IoT Based Home Automation System using Raspberry Pi 3 Model B

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Abstract— As we are emerging into modern era with innovative and creative things, manual human work is deprecating from our daily activities. The concept of Automation is increasing in most of area like banking, education, engineering, medical, agriculture, etc. To update ourselves with this creative world, it is necessary to control home appliances from any desire location. Our system is representing such home automation that requires hardware and software requirements. This system allows us to control over the home appliances automatically using Raspberry Pi model either by locally presented machine or by web pages. We are designing this project with optimum cost and can be extensible by allowing variety of devices to be controlled. We are adding major environmental details like temperature and humidity to achieve more appropriate decision with environmental aspects. This system is good for time consuming automatic result over the home appliances. We are also providing user interface to get device status and environmental information like temperature and humidity with respect to time.

Key words: Home Automation System, IoT, Raspberry Pi, Temperature, Web Page

I. INTRODUCTION

For simplicity of life, people expect new device and technology. IOT is an upcoming technology that allow us to control hardware devices through internet. By using IOT to control the home appliances result in smarter home and healthier standard of living [12]. The paper mainly concerned with the automatic control of light or any other home appliances using the internet. Nowadays ,increasing various computing devices such as laptop, computers ,mobiles, etc shows that user prefer things which are more comfortable to use i.e. rather than physically going to the place and doing something remotely saves the time. In this paper, we used Raspberry pi 3 model B. Raspberry pi has been used as the main server in the whole system. The server will be interface with relay hardware circuit that controls the appliances running at home [13]. Raspberry pi is a credit card sized single –board computer developed in the UK by the Raspberry pi foundation .The Raspberry pi board contains a processor, program memory (RAM) and various interfaces and connectors for external devices. . A different type of automation services offers wide range, monitoring security camera, live video surveillance etc. whole things are only controlled by raspberry pi [11].

II. MOTIVATION

`The increasing demand of the Automation supplies requires a rapid improvement in electrical and electronic technology production technology. In many countries where technology plays an important part in shaping up the economy and other major fields, but still we are not able to make full use of automotive resources. One of the main reasons is the lack of efficiency. Also, there is not enough old techniques for automatic control of home appliances. Relay circuit could get precise status of electronics devices and can be stored electronically for further use. In addition, a temperature sensor, the most significant advantage is that the change in climate can be easily detected. In recent times, we had been using old technique through the manual control in which we had to take lots of efforts. This process sometimes consumes more costly electricity. There is a place like hilly areas or forests, in which it requires electricity on roads at least but we have to do it manually, in such cases automation can work more efficiently to save electricity.

III. LITERATURE SURVEY

Various eminent researchers have worked on home automation system and tried to find out successful methods and techniques .Different wireless technology that support remote data transfer, control and sensing such as RFID, WIFI, Bluetooth, have evolved to add intelligence at various levels in the home. This literature review focus on various technologies that has been used until now.

A. Muhammad Asadullah and Khalil Ullah, "Smart Home Automation System Using Bluetooth Technology" (2017).

In this paper, design of proposed method is based on Arduino board, Bluetooth module, sensors and Smartphone application. Bluetooth technology has ability to transmit data serially up to 3 Mbps within a physical range of 10m to 100m depending on the type of Bluetooth device. Proposed system is analyzed and tested within the range of 40m [1].

B. Martin V. Urgiles and Paul E. Arpi, "Lighting Control Actuator Design and Development. For a ZigBee Network with a Web Server Mounted on Raspberry Pi" (2015).

The paper represent the ZigBee network that is not secure like Wi-Fi based secured system .Replacement cost of ZigBee module was high when any problem occur in ZigBee compliant home appliances. The coverage area is limited and hence cannot be used as outdoor wireless communication system .It can be used only in indoor wireless application [2]

C. Nicholas Dickey, Darrell Banks, and Somsak Sukittanon, "Home Automation using Cloud Network and Mobile Devices"(2012).

The paper deals with cloud networking in which systems can be controlled by locally and remotely by using cloud network. Cloud networks allow individuals to monitor, manage and control their personal data points through the internet. One of the available service is Pachube, which has to be used. However, the propose system required a large amount of technology .That is why user interface must be required as powerful as possible [3].

D. Sarthak Jain, Anant Vaibhav and Lovely Goyal, "Raspberry Pi based Interactive Home Automation System through E-mail" (2014)

The paper represents the home automation of Raspberry pi through reading the subject of E-mail. 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 message body of received E-mail is read by the developed algorithm fed into Raspberry pi and it will resend the acknowledgment to that mail-id. This algorithm is developed in python language [4].

