Wireless Home Automation Using Internet of Things

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ABSTRACT

Home automation is on the rise due to the popularity of IoT and various other reasons. It could make life more comfortable and increase the standard of living. Home Automation means the ability to control various home appliances remotely and also automate various processes using different triggers through sensors. The devices utilized for home automation are capable of exchanging information in between themselves to provide better functionality through Internet of Things (IoT). The work focuses on various home automation technologies that were in the market so far and a detailed analysis of different features and their pros and cons standpoint. The work focuses on analyzing the features and functionalities required for a home automation system to stand out.

This paper presents the design and fabrication of a Wi-Fi based home automation module by which a single module can be connected to a normal home appliance, to control and monitor it remotely, using the concept of IoT. In today's market, the price of such IoT enabled devices is high due to higher demand and lesser availability. One of the primary objectives of this project is to be effective at a lower price. This paper intends to fully demonstrate the working and methodologies used behind this project.

Keywords: IoT, Wi-Fi, Smart appliances, Bluetooth, Home automation, Blynk, NodeMCU(ESP8266)

1. INTRODUCTION

Smart homes are growing very fast, they are creating comfort, convenience, quality of life and security for the users. Nowadays these are used to give more comfort to elderly and disabled people so they can easily operate without actually moving. As we all know we have multiple ways to get our work done there are multiple technologies to make a normal appliance to a smart appliance and that will convert a normal home into a smart home. This idea of home automation or smart home was not today's, back in 1930 the inventors already had already imagined how the world is going to be changed by the home automation. In 1950 the first computer chip which brought our home automation to thus level was invented by Jack Kilby and Robert Noyce.[1]

The first home automation device was invented in 1966 by Jim Sutherland. It is called as "ECHO" (Electronic Computing Home Operator). This device is used to send relay messages, control house temperature and can turn on or turn off home appliances. The wireless technology we still use for Bluetooth, Wi-Fi by upgrading till date is 802.11 was invented in 1980, from then the home automation has been used in garage doors, house security systems, thermostat controls and many mire technologies. Then form the late 1990's and early 2000's smart devices, smart appliances and smart homes became more common.[1]

There are many technologies used in wireless home automation, some of them are widely used because of the advantages they provide. They are

- **Wi-Fi –** This is one of the widely used protocol in home automation because of its multiplexing technology which allows the connection of smart devices. This is the fastest operated protocol when compared to other. But adding more automated devices may result in slow operation.[2]
- **Bluetooth –** This is another widely used protocol because we can connect multiple devices which have Bluetooth feature and can be operated in short distances only. It is used widely because it consumes less power. It is commonly used in lights, fans and smart locks.[2]

Radiofrequency – This is diminishing technology, while compared to the other technologies this is very old and can only control home gadgets. There will be a radiofrequency remote which is linked with a microcontroller transmits the on or off signals to the appliances.[2]

- **ZigBee –** This is an advanced protocol which is completely wireless using radio frequency to operate multiple devices at a time. This is widely used home automation protocol because it is highly customizable, an open technology and consumes very less power.[2]

Every technology for home automation needs more certain interfacing of more than one sensor or module to complete the setup. To ease that in this paper presents a module with using NodeMCU, Diodes, Step Down Transformer, Capacitor, 5V Relay module and Voltage Regulator, which are compact and easy to connect to your home appliances and can be operated using a mobile application very easily

2. LITERATURE REVIEW

In this section, various home automation systems, their benefits and their disadvantages are discussed.

1. Khusvinder Gill, Shang-Hua Yang, Fang Yao and Xin Lu studied the reasons behind the slow adoption of home automation in the era of rapid digital growth and addressed the potential of Zigbee technology as the medium for establishing a reliable and flexible home automation system. The project utilizes both ZigBee and Wi-Fi as medium through an entangled home gateway for reliability. The product is provided with an easy-to-use network interface and remote access to the automation system. But the limitations faced by the project are low transmission rate and incompatibility with many end devices.

