Proceedings of the Third International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC 2019)
IEEE Xplore Part Number:CFP19OSV-ART; ISBN:978-1-7281-4365-1

Review and Performance Analysis on Wireless Smart Home and Home Automation using IoT

Kabita Agarwal
Department of Instrumentation and Electronics Engineering
College of Engineering & Technology (CET)
Ghatikia, Kalinga Nagar, Bhubaneswar-751003, Odisha, India
akkavita22@gmail.com

Arun Agarwal*
Department of EIE, ITER
Siksha 'O' Anusandhan (Deemed to be University)
Khandagiri Square
Bhubaneswar-751030, Odisha, India
arunagrawal@soa.ac.in
*Corresponding author

Gourav Misra
School of Electronic Engineering, Dublin City University, Glasnevin, Dublin 9, Ireland
gourav.misra.ima@gmail.com

***Abstract*— The concept of Internet of Things (IoT) requires the seamless connectivity of millions of heterogeneous devices. In today's World, implementation of IoT based smart home has drawn a huge attraction and become a prominent area of research. This research work presents an approach for smart home automation using IoT that can be controlled wirelessly. Home automation system means monitoring and controlling of home appliances remotely using the concept of internet of things (IOT). In this method we use mobiles or computers to control the basic home appliance and make it function through the designed web page with internet connection/local area network (LAN) servers. This type of home is also known as smart home. The concept of applying automation in the sectors of housing is selling like hot cake. Western countries have welcomed the concept of automation into their homes with open arms. Our country is keeping up with the pace of modernization too. Different approaches to automating homes have been implemented. The best among this is home automation system using IOT. IOT provides the feasibility of operating the home automation system from anywhere around the world using internet. It reduces use of excessive or unnecessary human efforts and improves the standard of living of the people in our society.**

Keywords— Home Automation, IoT, Smart Home, LAN, Internet, Home security

I. INTRODUCTION

A. Motivation

The Globalized demand for energy consumption has reached newer heights. With the advancement of state of the art technologies, demand for power as a form of energy has increased. Energy in its basic forms is being utilized in pencil cells to hydro-electric projects [1].

With the upward demand of energy, the motion of energy consumption is high. Corporations and industries spend thousands of dollars on energy and millions more in efforts to find ways for energy conservation.

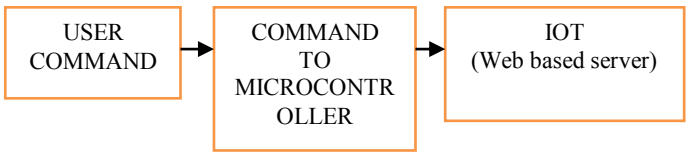

Fig. 1 Working principle

Home automation takes this idea forward and helps equip homes to use less mechanical and electrical energy, reducing human effort by operating systems at our finger tips and increasing savings in terms of cost efficient bills [2].

B. Design goals

One of the important aspects of home automation system is to provide convenience for the consumer. It can be used to save energy and can be used at ease [3]. As we know that there are enormous number of solutions available for home automation systems which are available nowadays but they vary in accordance to reliability, affordability and most important of all their ability to withstand the all-important tests of time.

- **User command-** the user input is referred to as user command it signifies the action that a particular person wants the system to do. For example – switching on/off the home. Lights, controlling the cooling system and opening the main gate.
- **IOT Based Server-** The user command reaches the microcontroller on concepts of internet of things, Here the microcontroller is connected to a Wi-Fi module and which is further wirelessly connected to the remote computer through LAN. The command is transmitted to the microcontroller from the PC through this LAN based server.

- **Command to microcontroller-** The command is received by the microcontroller and is then further implemented to the specified action.

C. Problem statement

We design a home automation system using the concepts of internet of things (IOT) enabling us auto-mate basic home functionalities like switching on/off Equipment lights, cooling systems, refrigerators and other home appliances that are operational in homes.

II. LITERATURE SURVEY

In this section of paper we have put light on some available different methods for setting up the home automation system and then will showcase about our method which we implemented in this work.

A. Bluetooth Based Automation System Using Cell Phone

In this system the home appliances are connected to Arduino BT board using relay [7-11]. The program is based on C language of microcontrollers. The connections are made using via Bluetooth. It is password protected so that only authorized users can access the system.

