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Email Based Global Automation with Raspberry Pi and Control Circuit Module: Development of Smart Home Application

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***Abstract*—**Global Automation is an emerging technology of today's era and is based on Internet of Things (IoT). Global automation deals with the controlling of electrical appliances throughout the world. The fabrication of this system has been carried out with interfacing an electrical control system module to Raspberry Pi. An electrical control system module includes a relay driver mechanism through which appliances are controlled automatically in respective condition. In this research project, one email ID has been assigned to Raspberry Pi, and the users from different location having different email ID can mail to Raspberry Pi on assigned email address "raspberrypilochan96@gmail.com" with subject heading "Device Control" with predefined command on compose email line. Also, a notification regarding current working condition of this system has been updated on respective user email ID. This approach is an innovative way of implementing smart automation system through which a user can control their electrical appliances like light, fan, television, refrigerator, etc. in their home with the use of email facility. The development of this project helps to enhance the concept of smart home application as well as industrial automation.

***Keywords*—**Control circuit, email, global automation, internet of things, Raspberry Pi.

I. Introduction

AN automation provides the concept of simplicity, through which the system can run without an effort by human being and can be operated automatically. This approach can be implemented through various platforms, and one of them is described on this paper that is global automation. In this platform, user can control all the electrical appliances throughout the world with a predefined command through Email. This research project based on smart automation needs a regular connectivity of an internet for a system operation. The concept that has been implemented on this approach is based on IoT. Through this technique, we can connect our electronic system with an internet, and the processing, device operation and notification can be updated on online platform with different web server. This paper has been focused on utilization of email facility on the field of Automation so as to perform real world operation. Global Automation has been implemented with Raspberry Pi 3 Model B on a Python programming platform. Raspberry Pi is a small computer which can be used on developing IOT projects because of having inbuilt WIFI Module. User can access this device through remote location, and this has been achieved with putty software as well as VNC Server. Through this platform, user can access their Raspberry Pi from a distance apart and can be interfaced with their PC through wireless connection as an Internet facility. The concept of accessing device through remote location provides a benefit like no requirement of other hardware devices for its operation as in computer system. We need monitor, mouse, keyboard and CPU for operation of normal computer, but for the operation of raspberry Pi we can directly interface with our laptop with some remote accessing software. The principle of operation of this project has been started from composing new email to real world operation as well as real time update through device can also be notified through Email. As per the coding, a respective General Peripheral Input Output (GPIO) pin of Raspberry Pi is operated as high or low. This amount of 5-V signal has been utilized for the driven of relay mechanism, through which an electrical load can be operated automatically. There are many automation projects which have been implemented using various controllers but for the implementation with Email platform, Raspberry Pi has been preferred for effective setup of internet connectivity. This project has electronic control circuit which includes relay driver IC Mechanism through which an electrical appliance is controlled.

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II. Related Works

In this section, automation related works by various authors based on IOT, Global System for Mobile Communication (GSM), and Raspberry PI has been discussed. Reference [1] develops a system for the control of agricultural water pump through GSM Technology. For this, a graphical user interface based android application has been developed by an author and is used to control the remote motor. Also, the motor operation notification is updated through android application. The technology that has been used on this project is an Arduino, SIM900 GSM Module and Android Application. Similarly, [2] developed a Bluetooth based home automation system, and the main controller used is an Arduino. This automation is also based on an android application through interconnecting with device Bluetooth with HC-05 Bluetooth module.

Reference [3] proposed a speech-based home automation system based on Bluetooth, Raspberry Pi, GSM, and also Raspberry Pi webcam is used to connect with an internet for accessing the home environment.

Reference [4] proposed a remote health monitoring system

for patients with home automation and alarm system based on Raspberry Pi 3 Model B. This project can provide the information through mobile notification of health condition of patients when sensor reading is above the threshold value and also gives a sound for the alert condition. An author of this paper has been discussed on monitoring of heart rate, blood pressure, respiration rate, body temperature, body movement and saline levels.

