IOT BASED SMART HOME SYSTEM

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Chapter 1: Introduction

Smart phones, Internet TVs, sensors, and actuators are just a few of the ordinary items that the Internet of Things (IoT) connects to the internet, allowing devices to communicate intelligently with one another and with people and other things. A dynamic network of Internet of Things (IoT) is projected to emerge as a result of today's widespread availability of connectivity.

A lot of people are becoming aware of the need to upgrade their houses to become more environmentally friendly. Smart homes incorporate technologies into the living space to enhance convenience, security, and energy efficiency for residents. Research and implementation of home automation are becoming increasingly well-known with the help of Internet of Things (IoT). Besides, bluetooth, Wi-Fi, RFID and cellular networks have all been used to embed varying degrees of intelligence in the house via remote data transmission, sensing and control. To save time, users may pre-program their automatic appliances.

In the previous several decades, smart home research has been well known. The present smart home technology is not intuitive for certain users. Particularly, some elderly and crippled citizens are affected due to its intricacy and high expenses on this technology. Additionally, Graphical User Interface (GUI) is much preferred to be implemented in this system for controlling and monitoring the sensors and actuators. Therefore, such an ideal solution is to utilize a web server, since a single website can be accessed by users on a wide range of mobile devices, while mobile applications require the development of individual versions for each kind of mobile device. As long as these devices have internet connection, users may operate their home appliances from laptop, tablet, or even a smart TV from any location.

By merging sensor-based home equipment with a website interface and user-manual buttons, this project aims to create a smart home system that will improve manual household operation. With this feature, users will be able to read sensor data and control actuators over the BLYNK application just by connecting to the internet, improving the efficiency and effectiveness. Through this application, the user will be able to check weather conditions and operate the fan and light. Additionally, a water sensor is utilized to determine whether it is raining so that the retractable roof will be closed if necessary. People with impairments and elderly will particularly benefit from this IoT based Smart Home System, as will the general public.

Chapter 2: Scope

The aim of this project is to develop a smart home system. The whole system is built with a combination of multiple types of sensors, those sensors will reflect the action with the actuator. The smart home system is a retractable roof, and with weather monitoring features. The weather monitoring system is controlling the roof, deciding whether the roof should be retracted or not. Meanwhile, in order to improve user experience, a led light and fan are added too.

The roof is built with a flexible waterproof material, which can withstand long periods of bending and exposed under the sunlight. The roof is retracting by the movement of the dc motor. The dc motor is controlling the gear to move the string to control the movement of the roof. To ensure the smoothness of the movement of the roof, the roof is connected to the wheel.

The device that is used to give command to the system is NodeMCU, ESP 8266. The data of the weather monitoring system is displayed by a mobile phone application, BLYNK. Besides that, the roof, led and fan can be controlled by the BLYNK application too. The BLYNK application is a web-based application that pairs with the NodeMCU through WIFI connection.

Chapter 3: Objective

The proposed IoT based smart house system in this project is developed to solve the problems of existing smart house systems that are not user friendly enough to certain groups of people. Additionally, this system is developed due to the problem of existing mobile applications requiring separate versions of applications and different types of operating system.
Therefore, the objectives of the project are listed as below:

1. To prevent wastage of electricity by turning off devices and appliances when unattended.
2. To reduce human efforts
3. To track real-time weather conditions

Chapter 4: Methodology

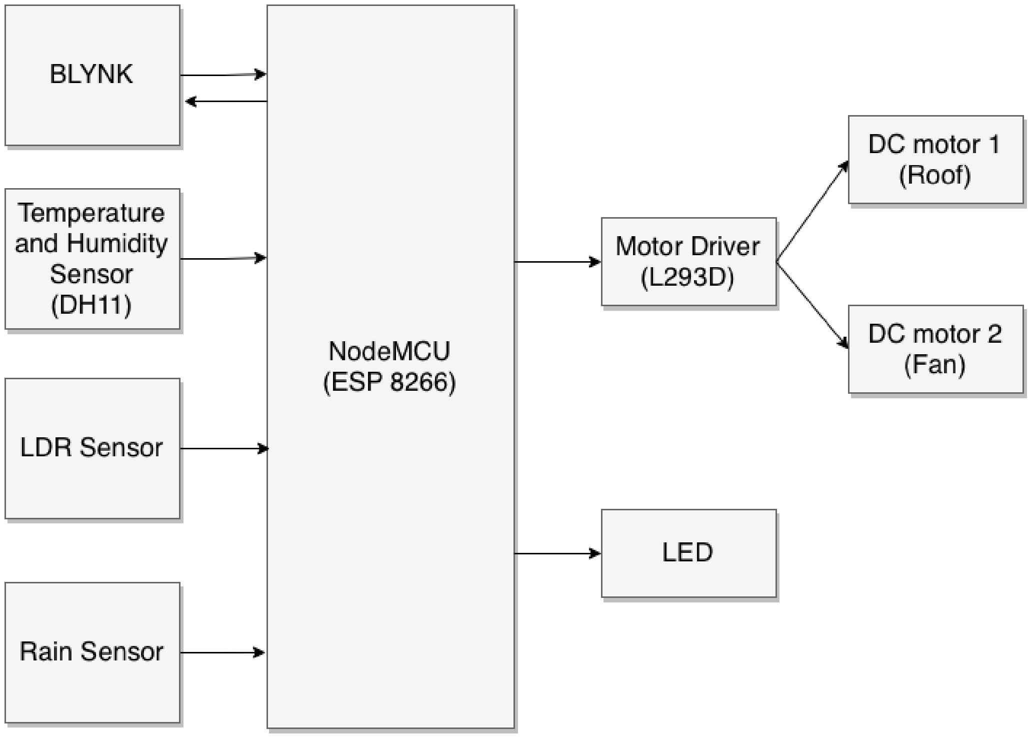


Figure 4.1: Smart Home System Block Diagram

There are 4 inputs and 2 outputs in this system, they are controlled by the NodeMCU. The BLYNK is used to control the output manually and it is also used to display the sensor's output. Outputs received by the BLYNK are surrounding temperature and humidity values detected by DH11, presence of light detected by LDR sensor, and presence of rains detected by rain sensor. There are two outputs, the first output is the motor driver which is used to control the movement of the DC motor. There are two dc motors connected to the motor driver. One of the dc motors is a fan, another one is the actuator of the roof. Then the other output is the LED lights.