E. Shaiju Paul, Ashlin Antony and Aswathy.B "Android Based Home Automation Using Raspberry" (2014).

The paper shows home automation through the use of a raspberry pi controller via an android interface. It employs the use of a Wi-Fi Local Area Network to connect the controller to the android interface. Thus by connecting any mobile phone to a Wi-Fi network setup at our home, office or any other locality, it is possible to control electrical appliances or machines connected to the processor board. The mobile phone is interfaced to the Raspberry pi with the use of an android application using control buttons. They interfaced the Raspberry pi with the switches by using relay. The control can only be achieved with Wi-Fi and hence is not applicable at large distances but it gives sufficient control from nearby places [5].

IV. BACKGROUND

The IOT based Home Automation system hereby reported, consisted of two components wireless sensor units (WSUs) and a wireless information unit (WIU), linked by radio transceivers that allowed the transfer of humidity, moisture and temperature data, implementing a WSN that uses Wi-Fi technology. The WIU has also a GPRS module to transmit the data to a web server via the public mobile network. The information can be remotely monitored online through a graphical application through Internet access devices.

A. Wireless Sensor Unit (WSU)

A WSU is comprised of a RF transceiver, sensors, a Raspberry Pi (1GB LPDDR2-900 SDRAM at centre and BCM43438 radio at right, above SD Card holder), and power sources. Several WSUs can be deployed in field to configure a distributed sensor network for controlling devices from remote location by sensor technology. Each unit is based on the Raspberry Pi (Microchip Technologies, Small PC) that controls the communication Wi-Fi (ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network) and processes information from the Relay Circuit (a BC337 NPN transistor, a diode, and 1K resistor), and the temperature sensor These components are powered by rechargeable AA 2000-mAh Ni-MH Cycle Energy batteries (SONY, Australia). The charge is maintained by a photovoltaic panel MPT4.8-75 (Power Film Solar, Ames, IN) to achieve full energy autonomy. The Raspberry Pi, radio modem, rechargeable batteries, and electronic components were encapsulated in a waterproof Polyvinyl chloride (PVC) container. These components were selected to minimize the power consumption for the proposed application.

B. Wi-Fi modules

The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much Wi-Fi ability as a Wi-Fi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community. This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth

Co-existence interfaces; it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts. The Wi-Fi devices operate in industrial, scientific, and medical 2.4-GHz radio band and allow the operation in a so-called mesh networking architecture, which can be differentiated into three categories:

1) Coordinator
2) Router
3) End device

C. Wireless Information Unit

The humidity and temperature data from each WSU are received, identified, recorded, and analyzed in the WIU. The WIU consists of a master Raspberry Pi, Wi-Fi module, a deep cycle 12 V at 100-Ah rechargeable battery L-24M/DC- 140 (LTH, Mexico), which is recharged by a solar panel KC130TM of 12 V at 130 W (Kyocera, Scottsdale, AZ) and Relay Circuit (a BC337 NPN transistor, a diode, and 1K resistor).

V. SYSTEM ARCHITECTURE

The objective of the system is to control system from anywhere in the world. Therefore, it uses internet services by using client-server architecture. System is divides into two parts as follows:

1) Server side
2) Client side

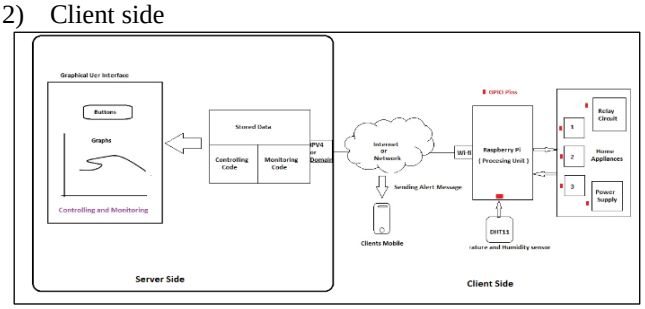

Fig. 1: a system diagram of IOT based home automation system

Server side contains web server or web hosting which is able to accept the request and provide services to clients. In the following diagram, web server takes charge to store data, control as per user requests and monitor the output to make results available. Client side contains hosts anywhere in the world and Raspberry pi near to the home appliances. User will request to web server using browser through domain name or website. Server prompts the web page having ON or OFF buttons. When user clicks 'ON' or 'OFF' button, this button status information will send to Raspberry-pi. Raspberry will trigger to home appliances by using relay circuit and directly ON or OFF the switch as per button status information. There are Red marks highlighted at Raspberry; these are the GPIO pins to input or to take output from Raspberry. Raspberry Pi is can communicate with other PC through Internet connection or local connection with Wi-Fi module. We output the status of home appliance and Temperature and Humidity graph in browser.

