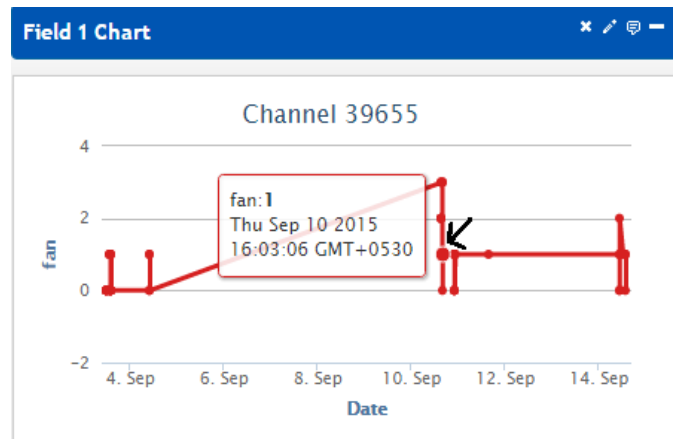


Figure16: shows the chart of 'fan'

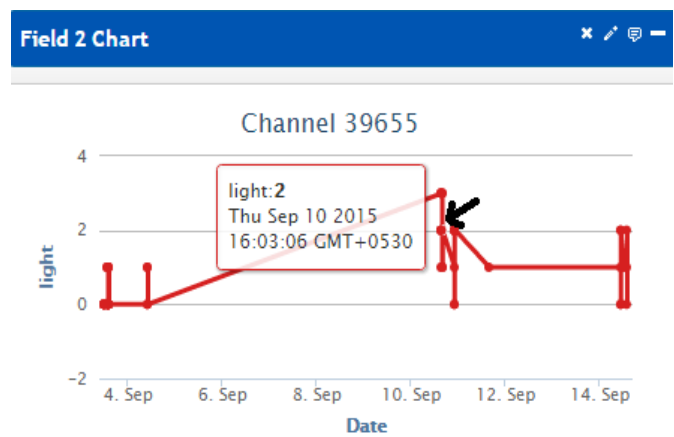


Figure17: shows the chat of 'light'

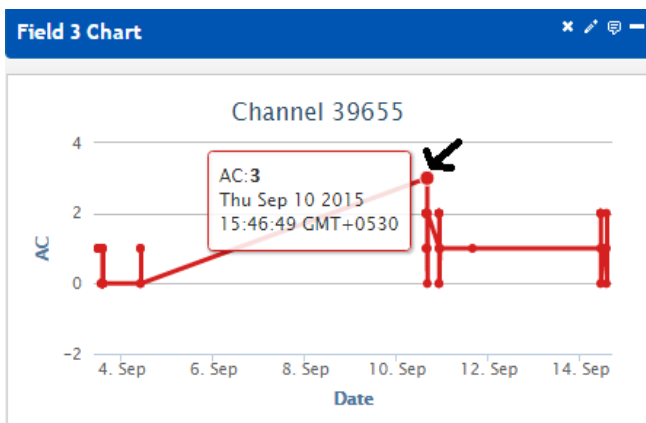


Figure18: shows the chart of 'AC'

V. CONCLUSION

In this highly technological environment, by its over clocking and future expansion capabilities, RaspberryPi proved to be easy, economic and efficient platform for implementing the home automation system. The results shown that, the basic application of home automation through reading e-mail using Raspberry Pi can be easily implemented and used efficiently. This work can be enhanced for future applications like power grid control and protection, surveillance, power monitoring, fault monitoring, security etc, easily. Apart from, this technique is better than other home automation methods, using SMS and DTMF as the call tariff, is a big drawback, which is not in the case of this proposed method, and in the Web server based home automation, the design of web server and the space required is eliminated by this method, because of it uses already existing web space provided by Gmail.

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