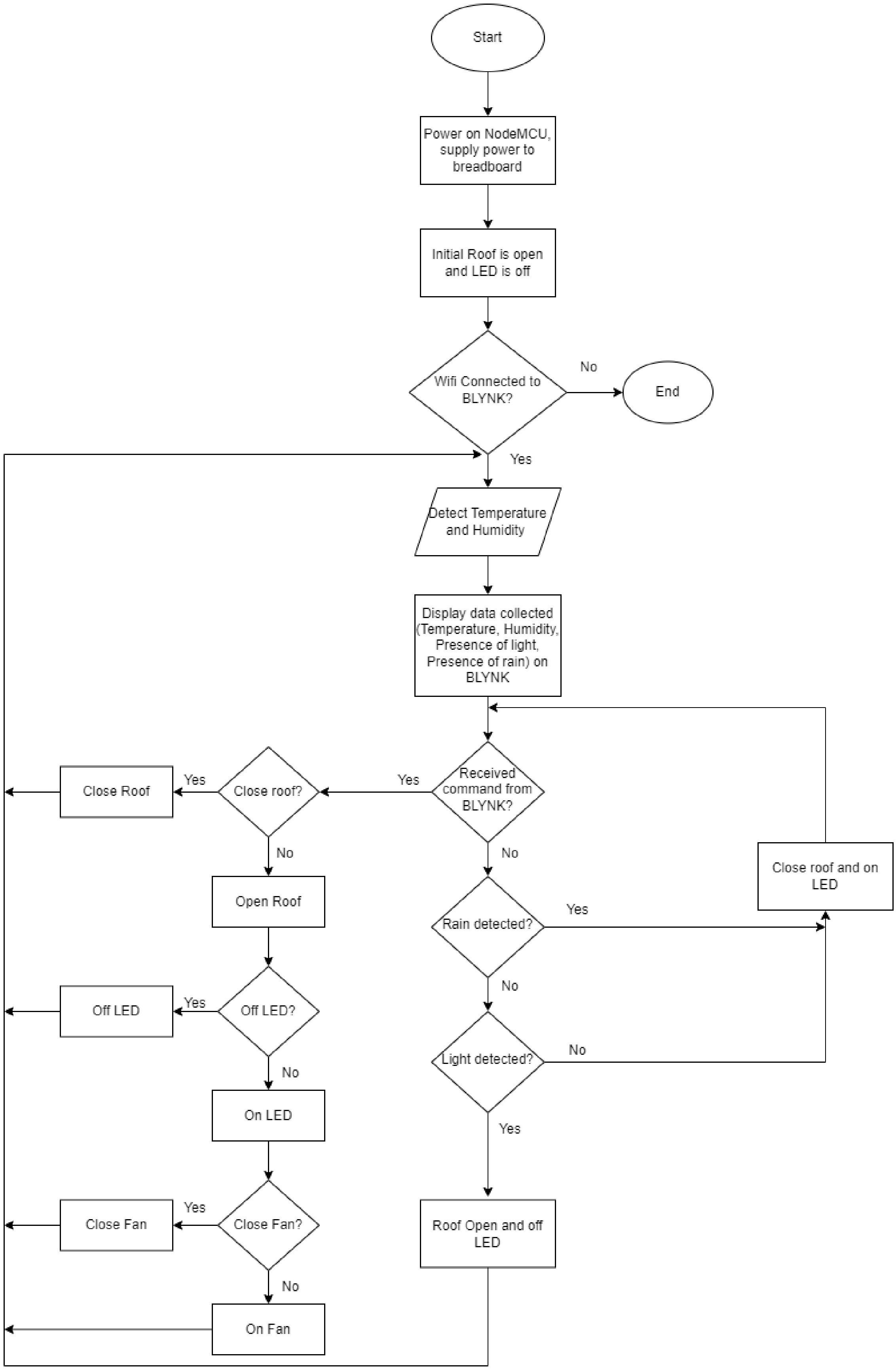


Figure 4.2: Flowchart of the system

Based on the figure 4.2, it is the working flowchart for the system. The first step we need to do is supply power to all the sensors, components and nodeMCU. The initial state of the roof will stay open and the led is in off state. Once the nodeMCU is powered up, we have to wait for the BLYNK app to connect to the nodeMCU through WIFI connection. The connection status can be monitored through the BLYNK app. Then the DHT-11 temperature and humidity sensor will detect the surrounding temperature and humidity. The data will be sent to the BLYNK app and displayed on it. After that, the system will check whether the user is sending a signal as input on the BLYNK app.

If the user didn't input anything, the system will go to automatic state. The automatic state means the output of the system depends on the rain sensor and LDR sensor. When the rain sensor detects rain, the system will activate the dc motor to close the roof and switch on the LED. Same goes to the LDR sensor, when the sensor did not detect any light, the system will control the dc motor to close the roof and switch on the LED. When the rain sensor does not detect rain or the LDR sensor detects the presence of light, the roof will remain open and the LED will remain off.

When the user is inputting a signal from the BLYNK app, the system will change to manual state. That means the output of the system can be controlled manually. There are buttons assigned on the BLYNK app. Users can control the roof on and off by pressing the assigned button, same with the LED too. The fan can only be controlled through the BLYNK app.