Reference [5] proposed their system IOT based home automation, and surveillance system has been implemented with an application of Raspberry Pi 3 Model B along with USB camera for capturing live streaming and broadcast through web server and also it captures a picture. A web page has been provided to the end user with username and password in order to allow the entry of only authorized users. After successful login, user is able to control the door by using open and close button and watch the live streaming video of the desired location especially near to the door.

Reference [6] developed a system called voice recognition automation through an android application "Lochan Voice Control". An author discussed about control system module for an operation of electrical appliances throughout the 50-m distance, and their proposed system is based on Bluetooth communication. The devices used for the implementation of this system are an arduino Atmega328, Bluetooth Module HC-05, control circuit module and an android application. An android application has been developed with MIT App Inventor platform, which is an effective and easy way of development tool for an android.

Reference [7] developed a system called voice recognition robot with real time surveillance and automation. Through this system, a robot was controlled with predefined voice control, which means if "Let's Move" is said, then robot moves in the forward direction, similarly Left, Right, Back movement has been implemented. The main features of this system are real time obstacles detection and avoidance through ultrasonic sensor interfacing with an Arduino. This system is also based on "Lochan Voice Control" android application which has been discussed on previous paper [6].

Reference [8] presented a review on home automation system. In this paper, brief overview of existing frameworks for development of IoT applications, techniques to develop smart home applications using existing IoT frameworks and generic framework for the development of IoT based smart home system is presented.

III. System Architecture

System architecture depicts an overall system operation with signal flow mechanism from one section to another section of a project. For the operation of this system, we need to login to our email and compose a new email along with mentioning predefined command and send it to a device email ID. Device email ID has been assigned to Raspberry Pi and the operation of Raspberry Pi is based on which GPIO pin needs to be operated as ON and OFF. In case of Raspberry Pi, high digital output is represented by 3.3 V, and low is represented by 0 V. These output signals are utilized to communicate with relay driver mechanism, which includes a control circuit for performing a real-world operation. An overall operation of this system requires an internet connectivity for an establishing communication platform between a user and a Raspberry Pi. A relay driver mechanism includes a relay driver IC, through which electromechanical relays are controlled. These relays are used to control all the electrical appliances that are connected to our home. This overall system architecture depicts that a single command from an email can perform a real-world operation.

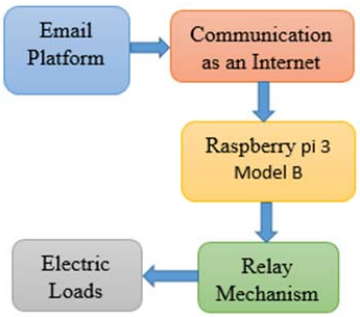

Fig. 1 System architecture

IV. Technology Used

Raspberry PI 3 Model B: Raspberry Pi is a small computer which has been operated with Raspbian operating system and it is based on LINUX platform. It has a SD Card for data storage and operating system installation where as in normal computer system there is a hard disk. Also, it has a RAM of 1 GB, Inbuilt WIFI and Bluetooth for achieving communication platform for interacting with other devices. For the operation of whole system, we can also connect with Monitor with HDMI cable, Mouse and Keyboard with USB Port. It has four USB ports, one Ethernet port, Audio port and Power supply port, 40 GPIO pins for input output operation, Pi Camera connector slot, and Pi Display Connector Slot has been implemented on this board [9].

Control Circuit Module: This module has been implemented for controlling an AC electrical appliance as well as buzzer. The development of this circuit has been carried out with the use of two NPN transistors BC547 acts as switching mechanism. Transistor as a switch has been performed and through this a relay can drive on respective condition, so that an electrical appliance can control through this device. Being an operating voltage of DC 5 V, user can interface this module with Raspberry Pi for an effective system implementation.

