Smart Home Control System Based on BLYNK Mobile Application and Node Microcontroller Unit (MCU)

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Abstract
Technology nowadays plays an essential role in our lives. Smart Home Control System is an intelligent system which aims to manage all the electrical devices using automation technology. There is an increasing demand in building for smart electric control system, where appliances or electrical devices can be controlled through switches and the BLYNK mobile application. Therefore, this home control system is designed by using the complete automation technology which includes the NMCU (Node Microcontroller Unit) connected with home electrical devices as well as control using BLYNK mobile application. To demonstrate the feasibility and effectiveness of this system, devices such as UV strip light, cooling fan and LED strip light have been integrated with the proposed home control system. As a result, the prototype of Smart Home Control System using Node MCU and hardware with the algorithm using BLYNK mobile application has been successful developed and proposed. From the results of the testing process, it shown that this prototype has successfully achieved its' aim. Due to its mobility and wide range of capabilities, this technology opens up new and exciting possibilities for increasing the connectivity of objects within the house for the purpose of smart home control. Through an internet gateway, they may connect with a smart home controller network. Therefore, for the future development of the smart home system it can be modified and added more home electrical control devices such as air-conditioning unit, water pump, security sensors and others. Finally, it shown that the smart home automation based on Android apps in the future will be more high market demand. This is because, it would be used to control home electrical devices through the internet connection as well as rapid development in information and communication technology will support more advancement of algorithm in future.

Keywords: electronics, automation, wireless.

1.0   Introduction

Nowadays the lifestyle of the people has changed tremendously, people prefer more sophisticated, secure and luxury life. Automation systems and electronic gadgets are rapidly evolving in the twenty-first century. The home automation concept has emerged in the early 1980's with the use of relays and followed by microcontrollers. The main drawback of relay is that they are hardwired and very difficult to troubleshoot and in the case of microcontrollers it is difficult for altering the existing system i.e. changing or increasing the number of inputs and outputs (Naveen, Naveen,

Arvind, & Senthilraja, 2016). Meanwhile, Sriskanthan, Tan and Karande (2002) presented a network that includes a remote, mobile host controller and many home appliances in a home automation and networking environment utilizing Bluetooth technology. An innovative technology that allows customers to operate their home appliances and systems using a mobile phone-based interface from afar was also introduced by Das, Sanaullah, Sarower and Hassan (2009).

In this paper, Node MCU is used to achieve home automation. Node MCU is an open source Internet of Things (IoT) platform. It includes firmware which runs on the ESP8266 Wi-Fi SOC from Espressif Systems, and hardware, which is based on the ESP-12 module. The term "Node MCU" by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language. This paper presents the design and implementation of various automatic control devices in home such as lights control LED, UV strip light and cooling fan control with the use of Node MCU. Smart home using Node MCU is all about making the home automate. To be smart, a home requires information, which comes in the form of programmes and commands from the user. This system have been developed and explanation of the functions and successful of the system will be explained in this paper.

2.0 Literature Review

2.1 Smart Home Automation

In the early 2000s, smart homes, also known as room automation, became increasingly common. As such, different technology began to emerge. Smart room suddenly became a more affordable option, and therefore a viable technology for consumers. Domestic technologies, room networking, and other gadgets began to appear on store shelves. Today's smart homes are more about security and living greener. Smart homes are sustainable, and they help to ensure that the homes are not expending unnecessary energy. They also help alert the users to intruders whether the users are at home or not. Direct mobile access, automatic lighting, automated thermostat modification, scheduling equipment, mobile/email/text alerts, and remote camera monitoring are all current home automation patterns (Hendricks, 2014).

2.2 Raspberry Pi Home Automation System

A simple Raspberry Pi home automation system that control appliances in the home from anywhere in the world. It will also allow the user to view data from the passive infrared (PIR) motion sensor via the internet to detect intruders. This project uses platforms like the Raspberry Pi, IBM's IOTF (Internet of Things Foundation) and Cloud (Formerly Bluemix) packages and can be used as a perfect project to get into the world of the Internet of Things (Sanjeev, 2018).