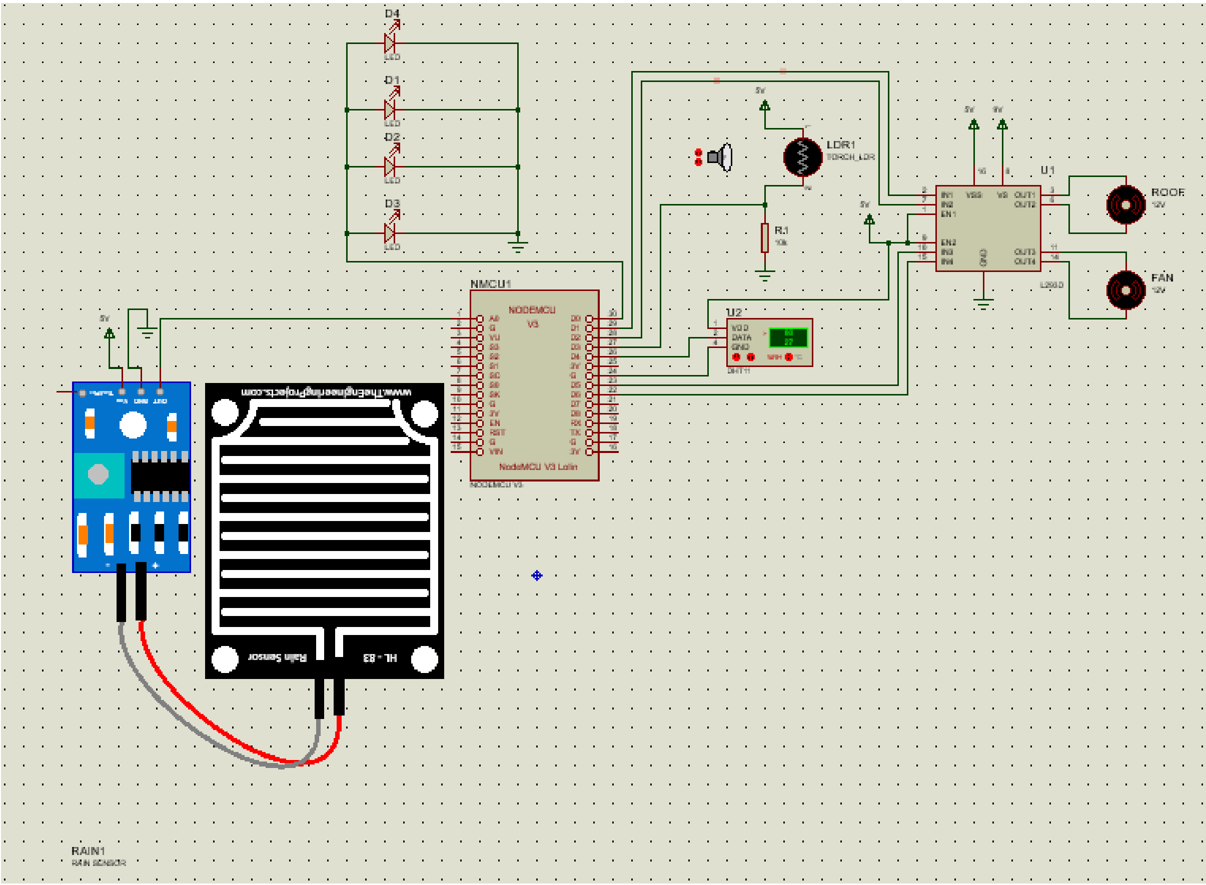


Figure 4.3: Schematic Diagram of the system

Figure 4.3 shows the schematic diagram of the system. The diagram is plotted with Proteus 8. There are not many calculations involved in this system design since all the components are having a safe working voltage. Therefore not much modification is needed, just connect the components directly to the microcontroller. Four of the white LEDs connected in parallel, the nodemcu pin is supplying 3V, therefore each of the LED is getting 3V supply voltage which is in safe working voltage. So no extra resistor is needed for the LED.

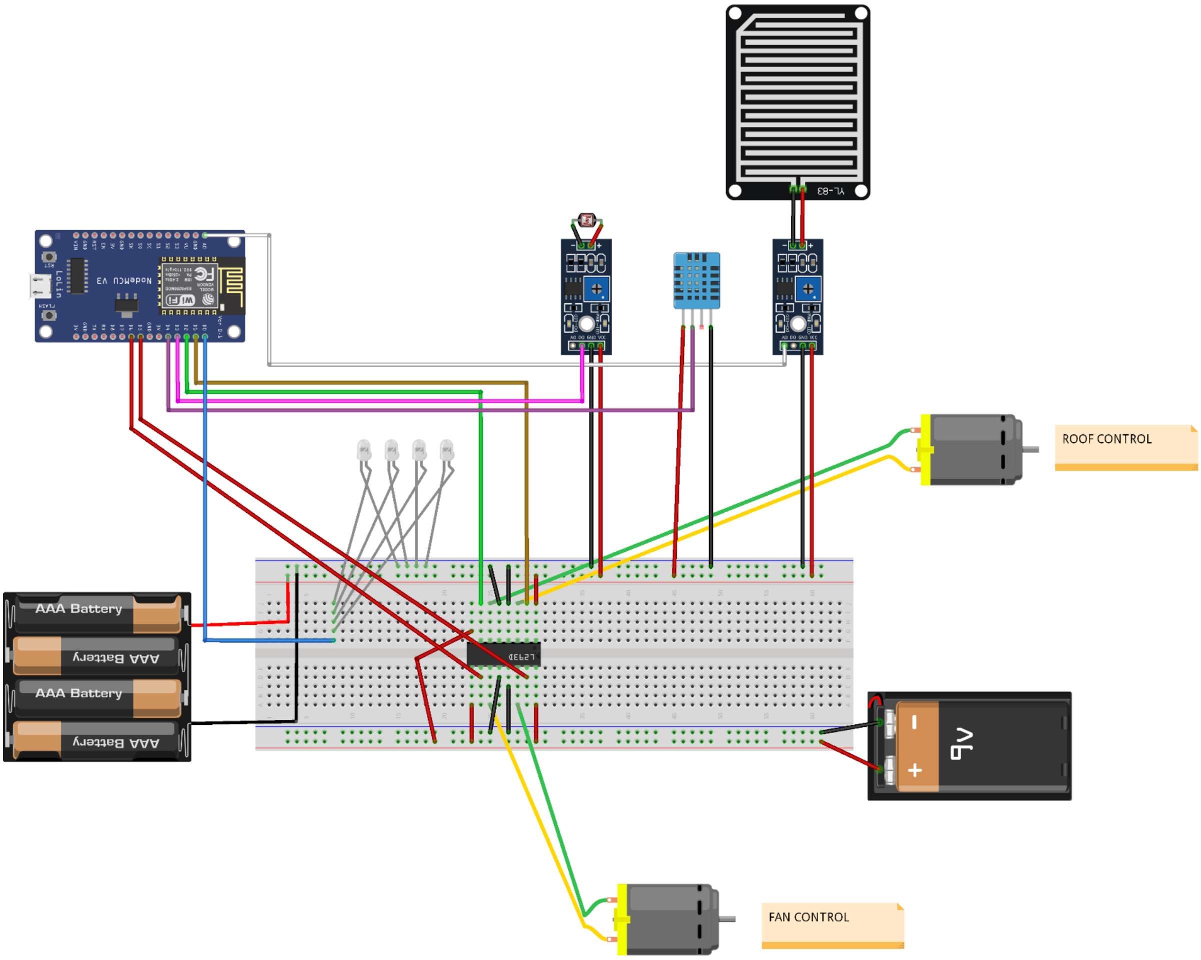


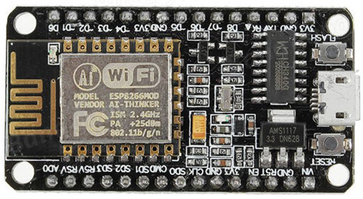
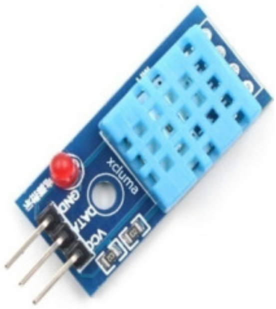
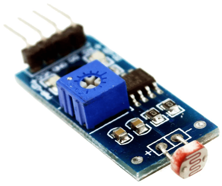
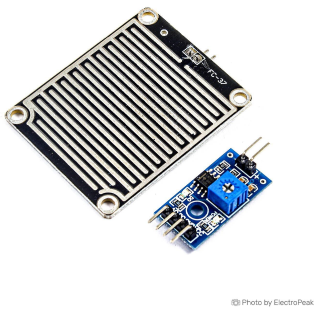
Figure 4.4: Drawing of the circuit

