

A Home Automation System Using Internet-of-Things (IoT)

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ABSTRACT

Automation systems provide users with a realm of seamless and convenient experience of controlling home, office and industrial appliances remotely via a computer or other related devices. The prevalence of the Internet and the advancements technology are responsible for the success stories recorded so far. Since this is a rapidly evolving area of research, more studies need to be done in order to meet the continuously changing technological landscape of the 21st century. In this paper, an Internet-of-Things (IoT) based home automation system is presented. The work utilizes low cost and readily available components and materials to achieve its objectives. An ESP8266 is used as the main microcontroller and a smart phone which features a Blynk IoT software was used as the processing device to manage the appliances via Wi-Fi. Four loads which were driven by relays were controlled. Result showed that the devices connected to the respective relays turned ON and OFF as per the users' request. Thus, this work finds applications in homes and small offices for controlling electric lamps, fans, and other light weight applications.

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INTRODUCTION

Today's technology has brought about many positive changes to our everyday lives. Many more tasks can be accomplished more conveniently and efficiently through the use of technology. The Internet, which is one of such technologies, is responsible for the rapid development experienced in present and emerging technologies. Its connection and usage has increased rapidly. Different things can be achieved via the Internet beyond just email and social media. The Internet of Things (IoT), which is a direct product of the prevalence of the internet is a new area of smart computing and is providing a privilege to communicate around the world to create smart homes, smart cities, smart grid, etc. A smart home allows home dwellers to access, monitor, and control home appliances such as CCTV cameras, refrigerators, lamps e.t.c remotely via a networked computer or mobile device. Home automation is reducing human

presence and intervention with home appliances to a minimum. Hence, the benefits for building automation systems for offices and homes are increasing by the day.

In this paper, an IoT based home automation system is designed and developed. The work utilizes low cost and readily available components and materials therefore making it suitable for application in homes and offices for controlling electric lamps, fans, and other light weight appliances.

REVIEW OF RELATED WORKS

Home automation was first introduced into the world market in the 1970s, but it failed to meet the expectations of people and was unsuccessful. There were various reasons associated with the failure of the home automation system then. The system was neither user friendly nor cost efficient (Kumar, 2016). Currently, the foremost point to keep in mind

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when designing a home automation system is that it should be cost-efficient and easy to install (Naseera et.al., 2018; Mounika et.al, 2021). Tan, Lee and Soh (2002) proposed the development of an Internet-based system to allow for the monitoring of important process variables from a distributed control system (DCS). Their work utilized both hardware and software to enable the user to access the process variables on the DCS. Jawarkar et. al. (2008) developed a remote monitoring system which uses mobile phone and spoken commands. The spoken commands are generated and sent in the form of text messages to the control system which then sends a signal to the microcontroller to perform a test based on the instruction contained in the message.

Sarwar, (2017) proposed an efficient low cost supervisory system for smart home automation that can be managed using IoT. The system is based on a priority algorithm which helps to monitor and control all the home appliances and electronic devices through a supervisory system in a most efficient and reliable manner. Both the consumers and the suppliers will get the opportunity to manage the power distribution by monitoring the electricity consumption.

Manish (2018) proposed a home automation system using voice through the Google assistant platform. The spoken commands from Google assistant sends message to the micro-controller which passes the message to a relay that switches an appliance on or off.

“UJALA-Home Automation System Using Google Assistant” This paper presents a design and prototype of Home Automation system that will use ESP8266 Wi-Fi module as a network provider in connecting with other appliances.

Aayush et. al. (2018) proposed the UJALA-Home Automation System Using Google Assistant which is based on the ESP8266 microcontroller. It uses the ESP8266 Wi-Fi module as a network provider in connecting with other appliances.

METHODOLOGY

The design of the system is divided into two main parts: Hardware and Software.

Hardware: The hardware refers to the physical components of the system that will be connected together to achieve the objective and they are as follows:

- I. The Power Supply: The power supply unit for the system is powered with Direct Current (DC) for the ESP and Relay while the load/appliances utilize Alternating Current (AC).
- II. The Control Unit comprises of the microcontroller - Node MCU and the 4 Channel Relay board. The Relay board uses Node MCU (ESP8266) to control the relays. The ESP8266 is a powerful microcontroller that contains an integrated Wi-Fi system embedded in it together with an integrated general purpose input/output (GPIO), a PWM, I2C, 1-Wire and ADC. The Node MCU's digital output pins are connected to the Relay pins of the Relay board.
 - a) The Relay: A relay is a switch that opens and closes electronically/electromechanically. It consists of mainly 5 pins. They are two coil pins, one connection pin, one no connection pin and one common pin.
 - b) The Loads: The Loads are the appliances to be controlled and this paper uses only four.