2. N Sriskanthan, F Tan and A Karande studied the feasibility of a smart home in the late 1990s. They focused their study to upgrade the houses to smart homes where the appliances and devices can be connected and controlled remotely without additional wiring and much cost. The popular and reliable wireless technology, Bluetooth is chosen as the medium technology for establishing a smart home. The project enforces Bluetooth technology as a medium, a remote controller and several client modules that are connected to each appliance that is to be controlled. The limitations of this project are that the network could fall apart anytime as the Bluetooth is not much reliable, as compared to other wireless technologies and the range of Bluetooth is shorter, Bluetooth also doesn't enforce any strict security policies or techniques and so the probability of intrusion is higher.

3. Deepali Javale, Mohd. Mohsin, Shreerang Nandanwar, Mayur Shingate studied the effectiveness of home automation system using Android ADK (Accessory Development Kit) in their research publication, 'Home Automation and Security System using Android ADK'. The component that acts as a microcontroller is the standalone embedded system board Android ADK. The end devices or appliances are connected to the ADK and are controlled through android mobile phones and tablets. A few limitations of the project are that the system functions only on an android platform and requires every household to possess at least a single android device and the flexibility of the system is less as the android platform itself is dependent upon the google for most of its features.

4. Ahmed ElShafee and Karim Alaa Hamed studied the implementation of home automation system that uses Wi-Fi as network medium for communication and control. The project consists of two integral parts: A web server that is used to monitor and manage the data of all the devices and devices themselves, A hardware module that is used to interface with all the components or appliances that are to be controlled. The feature that stands out in this project is that the devices can be controlled either through LAN (Local Area Network) or through Internet from distant places. One of the few disadvantages of this project is from the commercial and affordability standpoint.

5. M Van Der Werff, X Gui and W L Xu studied the implementation of home automation system through advanced mobile communication technology. This system enables all the household appliances to connect with each other and exchange information and work in harmony through mobile phone. This system consists of mobile phone with java capabilities, a cellular modem for wireless connectivity and a home server. The user commands are sent to the home server which then re propagates those commands to the intended appliances. The home server is built using GPRS capabilities so that any Java enabled mobile phone can be used as the controller.

3. OBJECTIVE OF THE PROJECT

- The purpose of this project to create a low-cost system that gives to the user absolute control of home automation over Wi-Fi
- The system should be controlled through smart phone

- The home appliance should be turn ON/OFF by connecting the module made by authors.

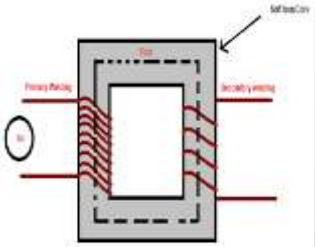
4. SYSTEM DESIGN AND IMPLEMENTATION

Smart phone is the practically important inputs used for man-machine interaction. Therefore, to make smart home user friendly, an android application can be used to control the home system.

System Requirement

NodeMCU (ESP8266)

Diodes(1N4007)



Step Down Transformer

Capacitor 50uf

5V Relay Module

Voltage Regulator

- Arduino IDE software
- Blynk application (mobile application)

The NodeMCU framework is a free and open source IoT platform. It includes firmware that runs on Espressif Systems ESP8266 Wi-Fi SoC and hardware that is built on the ESP-12 board.

Diode is a semiconductor device with two terminals, typically allowing the flow of current in one direction only.

Step down transformers is used in power distribution systems. In a various phase of supplying power, step down transformers is used to reduce voltage whenever necessary.

Capacitor is used to store an electric charge, consisting of one or more pairs of conductors separated by an insulator.

A Relay module is an electrical device, typically incorporating an electromagnet, which is activated by a current or signal in one circuit to open or close another circuit and can also be used as switch.

The voltage regulator is needed to keep voltages within the prescribed range that can be tolerated by the electrical equipment using that voltage.

Arduino IDE software is used to compile the code

Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, visualize it.

5. WORKING MODEL

The working of device is shown in figure below. As shown initial requirement is the Wi-Fi router to access your smart home. After triumphant connection, users will be able to access their smart home appliance over a Wi-Fi.

- **Introduction of IoT**

The methodology defines what activity of research is, how to proceed, what tools and equipment are used to carry out research. In this paper it presents two components of the research methodology from a real project: the theoretical design and framework respectively.