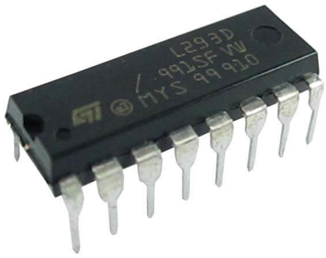
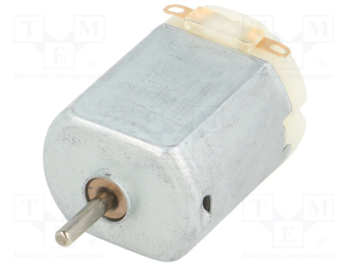
Figure 4.4 is the drawing of the circuit, which is drawn by using the fritzing software. The purpose of the drawing is to show a clearer view of how the actual circuit will be connected. All components are connected based on the Table 4.1 specification table, to ensure all components are working in a safe voltage range to avoid damage to the components. From the figure 4.4, the 9V battery is added just for the motor driver. It is because the motor requires a lot of voltage to operate. The voltage can be increased until 36V to maximise the performance of the dc motor. But for the 4.8V battery, it meant to be fixed at the voltage. This is because most sensors are having the maximum working voltage at 5V. If more than 5V is supplied to the sensor, the sensor might be damaged and not working properly.

Specifications of the project

Hardware involved

Table 4.1: Hardware specifications

Name	**Photo of components**	**Specification**
ESP 8266		● The Nodemcu wifi module comprises ESP12E chip (the brain of the module), GPIO pins for easy interfacing, 3.3 Volt Voltage regulator, onboard LED, USB to serial converter IC, USB port, and more.
DHT-11		● Temperature and Humidity sensor ● Detects surrounding temperature and humidity. ● Working voltage = 3.3V - 5V ● Temperature range = 0℃ - 50℃ ● Humidity range = 20% - 90%
LDR Sensor		● Light Dependent Resistor ● Detects presence of lights ● Working voltage = 3.3V - 5V ● Resistance decrease when light detected
YL-83		● Rain Drop Sensor ● Detects presence of rain ● Working voltage = 5V ● Resistance decrease when rain drops on the sensor

L293D		• Motor driver • Control rotating direction of DC motor • Working voltage 4.5V - 36V
DC motor		• Control movement of roof • Control movement of fan • Working voltage = 3V - 12V • Maximum rpm = 170 rpm
White LED		• Supply light source • Working voltage = 3V - 3.4V
9V Battery		• Supply power to motor driver
5V Power supply		• Supply power to sensors

Software involved

Blynk

Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, visualize it and do many other cool things.

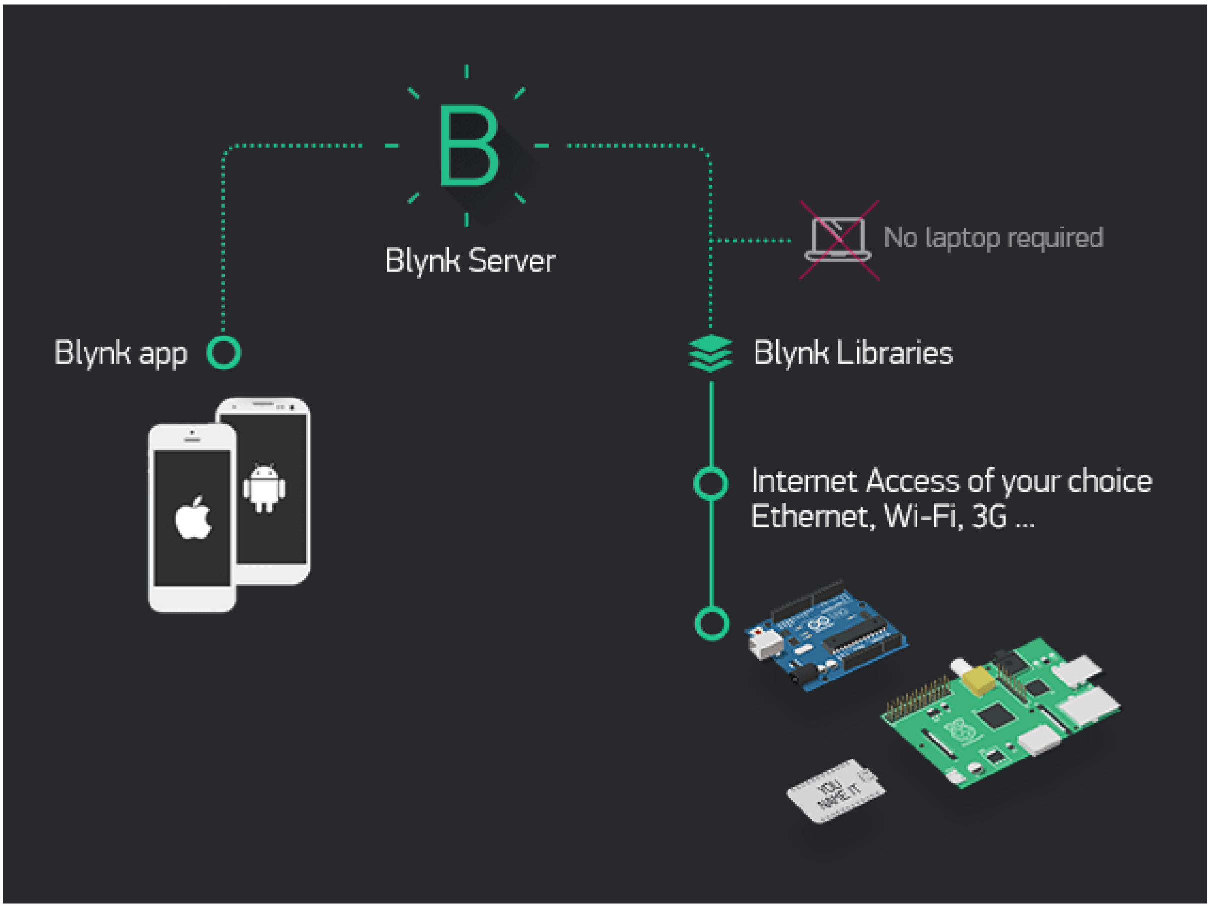


Figure 4.5: BLYNK software

There are three major components in the platform:

- **Blynk App** - allows us to create amazing interfaces for your projects using various widgets we provide.
- **Blynk Server** - responsible for all the communications between the smartphone and hardware. We can use the Blynk Cloud or run your private Blynk server locally. It's open-source, could easily handle thousands of devices and can even be launched on a Raspberry Pi.
- **Blynk Libraries** - for all the popular hardware platforms - enable communication with the server and process all the incoming and outcoming commands.

