UNIVERSITY OF ENGINEERING AND MANAGEMENT, KOLKATA

ELECTRONICS AND COMMUNICATION ENGINEERING

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Introduction

A smart home system is defined as a collection of sensors, actuators, communication devices, and computing devices that are connected to each other to provide homeowners with services and applications (e.g., safety and security, automation, entertainment, and energy management) with a minimum or no intervention. However, smart home safety and security systems are in high demand and always needed for many reasons including people's desire to feel safe in their own houses and to avoid a high rate of crime. Additionally, recent advancements in the Internet of Things (IoT), pocket-size microcontrollers, and inexpensive sensors/actuators have provided many opportunities to enable safety and security in smart homes. Safety and security systems are employed to monitor indoor environments to provide homeowners with live updates and alarms when harmful situations may arise while they are far away. The aim of these systems is to interpret the sensory data collected (via sensors) from the surrounding environment to issue alarms or to carry out some appropriate actions (via actuators) against unwanted events. For instance, fire in homes could occur for a number of reasons, such as the burning of materials, gases, and electrical circuits, which could cause serious accidents. A communication medium is required to interact with these systems. Wireless communication, such as the Global System for Mobile Communications (GSM), Bluetooth, and WiFi, is widely used in this context. Of course, the selection of the appropriate communication medium is subject to a number of factors, including the cost, range, and technical specifications.

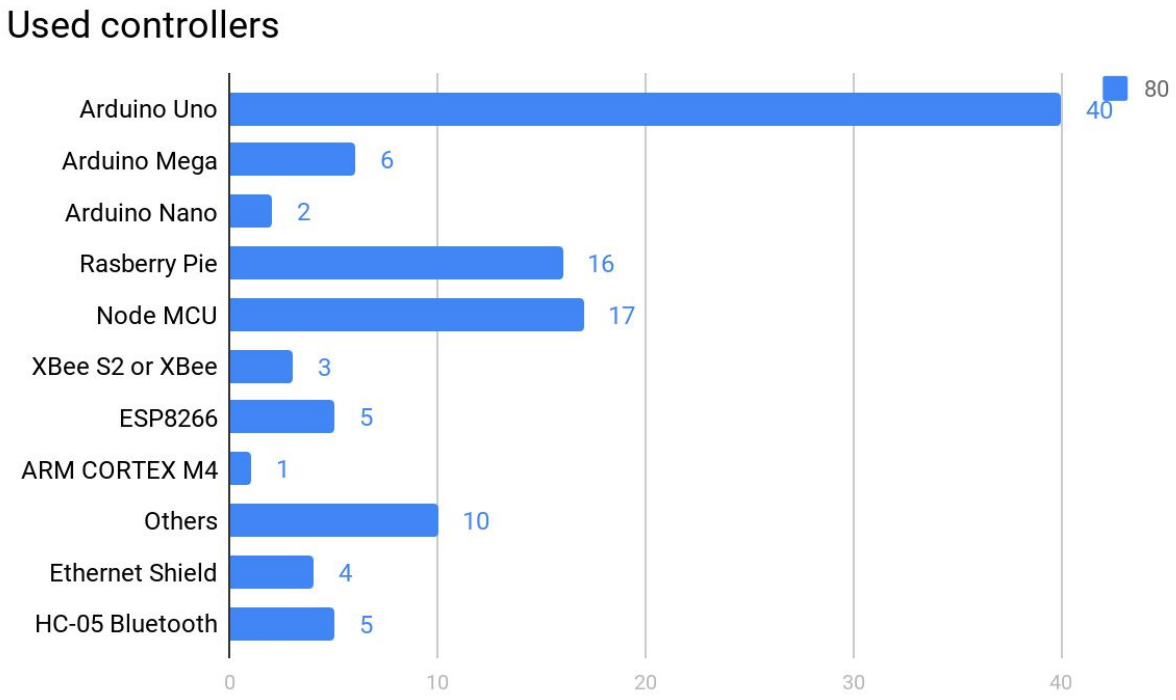
Literature survey report

For the purpose of our final year project work, we have done a literature survey over IoT based home automation, security, energy management, and safety. We gathered a huge amount of research and project works from some popular sites *(IEEE Xplore, IJSER, Researchgate, Creat Arduino, Google Patents, etc.*), which are done before and tried to come over with a new idea to pass through those difficulties, which were faced by the previous workers.

A survey of 80 papers is presented here.