Advantages:

- It is a wireless communication.
- Only authorized users can access the system.

Disadvantages

- It can be used only up to the specified range of area as it is connected to Bluetooth.

B. GSM Based Home Automation System Using Cell Phone

As the technology is increasing so fast so now days GSM based home automation system have also came to research. Here in this field we can go through SMS based home automation, GRPS based home automation and dual tone multi frequency (DTMF) are the options that we can go through using GSM technology. Here the home sensors are connected with the home network through SIM. Here transducer is used which converts machine function into electrical signal through microcontroller. Here the sensor senses and converts all the physical quantities to voltage and then it is controlled by GSM[12-13].

III. PROPOSED METHOD

Home automation system using internet of things (IOT) means monitoring and controlling of home appliances remotely using the concept of internet of things (IOT). In this method we use mobiles or computers to control the basic home appliance and make it function through the designed web page with internet connection/local area network (LAN) servers. This type of home is also known as smart home.

Here we have designed a system as well as an html page from which we can control the whole communication board. We have used the embedded C language where we have provided the user name and password so that when we start the communication board it automatically gets connects to the devices hotspot.

- Here we have used a development controller board as Arduino which is connected to an in-built Wi-Fi through which we operate the communication board.
- As soon as we plug in, the communication board starts and initializes all the components over there and then it gets a command to check for the given devices hotspot is available or not, if it is not able to find the device then it again goes to initialization of all the components but if it finds the device then it connects with the local Wi-Fi.
- After connecting with the device the command is given to read the data from the web page.

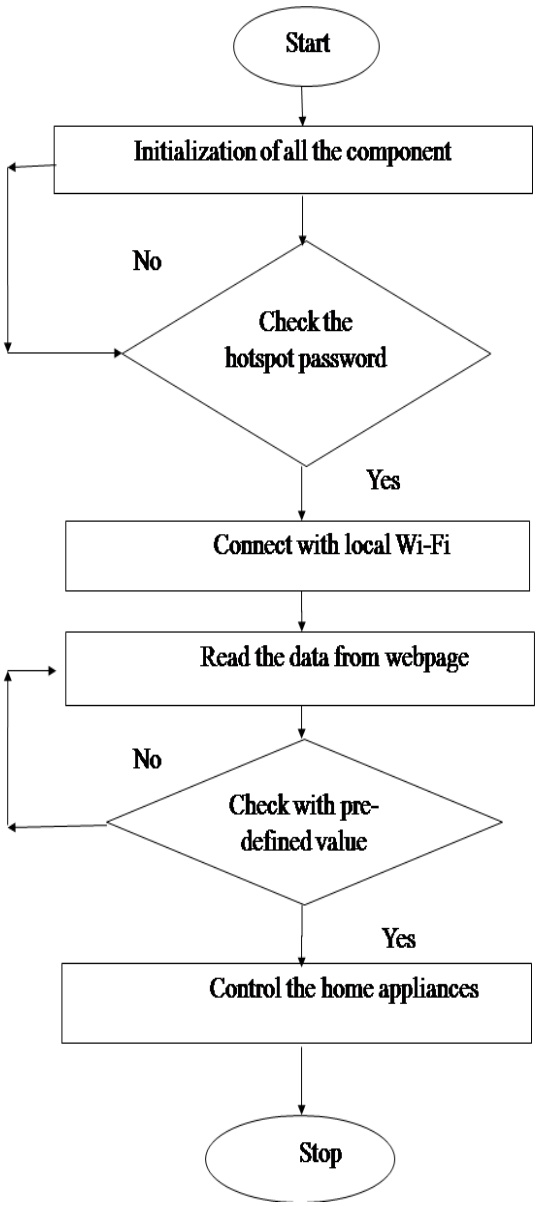

Fig. 2 Flow chart of proposed home automation system.