2.3 Bluetooth Based Home Automation System

Bluetooth technology, which first appeared in the late 1990s, is an excellent choice for home automation and networking for busy families and

those with physical limitations. Home Automation Protocol allows the user to monitor and control various appliances linked through a Bluetooth network. The system's functionality has been shown through the development of a room temperature control system (Sriskanthan, Tan & Karande, 2002). Wireless Bluetooth technology was also used to control electrical equipment and monitor room temperature from a smartphone. The system is designed with a simple user interface and is easy to use for the elderly and those with physical limitations (Saadon, Tukiran, Ismail & Ismail, 2021).

2.4   Cell Phone Based Home Automation System
This technology operates with the help of a controller and a cell phone. The system may be utilised as a testing ground for any application that relies on on-off switching. The ability to control appliances remotely via a cell phone will one day become a reality, and one should be grateful for Home and office appliance control system' capabilities. According to Das, Sanaullah, Sarower and Hassan (2009), home and office appliance control system might become a standard feature in new homes in the future.

2.5   Java Based Home Automation System
Al-Ali and Al-Rousan (2014) had developed a Java-based home automation system. All home automation devices are physically connected to the embedded board and use a Java web server to provide remote access to the system.

3.0   Design and Development of Prototype System
The project design includes the hardware and software system development. A micro web server is used as an application layer for communication between remote users and home devices. This entire system communication is enabled through internet. The user can operate wirelessly through the BLYNK mobile application. All these together forms a complete capable, flexible smart home control and monitoring system, based on IoT technology.

Figure 1 shows the block diagram of the system that been developed. It includes of Node MCU (Node Micro Controller Unit) lies at the centre of the system, controlling the function of all devices connected to it. The operation of smart home started from the phone when a command such as ON or OFF is sent using BLYNK Apps using Wi-Fi. After that, the BLYNK Apps as a Cloud will send the command through wireless connection to the receiver which is Node MCU. Then the Node MCU will send the command ON or OFF to the UV strip light, cooling fan and LED strip light. To make sure the electrical devices is directly connected, the Node MCU will send back information to the BLYNK. The system is based on Node MCU board as an internet of things system. The Node MCU is connected to the internet from the hotspot of the smart phone via WIFI connection as the Node MCU has ESP8266 circuit to connect with the internet. To link a node MCU to a smart phone's hotspot, the name of the hotspot, the password, and the token code must be known, allowing the BLYNK server to connect them. The computer is needed once to transfer code from Arduino IDE to the Node MCU kit to prepare the software part of the project.
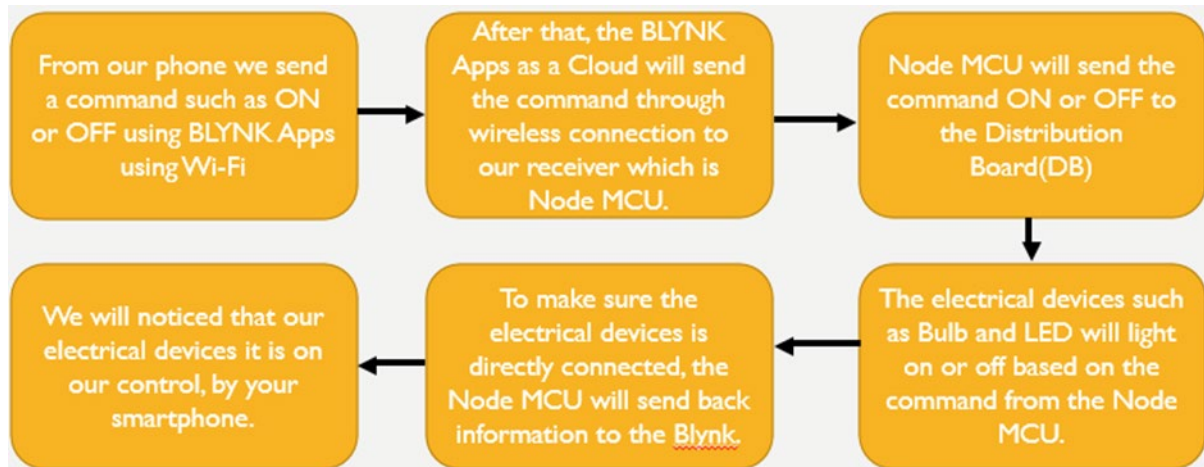
Figure 1: Block diagram of smart home control system using Node MCU.