Chapter 5: Result and Discussion

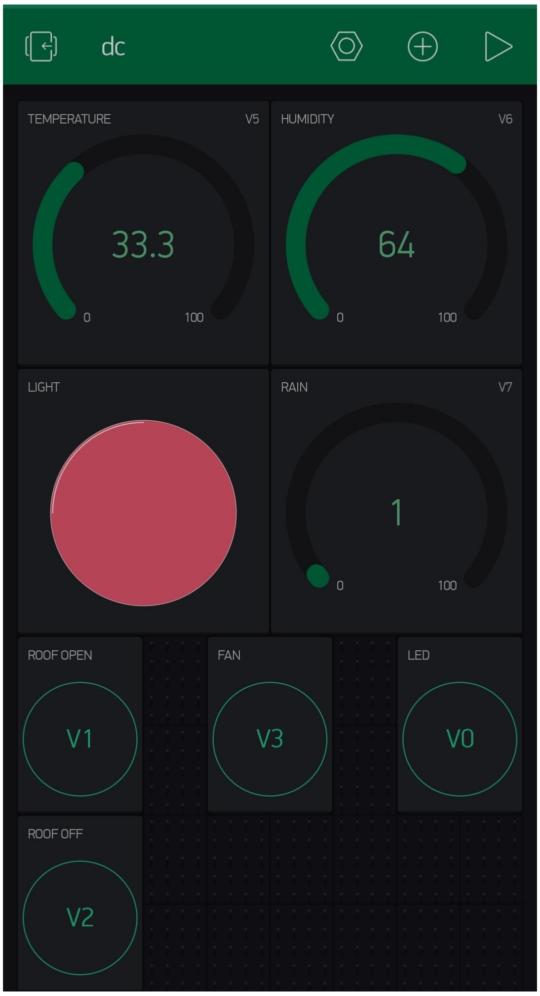


Figure 5.1: BLYNK user interface

From the figure 5.1, the top 4 boxes are displaying the data collected by the sensor. Then those bottom circles are the button or switch used to send input to the system.

Figure 5.2: Temperature and humidity display

Figure 5.2 shows the temperature and humidity value that was collected by the DHT-11 sensor.

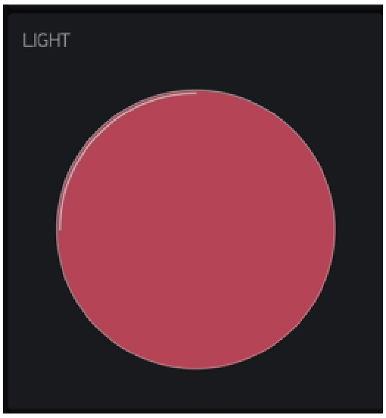


Figure 5.3: Presence of light indicator

About the figure 5.3, it is a virtual LED that was created to indicate the presence of light. The light is detected by the LDR sensor. When light is detected the virtual LED will remain lit up in red colour. If no light is detected the virtual LED will be switched off. This is useful for users because the user does not have to go outdoors and check by him or herself. Just monitor the presence of sunlight through users' smartphones.

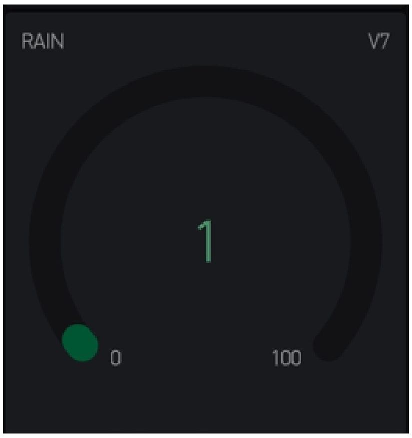


Figure 5.4: Presence of rain drops

Figure 5.4 shows the meter of rain drops that was detected by the rain drop sensor. When no rain is detected, the number will remain at 1. The number of the meter depends on the amount of rain drop on the surface of the sensor. When a certain amount of rain is dropped on the sensor, the number will reach 100 as the maximum number of the meter.

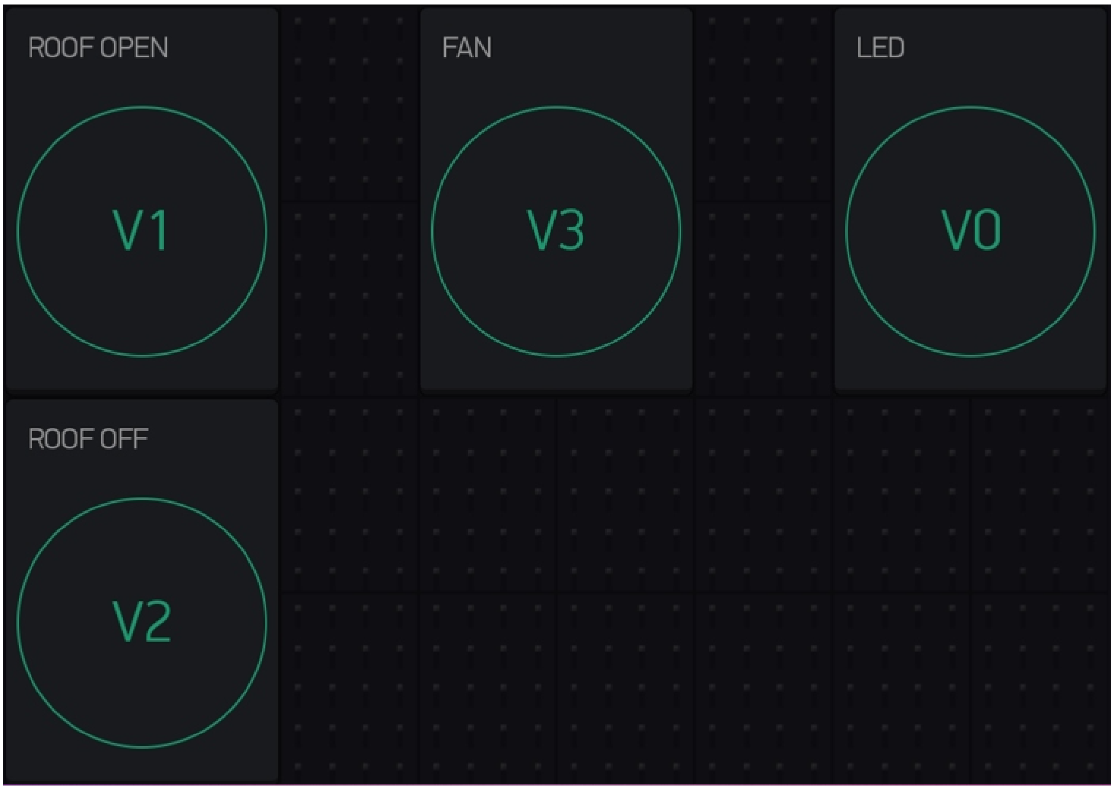


Figure 5.5: Input buttons

Based on the figure 5.5, there are 5 circles which are buttons for the user to send the input signal to the system. Those two buttons on the left are used to control the movement of the roof. Pressing the top button is to open the roof and the bottom button is to turn off the roof. The middle button is used to switch on and off for the fan which is powered by a dc motor. Then the right side button is used to switch on and off of the LED.