IV. DESIGN SCHEME

A. Optocoupler and Triac Circuit

As shown in Figure 3, Optocoupler is a driver which is optically connected through the light without any wire connection and Triac is a switch or transistor for AC current. The driver connects the microcontroller to the AC load in the circuit. Through the microcontroller 0 or 1 input is given to infrared ray (IR). When the ray falls on the photo-diode it gets becomes active and forward-biased which results in the flow of current in the circuit to the gate terminals T1 and T2. When the input is given as 1 the photo-diode is activated and the gate terminal triggers and the moment it triggers T1 and T2 are connected resulting in a closed circuit. When the input is given as 0the photo-diode works in reverse biased condition resulting in an open circuit as T1 and T2 are not connected.

B. Methodology

Here we have designed a system as well as an html page from which we can control the whole communication board. We have used the embedded C language where we have provided the user name and password so that when we start the communication board it automatically gets connects to the devices hotspot. Here we have used a development controller board as Arduino which is connected to an in-built Wi-Fi through which we operate the communication board. As soon as we plug in, the communication board starts and initializes all the components over there and then it gets a command to check for the given devices hotspot is available or not, if it is not able to find the device then it again goes to initialization of all the components but if it finds the device then it connects with the local Wi-Fi. After connecting with the device the command is given to read the data from the web page. Then it checks the predefined value whether it's 0 or 1. If its 0 then it again jumps to "reading of data from the webpage" after that if the value comes 1 i.e. yes then we are able to control the home appliances through our device.

Pseudo Code for the Microcontroller:
1) Import library files and initialize resistors
2) Configure SSID and Password
3) Connect to Wi-Fi network
4) Start the Server
5) Print the IP Address.

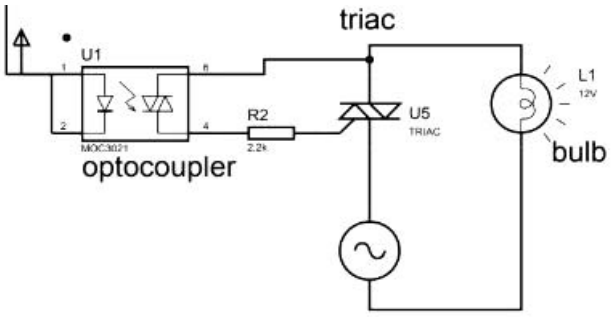

Fig. 3 Optocoupler and triac (driver)

6) Check if client is connected or wait until the client sends some data.
7) Read and match the Request and set Led-pin accordingly to the request.
8) Return the response and reflect the Status.

C. Component Design and Implementation

The project is divided into various parts and sub-parts which are finally put together to get the desired output. Figure below depicts the flow chart for writing and reading to and from register.

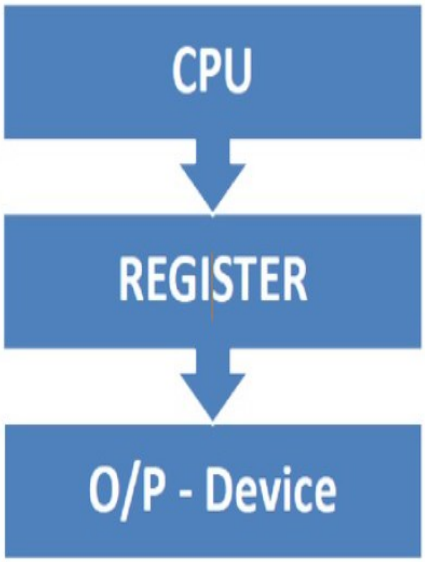

Fig. 4 Flow chart for Writing of Register

Fig. 5 Flow chart for Writing of Register.

D. Experimental Details

First of all we thought that we would design a system using Bluetooth that would help us operate home appliances. But if we would have designed a project that would have operated using Bluetooth then the project would be simple and of limited use for future development. We have intentionally used Arduino as a development board with the help of concepts of Internet of Things. As the scope of research and development is blooming in the field of automation and IOT. Arduino and IOT would ensure drastic and efficient research related to our project. As Arduino dubbed with the Wi-Fi module is the basic and efficient development board which is easy to configure with the limited knowledge of embedded C. We have decided to use Arduino as our microcontroller device. Then after browsing the internet, we got to know how to use embedded C. As Arduino IDE is a public platform sharing knowledge and information or coding related to microcontroller. We also took the help of YouTube which gave a precise idea regarding coding using embedded C in microcontroller to operate the appliances. With the help of above mentioned resources and knowledge we were able to configure the controller to control the home appliances. Now the only thing remaining was designing the system to obtain the desired output.