Figure 2 shows that the server of BLYNK application will process the smart phone Node MCU connection. BLYNK libraries are ZIP files that can be downloaded and imported into the Arduino IDE library from the GitHub website. (Ahmed, 2019).
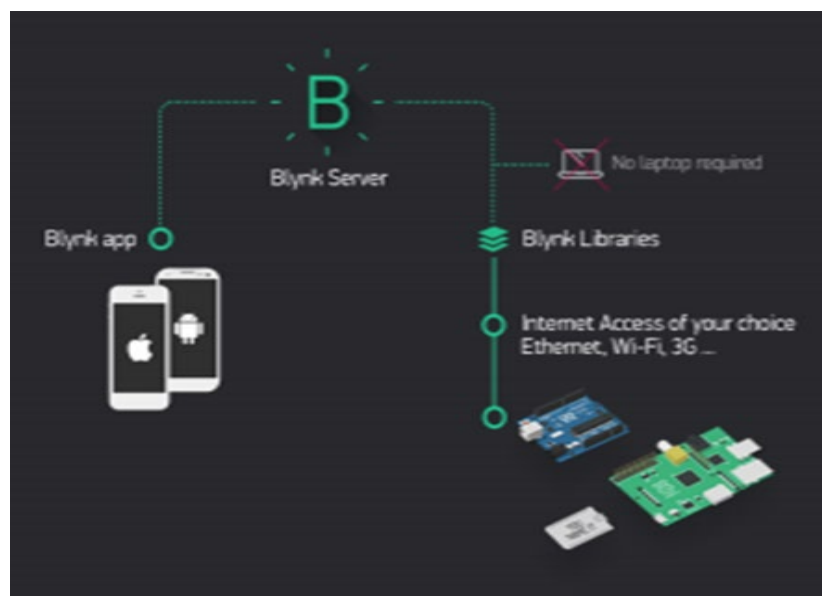

Figure 2: BLYNK system principle (Adapted from Abu & Kamarulzaman, 2018).