A. Relay circuit

It is used to switch home appliances. We will control ON/OFF signal from user through this Relay Circuit. We are connecting these in between Raspberry pi and home appliances (fan, light, etc.)

B. Power supply

We require Power supply is mainly two types. One is AC power supply (230V, 50Hz) which is used for Home appliances, while other is DC power supply (3.5V to 5V)

C. Raspberry Pi

This is core part of our system, which is responsible for sensing data and processing to get user convenient output.

D. Internet or Network

Using this, we are going to communicate with raspberry pi. Our processing unit is working as Server machine and the PC from which we are browsing output is client machine. All the information from the server machine can be displayed to client machine.

E. Stored Data

Server machine will store all the data of our system, which includes Controlling code, Monitoring Code, ON-OFF status, Temperature Humidity sensed by raspberry pi.

F. Controlling Data

To control over the system automatically, we pre-code the system and save it in Server as well as Raspberry pi.

G. Monitoring Data

System will store the information like Temperature, Humidity in the database to monitor it. Graphical User Interface: This system can monitor two things here: One is status of Home Appliances and second is Temperature and humidity with the help of graphical entity.

VI. IMPLEMENTATION

Procedure for Home Automation project:

1) Start Raspberry Pi using USB.
2) Connect raspberry pi with putty using IP address.
3) Go to directory of your python program (\\Desktop\Adafruit_DHT_Master\examples)
4) Run the python program using following commands
5) Python<program name (B1)>.py (Keep running this program whenever you want to control the device)

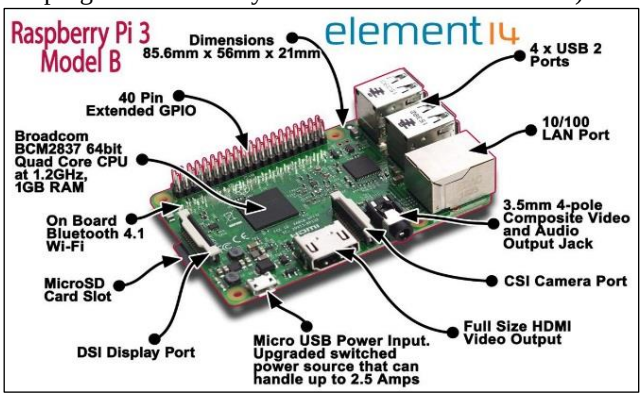

Fig. 2: Raspberry pi 3 Model B

6) Go to website www.webinfosense.co.in from browser.

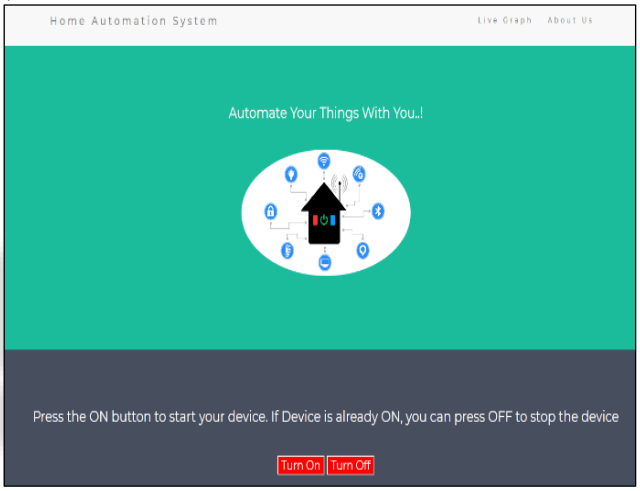

Fig. 3: Screenshot of website from which you can control the device

7) Click ON button to ON the device, or click OFF button.
8) Check the status of Graphical User Interface of Temperature and Humidity

Procedure for Graphical User Interface:

1) Start Raspberry Pi using USB.
2) Connect raspberry pi with putty using IP address.
3) Go to directory of your python program (\\Desktop\Adafruit_DHT_Master\examples)
4) Run the python program using following commands
5) Python<program name (g4)>.py (Keep running this program whenever you want to control the device).
6) Go to website www.webinfosense.co.in from browser or Android application.
7) Check the Temperature and Humidity readings by clicking live graph present in right side of home page. of Graphical User Interface of Temperature and Humidity