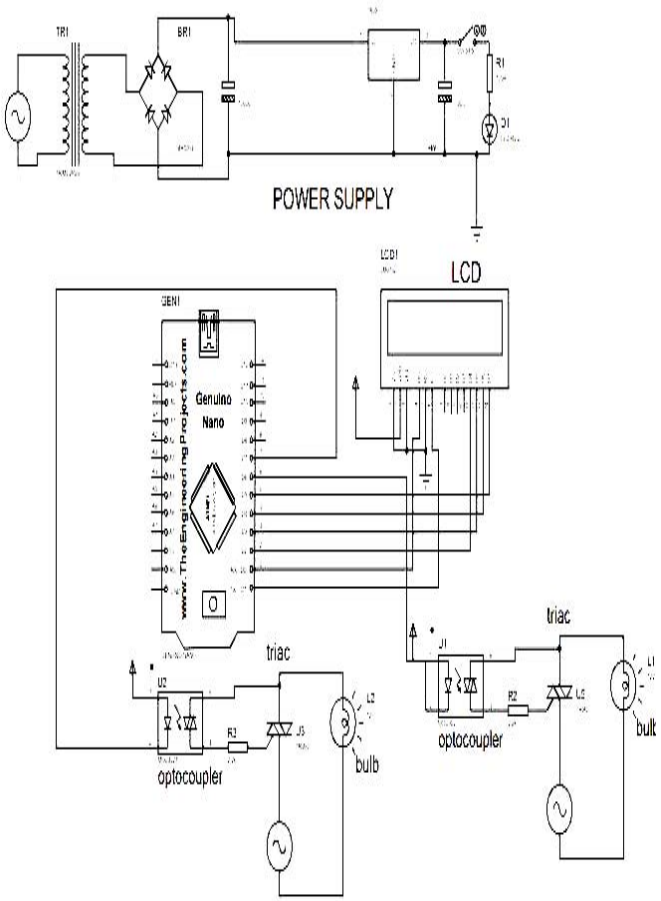

Fig. 6 Main Circuit diagram of proposed technique.

V. ANALYSIS AND RESULT EVALUATION

A. Analysis

The overview step analysis form the user command to the task execution is mentioned below for the IoT based Home Automation System-

1) Initially, when Power is switched on, the Wi-Fi module searches for the specific SSID and password configuration from the list of available connections. This runs in loop unless the listen connection is connected.

2) The Device then connects to the required/listed connection and waits for the sever response.

3) The user sends the desired command in terms of switching on/off the listed devices.

4) The command is received by the microcontroller with intentional delay.

5) The Microcontroller triggers the opto coupler by providing an input depending upon the user command.

6) The opto-coupler triggers the gate terminal at Triac resulting in the device turning on/off.

B. Evaluation

The Home automation had a traditional concept of working on the principle of bluetooth module but it lacked behind in terms of range. The bluetooth technology forced smart homes to work in very limited range and thus the concept of implementing IOT based wireless home automation crossed our Mind. The purpose of using Wi-Fi was significantly better than that of using Bluetooth as it provided long ranges over wireless local area connections and an infinite range over the cloud.

The Wi-Fi Module allows us to connect /send/receive data over the internet if proper database and domain infrastructure is made available. Proposed Home automation system enabled us to operate on local area connections effortlessly. The system worked flawlessly and enabled us to control switches that represent the home appliances with remote computers and devices connected to the local area connection.

C. Safety issues and precautions

The following safety issues and their precaution should be considered when using home automation.

1. Factors can lead to device failure if the centralized communication hub stops working or breaks due to internal or external factors which would ultimately result in breakdown of the whole system. So, proper backup measures including a self-unlock feature upon failure and a mechanical release can be provided in the central communication hub.

2) The installation of this home automation system can lead to exposed Security concerns, if not handled by professionals and efficient corporations who can invest and develop efficient cyber security.