Then, the BLYNK server will check for internet connection, Node MCU with android hotspot, the Node MCU code includes the token code, the name of hotspot and its password. The information included to the code must be match with the hotspot information to allow ESP8266 connect with the WIFI to be as a channel to exchange commands between smart phone and Node MCU. Remaining processes are just commands sent from BLYNK application to Node MCU to control loads those are connected to the relay kit as shown in Figure 3.
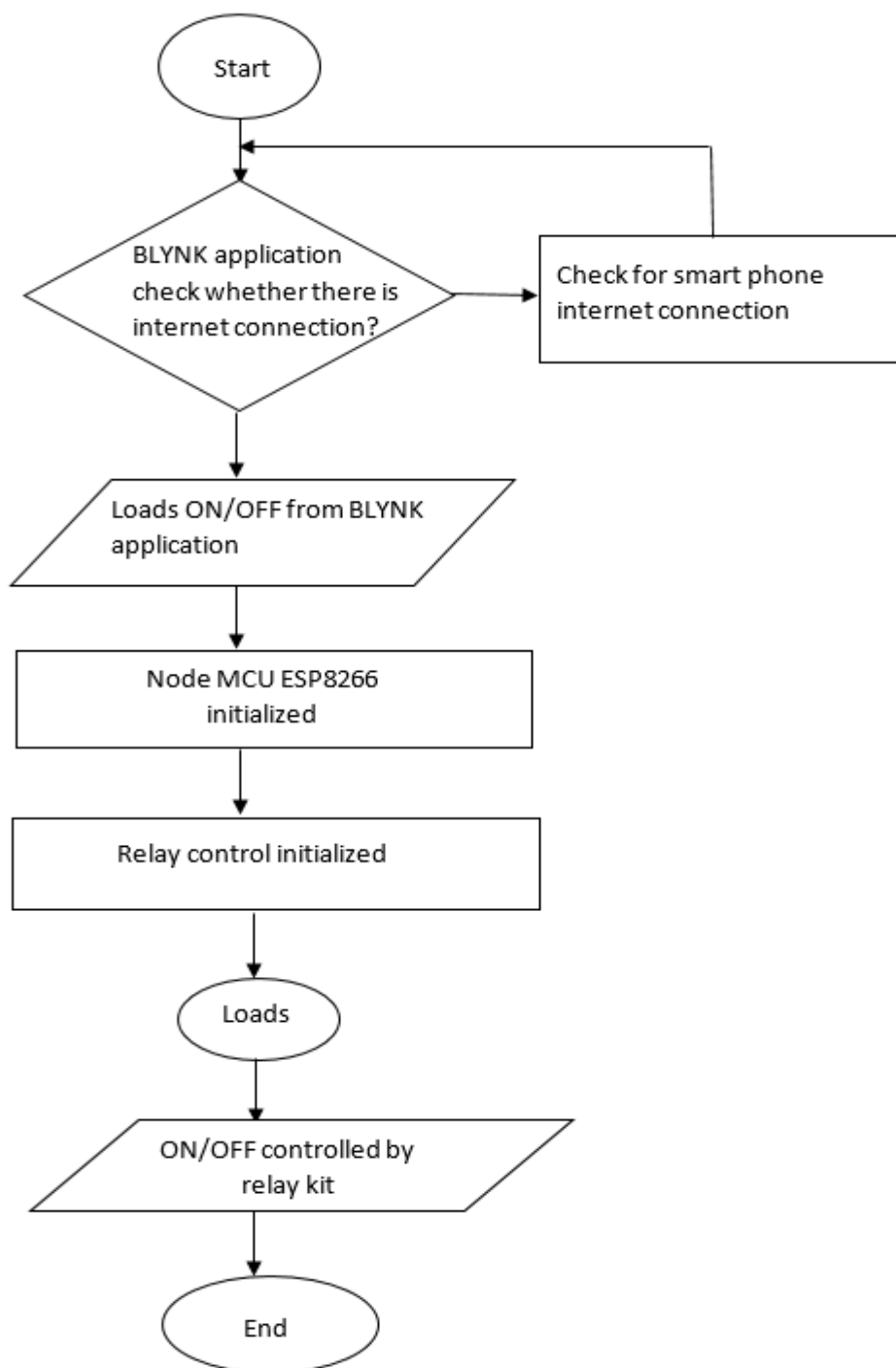
Figure 3: Flowchart of BLYNK application to switch ON/OFF load by using Node MCU.