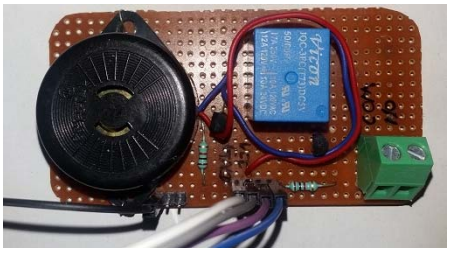

Fig. 2 Control circuit module

V. Hardware Testing

Hardware testing has been carried out before developing an appropriate prototype. Firstly LED testing has done with raspberry pi to check the condition of an entire system as shown in Fig. 3. Similarly, the task of display connection has been depicted in Fig. 4. After connecting display, it is easy to handle raspberry pi and run the definite program manually and also it will need to require an external peripheral interface to drive the raspberry pi more effectively.

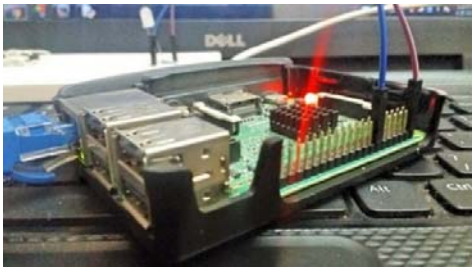

Fig. 3 LED testing

Fig. 4 Raspberry Pi display connection

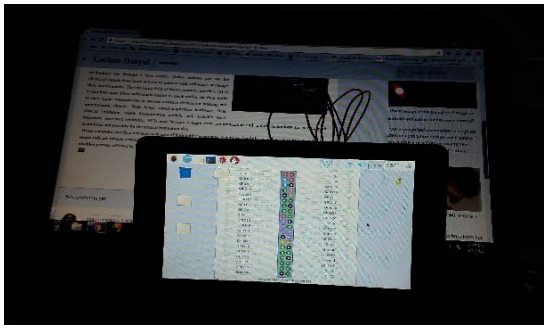

Fig. 5 Raspberry Pi display

Fig. 6 Peripheral interface with Raspberry Pi

VI. Results

The results of global automation as sending email to the raspberry pi and program execution has been depicted in Figs. 7 and 8 respectively. The process of sending an appropriate command "gpio:18:on" through user email ID "bashyallochan@gmail.com" to the raspberry pi email ID "raspberrypilochan96@gmail.com" can produce a digital signal "HIGH" only when the condition inside a python script has resemblances. Finally that digital signal has been further processed with control circuit module which includes a relay for real-world operation.

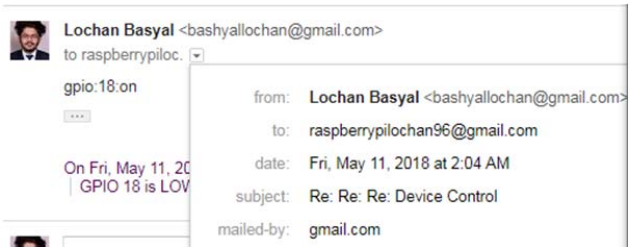

Fig. 7 Sending email to Raspberry Pi

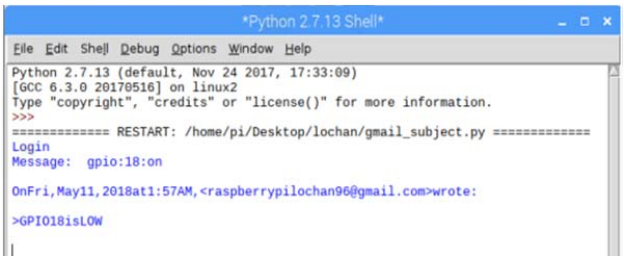

Fig. 8 Program execution

VII. Conclusion

Global Automation has been achieved with the use of Raspberry Pi 3 model B interfaced with electromechanical relay mechanism to drive electrical Loads. This system can control and provide current notification of electrical appliances through Email Platform with an application of Internet of IOT. A single predefined command can control electric load throughout the world, this is highly applicable on today's running days. As talking about the future modification of this research project, it can be implemented on the field of intelligent security system as well as an automation based on Artificial Intelligence (AI).

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