3) Invading of Privacy is a general concern if we have smart parts manufactured by different companies installed to check and control your homes security? Eavesdropping compromised security concerns, hacking and intruding are

some of the other concerns that can be avoided by taking strict security measures with cyber security practices.
4) Can provide easy entrance measure if it is just controlled by your smartphone (if stolen or taken without permission) and is not biometrically protected.
5) A secure and stable local area network or any other private network should be provided to the automation system for smooth functionalities.

VI. CONCLUSION

As we know Internet of things (IoT) is one of the most important features of home automation system. It provides the easier living for any person and helpful for disabled also. In this project, an approach is made towards developing an Internet of things (IoT) based home automation system. We used the controller board as arduino ESP8266 with wireless module equipped in it to control the system. We also designed an html page to control the appliances. For the software purpose embedded C is used. This project mainly focuses on safety and security perspective of home automation through using the technologies of home automation which can be automated and controlled inside a smart home from anywhere all around the servers. It saves the electricity and keeps control on saving energy as it is specially designed in such a way that enables disabled person to keep control on their smart homes. As we are connecting this to Wi-Fi module so it enables us to control the system from 7-8 different devices at a time which was not possible while using bluetooth and range was also less over there. It reduces use of excessive or unnecessary human efforts and improves the standard of living of the people in our society which in turn helping us to make our life simpler and more comfortable.

REFERENCES

[1] K. Venkatesan and Dr. U. Ramachandraiah, "Networked Switching and PolymorphingControl of Electrical Loads with Web and Wireless Sensor Network", *2015 International Conference on Robotics, Automation, Control and Embedded Systems (RACE*), Chennai, (2015), 1-9

[2] Raj, J. S. (2019). "QoS optimization of energy efficient routing in iot wireless sensor networks'. *Journal of ISMAC*, 1(01), 12-23.

[3] VishwatejaMudiam Reddy, NareshVinay, TapanPokharna and Shashank Shiva Kumar Jha, 'Internet of Things Enabled Smart Switch', *Thirteenth International Conference on Wireless and Optical Communications Networks (WOCN),* Hyderabad, (2016),1-4

[4] Warsuzarina Mat Jubadi and NormaziahZulkifli, 'Programmable Infrared Accessory Light Switch', *International Conference on Intelligent and Advanced Systems*, Kuala Lumpur,(2007), 1130-1134.

[5] Shih-Pang Tseng, Bo-Rong Li, Jun-Long Pan, and Chia-Ju Lin, 'An Application of Internet of Things with Motion Sensing on Smart House', *International Conference on Orange Technologies,* Xian, (2014)

[6] T. Thaker, 'ESP8266 based implementation of wireless sensor network with Linux based web-server', *Symposium on Colossal Data Analysis and Networking (CDAN),* Indore, (2016)

[7] R. Piyare, and S.R. Lee (2013), 'Smart home-control and monitoring system using smart phone, The 1st International Conference on Convergence and its Application, vol.24, pp 83-86.

[8] S. Karaca, A. Şişman and İ. Savruk, "A low cost smart security and home automation system employing an embedded server and a wireless sensor network," *2016 IEEE 6th International Conference on Consumer Electronics - Berlin (ICCE-Berlin)*, Berlin, 2016, pp. 73-77.

[9] https://www.arduino.cc/en/main/arduinoBoardUno

[10] https://www.northdoor.co.uk/iot-device-action

[11] V. D. Vaidya and P. Vishwakarma, "A Comparative Analysis on Smart Home System to Control, Monitor and Secure Home, based on technologies like GSM, IOT, Bluetooth and PIC Microcontroller with ZigBee Modulation," *2018 International Conference on Smart City and Emerging Technology (ICSCET)*, Mumbai, 2018, pp. 1-4.

[12] V. Ricquebourg, D. Menga, D. Durand, B. Marhic, L. Delahoche, and C. Loge, "The smart home concept: our immediate future," in 2006 1ST *IEEE International Conference on E-Learning in Industrial Electronics,* pp. 23–28, Hammamet, Tunisia, 2006, IEEE.

[13] W. K. Edwards and R. E. Grinter, "At home with ubiquitous computing: seven challenges," in Ubicomp 2001: *Ubiquitous Computing*, pp. 256–272, Springer, Berlin, Heidelberg, 2001.