3.1   Node MCU

Open source prototyping board prototypes are available for Node MCU as shown in Figure 4, which is an open source firmware. The name "Node MCU" combines "node" and "MCU" (micro-controller unit) ("Introduction to IoT with Node MCU," 2020). The firmware uses the Lua scripting language. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266 (Shekh, Asha, Hariprakash, & Harshitha, 2018). It

makes use of a number of open source projects, including lua-cjson and SPIFFS.
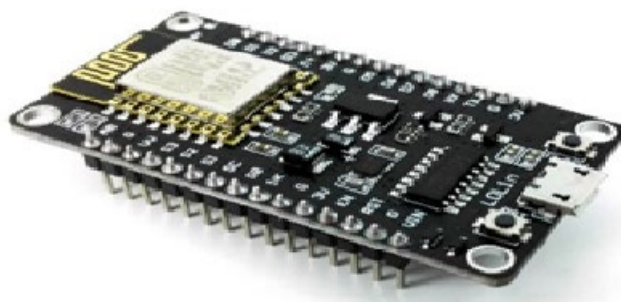
Figure 4: Node MCU

3.2   Electronic Circuit Diagram

Figure 5 show the prototype Smart Home Control System Using Node MCU electronic circuit that have been designed.
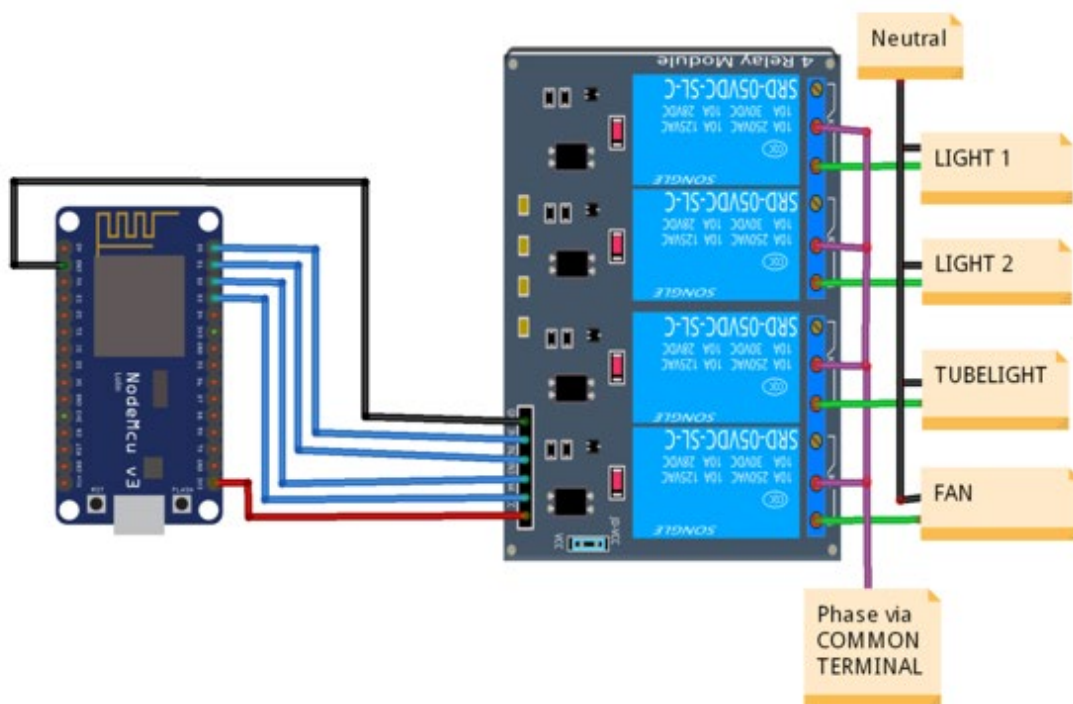

Figure 5: Prototype smart home control system using Node MCU electronic circuit.