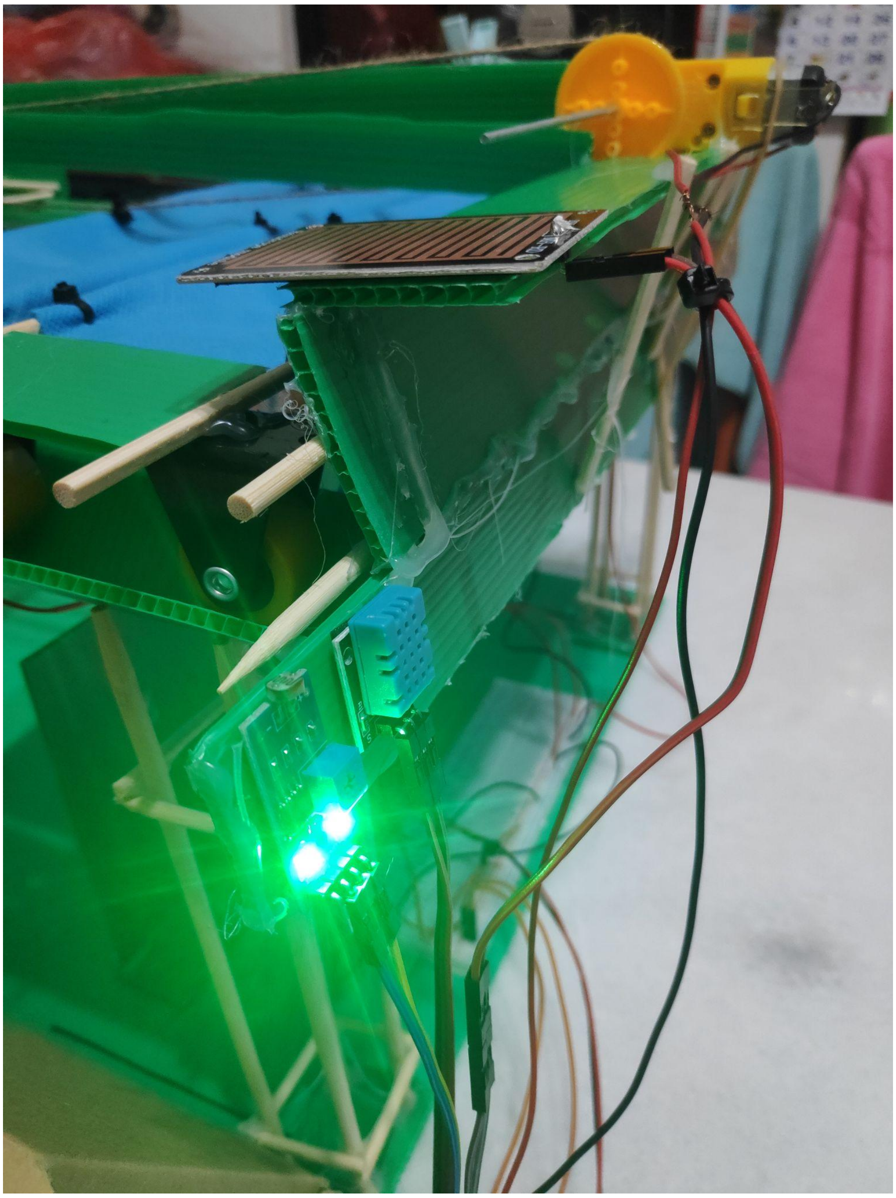


Figure 5.6: Placement of the sensors

Figure 5.6 shows the placement of the sensors. The rain sensor is located at the highest position of the roof, since it can ensure the detection of rain faster and easier. Then for the DHT-11 temperature and humidity sensor and the LDR sensor are located at the side of the roof. This is because both sensors are meant to work in a vertical position. Especially the LDR sensor, the detection area is at the top of the circuit board. All three sensors are supplied 5V voltage, and the data will be fetched back to the BLYNK app.

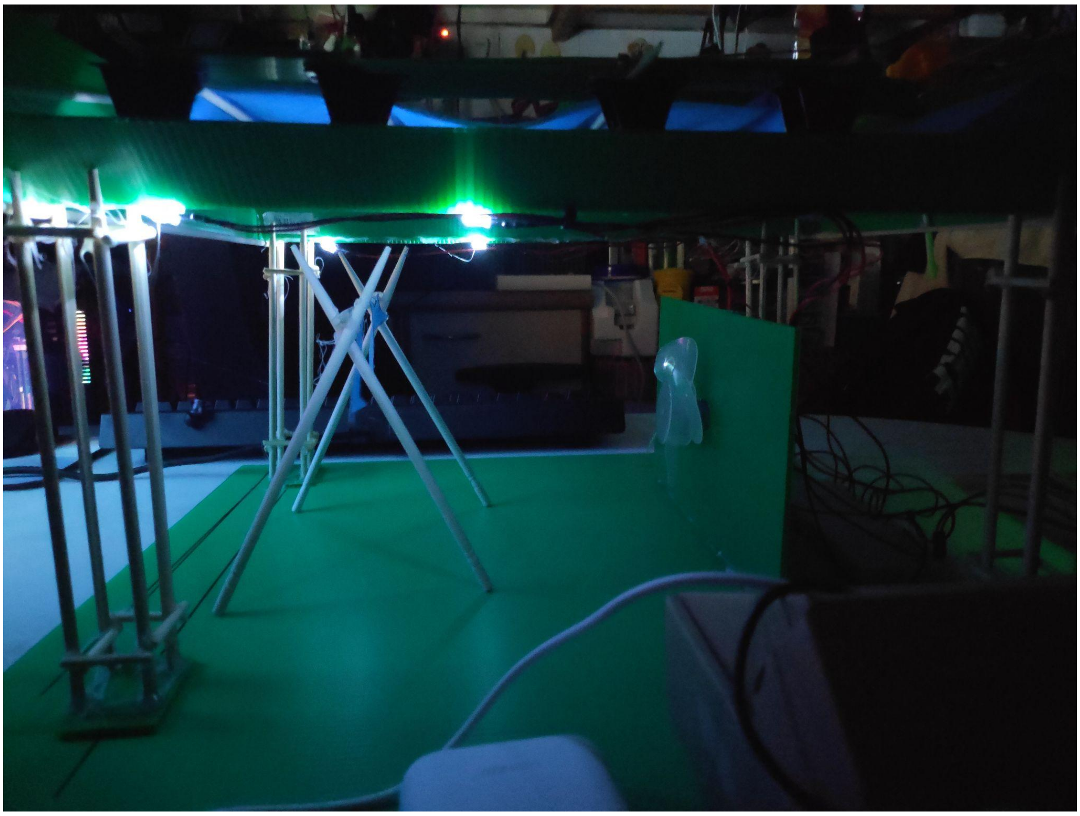


Figure 5.7: Placement of LED and fan

From the figure 5.7, it indicates that the placement of the white led and the fan is controlled by a dc motor. There are a total of four white LEDs attached during the roof. The purpose of the white LED is to provide a light source when the surrounding is too dark. The fan is used to reduce the humidity of the room. For our case, the room is used to dry clothes, so the fan can dry the clothes even during the rain or night time.