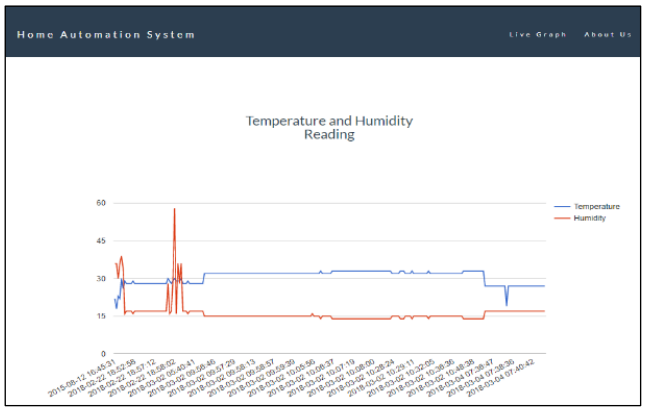

Fig. 4: Graphical User Interface of temperature and humidity

REFERENCES

[1] Muhammad Asadullah and Khalil Ullah, "Smart Home Automation System Using Bluetooth Technology", (ICIEECT) IEEE International Conference on April 5-6, 2017.

[2] Martin V. Urgiles and Paul E. Arpi, "Lighting Control Actuator Design and Development. For a ZigBee Network with a Web Server Mounted on Raspberry Pi", presented at the Automation science and Engineering (CASE), IEEE International Conference on Aug 24-28, 2015.

[3] Nicholas Dickey, Darrell Banks, and Somsak Sukittanon, "Home Automation using Cloud Network and Mobile Devices", presented at the Southeastcon, 2012 Proceedings of IEEE, March 15-18, 2012.

[4] Sarthak Jain, Anant Vaibhav and Lovely Goyal, "Raspberry Pi based Interactive Home Automation System through E-mail" presented at (ICROIT) , IEEE International Conference on Feb 6-8 ,2014.

[5] Shaiju Paul, Ashlin Antony and Aswathy.B "Android Based Home Automation Using Raspberry Pi", IJCAT, Volume 1, Issue 1, 2014.

[6] Muhammad Asadullah, Ahsan Raza, "An Overview of Home Automation Systems" presented at Robotics and Artificial Intelligent (ICRAI), 2nd International conference on 1-2 Nov 2016.

[7] Vishwajeet Hari Bhide, Dr. Sanjeev Wagh, "I-Learning loT: An Intelligent Self Learning System for Home Automation Using loT", presented at International Conference on Communication and Signal Processing, IEEE International Conference on April 2-4,2015

[8] Jin-Shyan Lee, Yu-Wei Su, and Chung-Chou Shen, "A Comparative Study of Wireless Protocols: Bluetooth, UWB, ZigBee, and Wi-Fi", the 3rd Annual Conference of the IEEE Industrial Electronic Society (IECON), Nov 5-6, 2007.

[9] Yin Jie, Ji Yong Pei, Li Jun, Guo Yun," Smart Home System based on IOT Technologies ", International Conference on Computational and Information Science (ICCIS), 5th International Conference on June 21-23,2013.

[10] V.Sandeep," Globally Accessible Machine Automation Using Raspberry Pi Based on Internet of Things ". (ICACCI), International Conference on Aug 10-13, 2015.

[11] Chirag Atha, Kshitij Baranwal, Varad Desai, Dr Sunil Wankhade," Review Paper on Home Automation System using Raspberry PI", International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169 Volume: 4 Issue: 10

[12] Sahil Saxena, Rohit Gupta, Sonali Varshney, Shubham Pratap Singh, Swati Kumari "Internet of Things based Home Automation using Raspberry Pi" IJESC, ,Volume 6 Issue No. 4 ,ISSN 2321 3361 © 2016 IJESC.

[13] Upadhye Madhuri Ganesh, R. A. Khan ," Raspberry Pi Home Automation Based on Internet of Things (IoT)", International Journal of Advanced Research in Computer and Communication Engineering Vol. 4, Issue 12, December 2015.

[14] S.Pandikumar, R.S. Vetrivel, "Internet of Things Based Architecture of Web and Smart Home Interface Using GSM", IJIRSET, Volume 3, Special Issue 3, March 2014.