4.0 Results and Discussion

In this project, Node MCU micro controller is used as an interface between the user and hardware components. It is programmed and connected to several components according to system designed as explain in section 3.0. Figure 6 shown the interface of BLYNK mobile application for Smart Home Control System Using Node MCU. There are three inputs on the interface of the BLYNK mobile application namely, LED strip light, UV strip light and cooling fan.
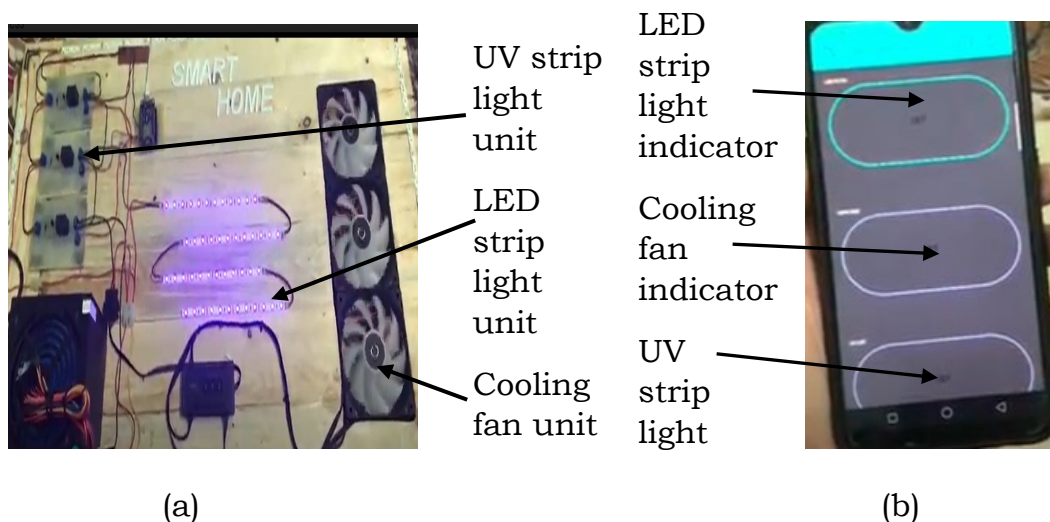
(a)	(b)

Figure 6: (a) LED strip light, UV strip light and cooling fan automatic control devices and (b) BLYNK mobile application interface used for smart home control system

For the testing purpose, the system has been developed the used of LED strip light indicator at BLYNK mobile Application interface. By pressing LED strip light indicator into 'on' as shown in Figure 6 (b) the respective LED strip light in the system will be active as shown in Figure 7. As well as with using of separate indicator at BYLNK mobile application such as cooling fan and UV strip light indicator, the output of the control devices will be activate as shown in Figure 8 and 9 respectively.
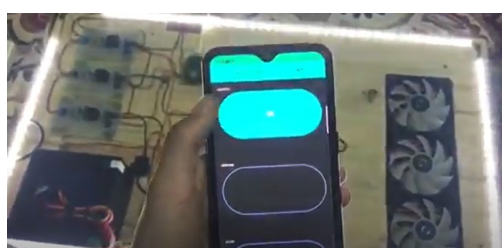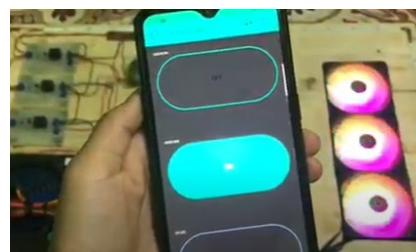

Figure 7: LED strip light is on.
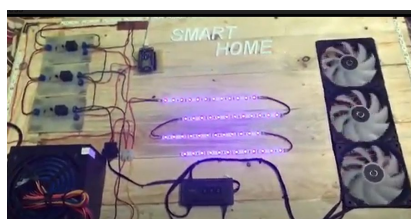

Figure 8: Cooling fan is on.

Figure 9: UV strip light is on.