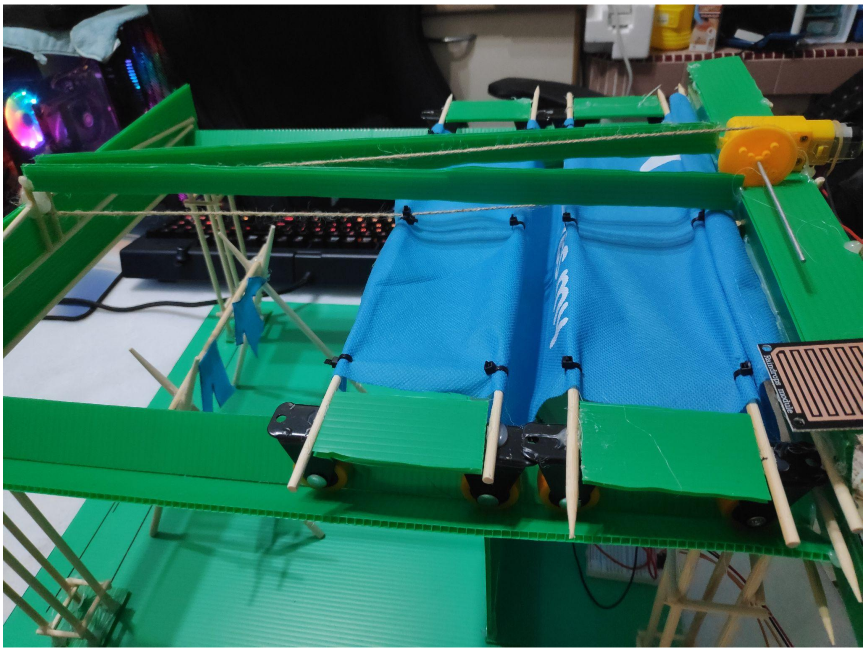


Figure 5.8: DC motor controlling roof

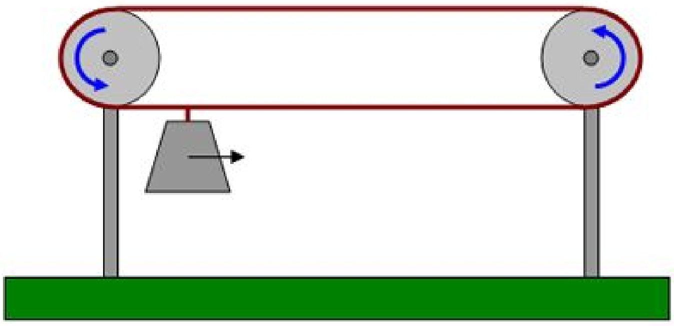


Figure 5.9: Roof moving mechanism

Figure 5.9 shows the working concept of the roof moving mechanism. In our case, the load in the figure is the roof connected with wheels. So the dc motor shown in the figure 5.8 is the force that is used to move the load. The roof is not that heavy, therefore one dc motor is enough to control the roof. The rotation direction of the dc motor determines the movement of the roof. In our case, when the dc motor is moving in an anticlockwise direction, the roof will be shutted off. When the dc motor is moving in clockwise direction, the roof will be opened.

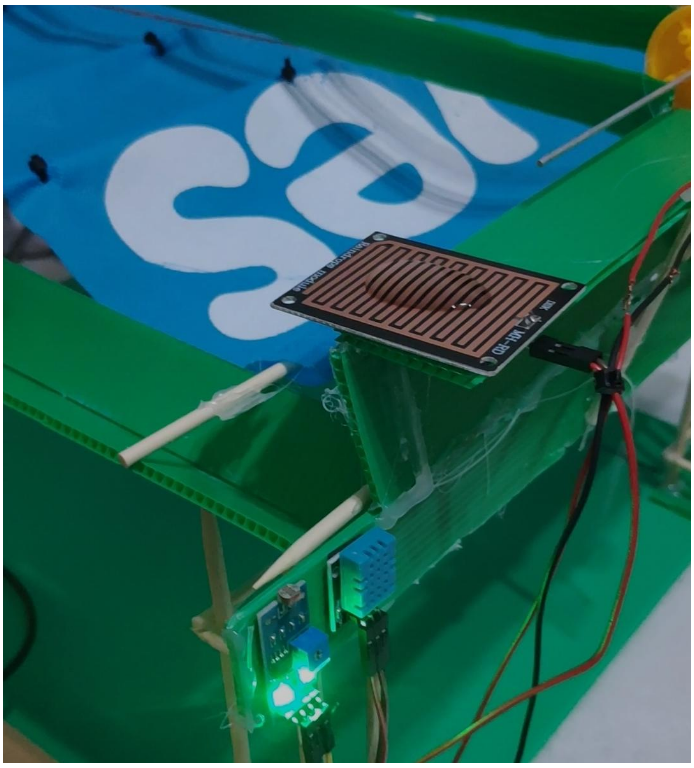


Figure 5.10: Raindrops on the rain drops sensor

Figure 5.11: Roof close when rain detected

The figure 5.10 shows when the raindrops fall on the rain drops sensor. When the sensor detects water, the roof will be fully closed and switch on the white led which is shown in figure 5.11. The roof will be opened back once the water on the sensor is wiped off with clothes.