Software: This refers to the aspects of the system that are not visible to the eye but they are essential in facilitating the inter-hardware processes, messaging and communication. The softwares used in this study are as follows:

- I. The Blynk App: Blynk is a software app that can be installed on an iOS or Android device. It has the capability to control Arduino, Raspberry Pi, NodeMCU and several other boards over the Internet. It can remotely control hardware and also display, store and visualize sensor data among other things. The Blynk app in this study will communicate with the microcontroller and

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- send the desired signals via Wi-Fi.
- II. The Arduino Integrated Development Environment (IDE): This is the environment where the instructions/commands and logic of the system is implemented.

The system in this paper is made up of five functional units which are as shown in the block diagram in Fig. 1.

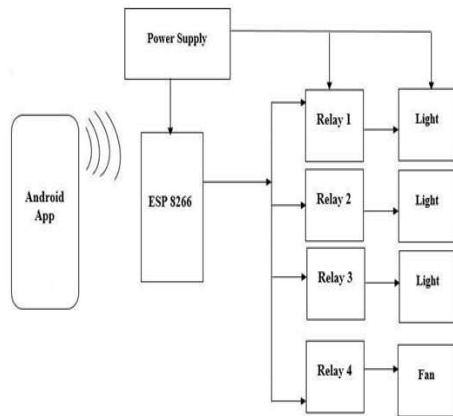


Fig.1: Block Diagram of the Home Automation System

Fig. 2 shows the circuit diagram of the Home automation system using Internet of Things while Fig. 3 shows the flowchart of the system. Fig. 4 shows the connections between the MCU, Relay and appliances. A Home Model of the study is presented in Fig. 5. The Blynk App on the android phone initializes when it is launched. It then searches for and connect to the MCU via Wi-Fi. Commands are then executed through the app to control the desired appliance.

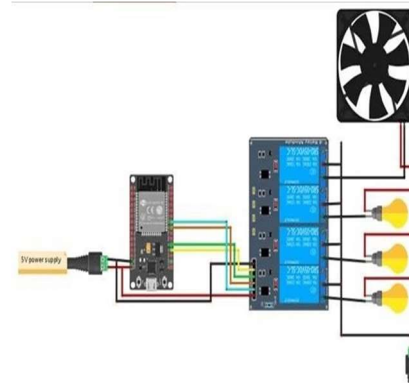


Fig. 2 Circuit Diagram

Fig. 3: System Flow chart

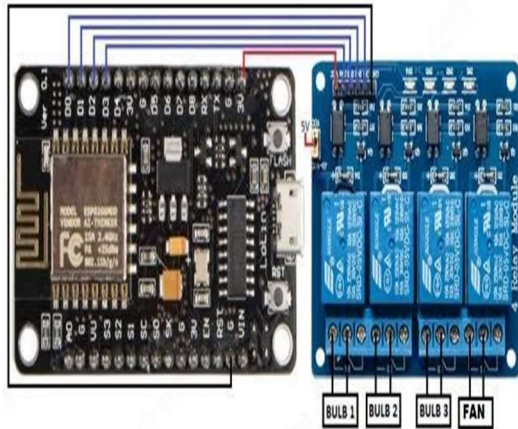


Fig. 4: Connection of ESP to Relay

OPERATIONAL PRINCIPLE OF IOT HOME AUTOMATION SYSTEM

The Home automation is operating with NodeMCU ESP8266 controller and the command is given by the Blynk android application in a mobile phone via the wifi network. The NodeMCU esp8266 has inbuilt wi-fi module and the devices connected with Home automation. Both wi-fi is connected with an authentication token. In this paper DC appliances and power supply are used, NodeMCU Vin and Ground were given 5 volts supply also power supply will be given. Digital Pins D1, D2, D5, D6 are connected to relay IN1, IN2, IN3, IN4 respectively and VCC and Ground of relays connected parallel to Vin and ground. Appliances connections were connected to output pins holder of relays



Fig. 5: A Home Model

PACKAGING

The components of the circuit are firstly mounted on a breadboard to test for reliability, functionality and mode of operation. They are then transferred onto a vero board, soldered, and then encased in a "6X6" plastic case as shown in Fig. 6 together with a Home Model.