Key words: Research methodology, Theoretical framework, Design

- **Approach**

Home automation is commonly called smart home. It involves the control and handle the things like light, fan, door, alarming for certain remainders, security purposes etc. The status of the appliances is controlled by the switch it either ON or OFF using LAN. Ease of use, hence it is adopted more. All the devices can be used in our own sitting place itself. The problem overcome by this paper is about that a normal fan or fluorescent light can also be controlled by smart phone, by planting a module between source and load.

Due to pandemic, every suburban home had to access for Wi-Fi. This module must need a router or LAN connection to be controlled by smart phone.

- **Flow Diagram**

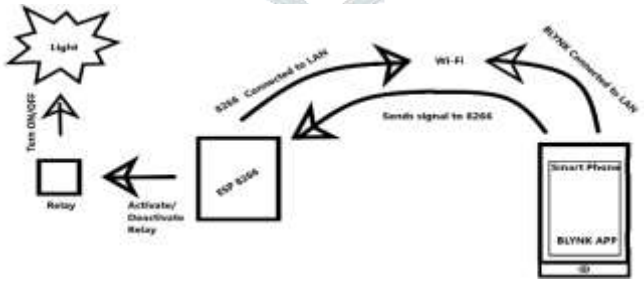


Figure 1: System Flow Architecture of smart and easily access Home Automation System

The 'Blynk' application connected to LAN by mobile hotspot. Similarly, NodeMCU module also connected to Wi-Fi by programming through Arduino IDE. In programming, need to mention SSID and PASSWORD of local area network in order to connect to Wi-Fi and token provided by Blynk Server. By connecting both devices to LAN, the NodeMCU can be controlled through smart device. The signal sent from smart device activates the relay module which is connected to NodeMCU module (also known as ESP8266). When relay is activated, the electrical circuit gets closed and turn on the electrical device (such as light, fan etc.,)

- **Internal Circuit**

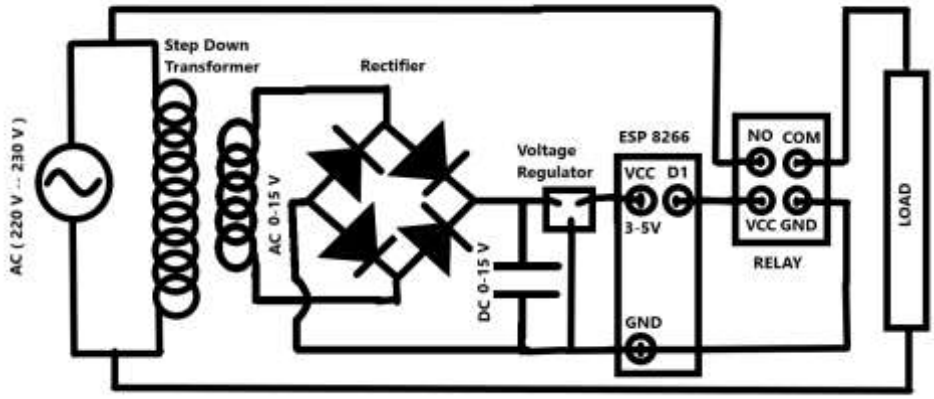


Figure 2: Entire circuit diagram of the module with load and source voltage

The module made by authors connected between the source voltage and load (such as fan or light). The load and source voltage are connected through relay module. So, when the relay activated the circuit will be completed and load gets the power. The relay module is also connected to ESP8266 digital pin. The ESP8266 need input 3.3V as VCC (+ Ve) and ground (- Ve).

- **Challenges Faced**

The NodeMCU only need 3.3-3.6 volts but, the source is AC (alternating current) with 230-240 V.

To overcome this challenge, a transformer, a rectifier and voltage regulator are used. The source voltage will decrease to 0-15 AC voltage. To convert AC voltage to DC voltage, the rectifier is placed. The rectifier converts AC voltage to DC voltage but, the voltage isn't pure. A capacitor is connected and voltage will take across the capacitor. The converted voltage is in range of 0-15V. To reduce the voltage to required amount, the voltage regulator will be placed. So, the voltage will be converted to 220-240 AC voltage to 3.3 Volts approximately. By using this voltage NodeMCU can be initialized. The relay is connected in normally open. Normally the circuit is open circuit. When the relay gets activated by ESP8266 the circuit get closed and the load gets activated.