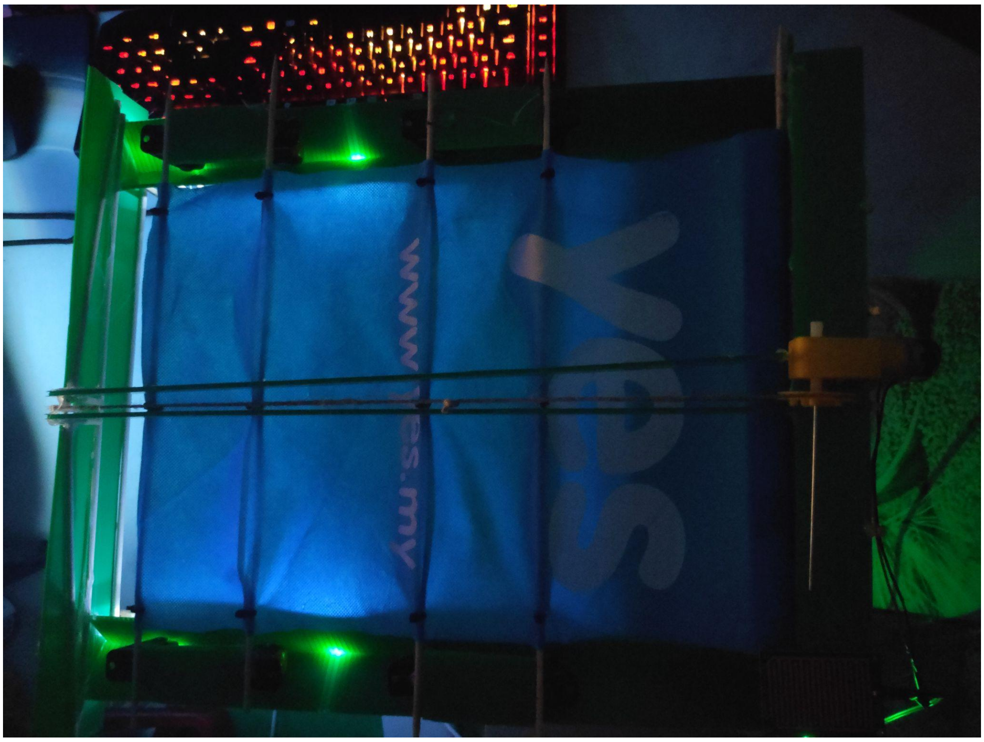


Figure 5.11: Roof close during night time

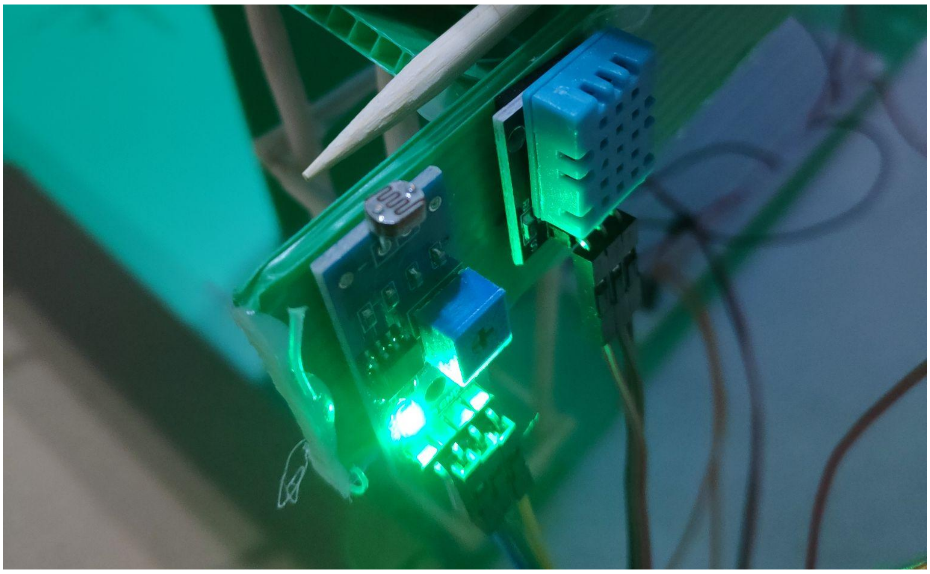


Figure 5.12: LDR sensor used to control roof

Figure 5.11 shows the roof status during night time, that means when the LDR sensor did not detect any light, the roof will close and switch on the white led.

Figure 5.13: Fan feature

Figure 5.13 shows the fan that is controlled by a DC motor. The fan can only be controlled manually through the BLYNK app on a smartphone. This is because the dc motor is connected to the same motor driver. The limitation of the motor driver caused the fan can’t work simultaneously with the roof moving dc motor. The purpose of the fan is used to reduce the humidity of the room, hence for a clothes drying room, it can help to dry the clothes even when no sunlight or raining day.

Chapter 6: Conclusion

In summary, the appliances of the smart house system that are developed using the BLYNK application are successful. The NodeMCU ESP8266 microcontroller acts as the bridge for users to read the input and control the output of the devices wirelessly. Users are also allowed to manually control the fan, light and the roof. Besides, users are also able to read the values of the temperature and humidity, and the presence of the raindrops. The proposed project helps users on controlling the smart house appliances in a mobile application platform without having to physically switch on and off the appliances. This will bring convenience and efficiency to the elders and disabled citizens.

Chapter 7: Future Work

For future work, more features such as surveillance cameras. The convenience and safety possibilities are also one of the concerns in smart home system research. For instance, with the development of Artificial Intelligence and Facial Recognition technology, remote security monitors can be applied in this smart home system. Smart Door Locks can also be applied in the smart house system, bringing the physical door locks to go keyless. Besides implementing keypads as door locks, there are other methods such as biometric fingerprint scan and smartphone apps.

Reference

Smartphone controlled Rover IOT robot using NodeMCU(ESP8266) DIY Kit. Superkitz. (n.d.). Retrieved February 5, 2022, from https://www.codes.superkitz.com/internet-controlled-rover-iotinternet-of-things-robot-using-blynk/

SriTu Hobby. (2021, October 7). IOT based weather monitoring system using NODEMCU and Blynk. SriTu Hobby. Retrieved February 5, 2022, from https://srituhobby.com/iot-based-weather-monitoring-system-using-nodemcu-and-blynk/

14 Types of Smart Home Technology Options (Ultimate Guide). Retrieved February 5, 2022, from https://www.homestratosphere.com/smart-home-technology-ultimate-guide/

Appendix

Datasheet:

1. Rain Sensor- https://urolakostapk.files.wordpress.com/2016/10/yl-83-rain-detector-datasheet_low.pdf
2. DHT-11- https://www.mouser.com/datasheet/2/758/DHT11-Technical-Data-Sheet-Translated-Version-1143054.pdf
3. LDR sensor- https://components101.com/sites/default/files/component_datasheet/LDR%20Datasheet.pdf
4. L293D- https://www.ti.com/lit/ds/symlink/l293d.pdf?ts=1644027236638&ref_url=https%253A%252F%252Fwww.ti.com%252Fproduct%252FL293D%253FDCM%253Dyes%2526utm_source%253Dsupplyframe%2526utm_medium%253DSEP%2526utm_campaign%253Dnot_alldatasheet%2526dclid%253DCOO0hNC-5_UCFQSHZgIdur8J7g
5. ESP 8266- https://components101.com/sites/default/files/component_datasheet/ESP8266-NodeMCU-Datasheet.pdf

Demo Link: https://youtu.be/VUZKHC9OSA0