Fig. 6: Completed Construction in a Packaging Case with Model

TESTING AND RESULTS

The component used in this entire circuit was selected in each of the associated stages to perform specific function that is suitable for achieving the aim of this study. Having completed the circuit, the first thing was to conduct a thorough test of the circuit. This involves a number of different procedures ranging from a visual check for faults using equipment such as multi-meter to test the circuit after construction.

In this paper, testing was carried out in three phases:

Phase 1: To ensure that all the components to be used are in good functional condition. They were first tested with a digital multi-meter and failed ones were replaced before finally soldering them on the Vero board.

Phase 2: To ensure that there were no breakages along the circuit path on the Vero board. Immediately after soldering on the Vero board the circuit paths were tested. This was done to ensure continuity of the circuit on the Vero board.

Phase 3: Reliability test was carried out on the complete system to ensure effective operation.

Fig. 7 shows the result obtained from testing the Home Automation system.

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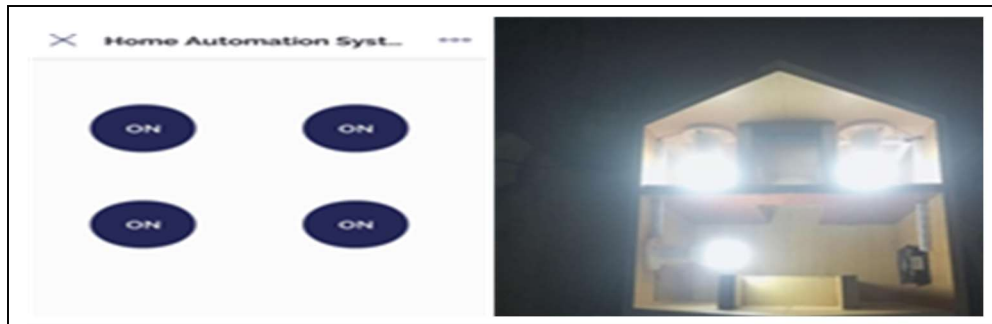


Fig. 7: Test Results

CONCLUSION

Home automation using Internet of Things has been experimentally proven to work satisfactorily by connecting simple appliances to it and the appliances were successfully controlled remotely through the Internet/Network. Home appliances like Bulb, Fan and Motor etc., are controlled according to the given commands. The commands given through the Blynk App are decoded and then sent to the microcontroller and it controls the relays. The devices connected to their respective relays turns ON or OFF as per the users' request. The microcontroller used is NodeMCU (ESP8266) and the communication between the microcontroller and the application is established via Wi-Fi. Consumers are looking to secure their home environment in today's unpredictable world, and this type of home automation service gives them the peace of mind they need to remotely manage their homes. Security of such systems will be considered in future works.

REFERENCES

- Aayush, A., Anshul, S., Asim, S. S., & Babeetha, S. (2018). UJALA – Home automation system using Google Assistant. In *IEEE International Conference on Communication (ICC 2018)*, (Vol. 04, Issue 02).
- Jawarkar, N. P., Ahmed, V., Ladhake, S. A., & Thakare, R. D. (2008). Microcontroller-based remote monitoring using mobile phone through spoken commands. *Journal of Network*, 3(2).
- Kumar, A. (2016). Home automation via Bluetooth using the Arduino Uno microcontroller. *California State University, Long Beach*.
- Manish, P. G. (2018). Google Assistant controlled home automation. *Department of Electronics and Communication, Maharishi Dayanand University, Rohtak, Haryana, India*, (Vol. 05, Issue 05).
- Mounika, K., Gayathri, P. V. S. N., Karunya, S., Srishyla, N., & Basavaraju, G. M. (2021). Arduino-based home automation using TV remote. *International Journal for Research in Applied Science and Engineering Technology*, 9(7), 30-33. <https://doi.org/10.22214/ijraset.2021.36231>
- Naseera, S., Sachan, A., & Rajini, G. (2018). Design of smart home using Internet of Things. In *Smart Trends in Systems, Security and Sustainability* (pp. 355-362). https://doi.org/10.1007/978-981-10-7868-2_34
- Sarwar, K. M. (2017). Efficient low-cost supervisory system for Internet of Things enabled smart home. In *IEEE International Conference on Communication (ICC 2017)*.
- Tan, S. H., Lee, C. S., & Soh, C. B. (2002). Internet-based monitoring of distributed control systems. *IEEE Transactions on Education, Energy and Power Engineering*. New Jersey, USA.

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