While, LED strip light, cooling fan and UV strip light are switched off by using BLYNK mobile application indicator respectively as indicated in Figure 10, 11 and 12.
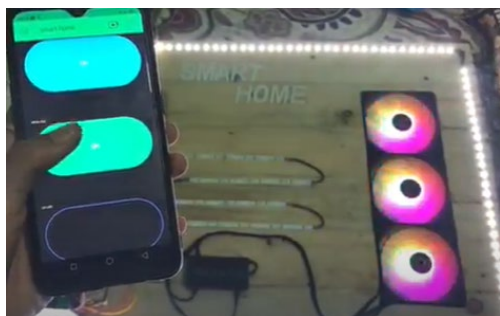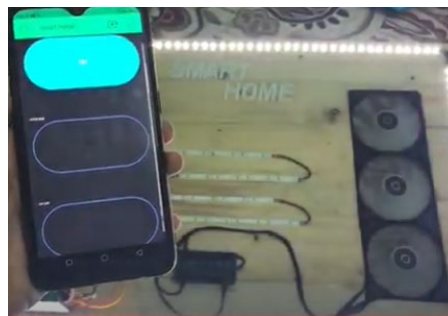
Figure 10: UV strip light is off.

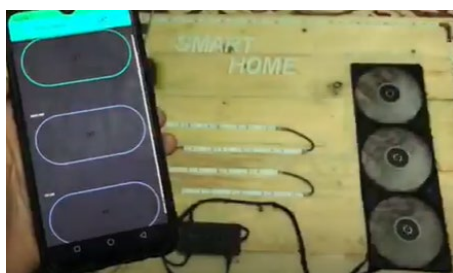**Figure 11:** Cooling fan is off.

Figure 12: UV strip light, cooling fan and LED strip light are off.

Meanwhile, Figure 13 shows the complete model of prototype of Smart House Control System using Node MCU that have been developed where BLYNK mobile application indicator are used in order to switch on and switch off LED strip light, UV strip light and cooling fan respectively. The project presented is a low cost and flexible home control and monitoring system using Node MCU Board with internet remotely controlled by Android OS smart phone.
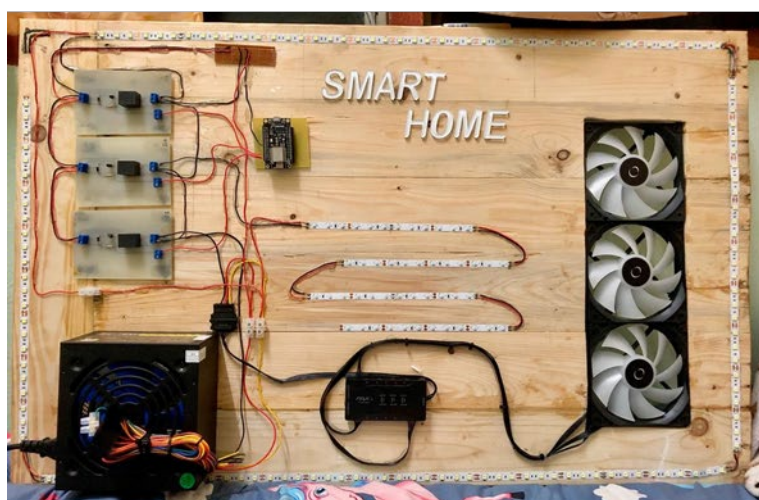

Figure 13: The prototype of Smart House Control System using Node MCU.

5.0   Conclusion

The prototype of Smart House Control System using Node MCU has been developed with the purpose of testing the algorithm using BLYNK mobile application and hardware devices such as LED strip light, cooling fan and UV strip light were successful developed. From the result of testing process, it shown that this project has successfully achieved its' aim, where LED strip light, UV strip light and cooling fan are switched on and switched off respectively by using BLYNK mobile application indicator. The technology used in this prototype shown that the BLYNK mobile application and node MCU communicate wisely, where the mobile phone can trigger node MCU then it will trigger the switch/relay and control the electrical devices as shown in the result section. Therefore, for the future development of the smart home system it can be added more home electrical control devices such as air-conditioning unit, water pump, various types of security sensor and others. Finally, it shown that the smart home automation based on Android apps in the future will be more high market demand because it uses low cost embedded systems.

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