The ESP8266 should be programmed through Arduino IDE. Arduino IDE is an open-source platform. The source code of BLYNK is available in Arduino IDE.

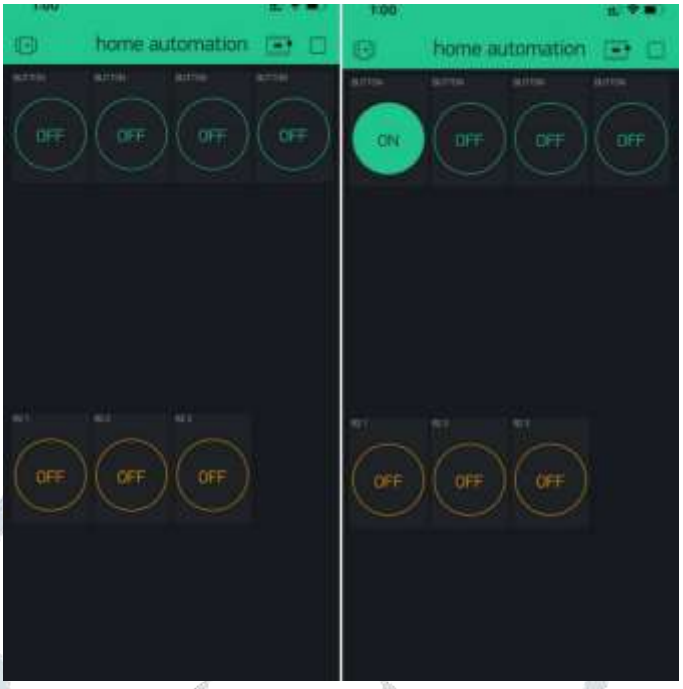


Figure 3: Blynk application use to turn on/off respective electric device

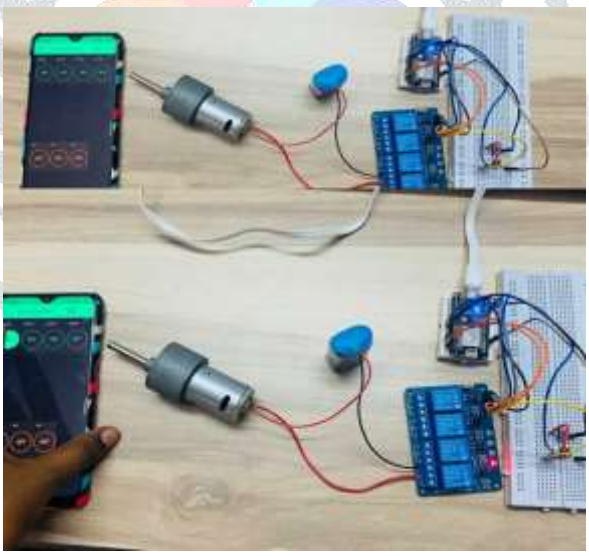


Figure 4: Accessing motor with smart phone through ESP8266

6. RESULT

The paper gives a theory and actual working of module described. The module can be connected in any house which was pre-installed with Wi-Fi router. The respective electrical device can be controlled through only predefined host. It is safe and secure to access through this method.

The relay module is chosen according to the input voltage in house and also according to the module NodeMCU output voltage. By using this module every house can be transformed into smart home. Just break the circuit and reconnect it with the module and access through smart phone. The connectivity depends upon the range of Wi-Fi installed.

7. CONCLUSION AND FUTURE SCOPE

This paper represents a working prototype of the proposed project with the specified functionalities involved. In the future upgrades, a better encryption system and security system can be implemented in this project so as to protect the devices from intrusion and eavesdropping on information being exchanged. A better storage system and agile functioning algorithms that could make use of minimal amount data that can work faster and more efficient.

8. REFERENCES

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