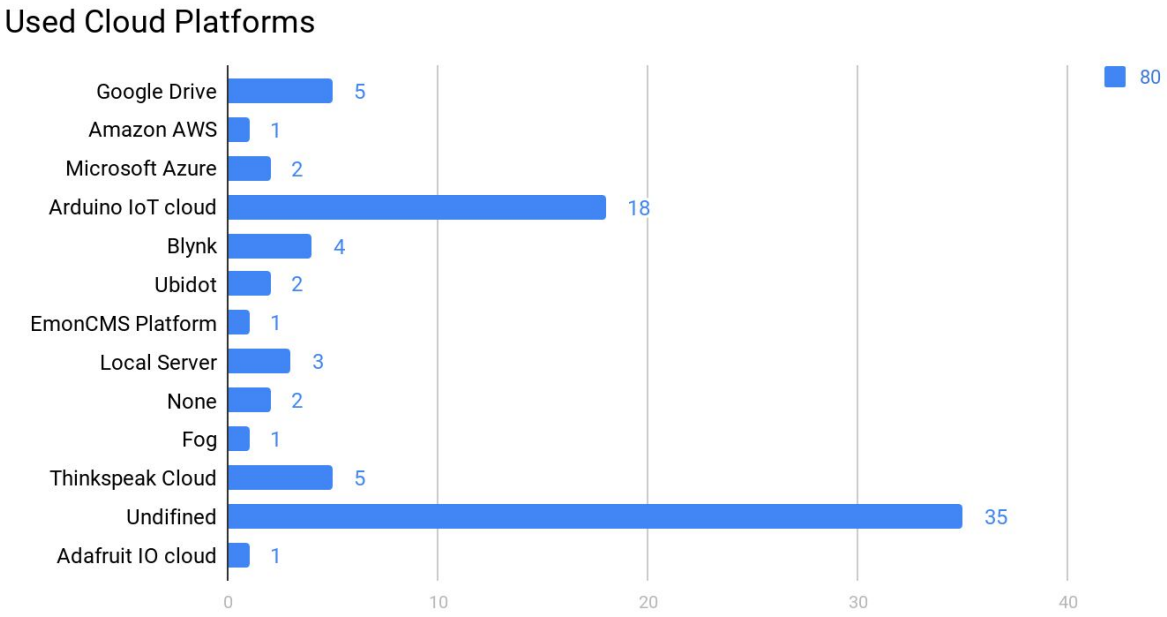
Some visual charts are given here for the batter understanding

1. Most used Controller Boards



The above bar chart is showing the popularity of some micro-controllers. From here we can get a rough idea about the useability of those micro-controllers.

2. Cloud Platform

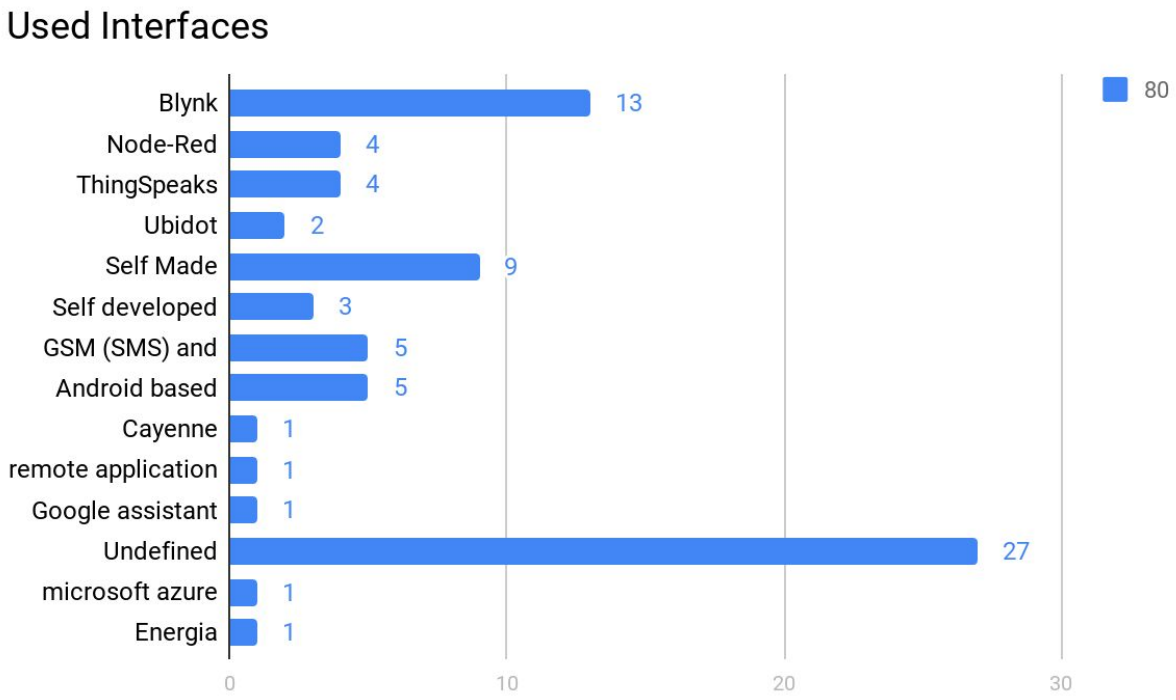


The above bar chart is showing the popularity of some Cloud-platforms. From here we can get a rough idea about the useability of those Cloud-platforms.

The cloud-platform is a very important part of IoT systems, as it stores all the values and the readings of the sensors of an automation system. It also presents the data to the user through a user interface. This user interface can be a web-page or an application or a GSM-based system.

The user interface is the gateway of the user and the Automation system. The user interface is used to visualize the data and to give commands to the system.

3. Used User Interfaces



The above bar chart is showing the popularity of some User-Interfaces. From here we can get a rough idea about the useability of those User-Interfaces. Some of them are applications, some of them are web-pages, even some of them are GSM-based systems.

The survey showed us that most of the previous work is done over remotely controlling home appliances and monitoring the environment's parameters through the Internet or GSM-based service.

Some of those projects are about the safety of houses and households. These projects are mainly based on temperature, gas, fire, and photosensors. The majority of those projects are monitoring and taking action through the interface on a user basis. Very few projects are able to

act autonomously while informing the user. One of those projects can turn off the electrical mainline and turn on the exhaust to avoid fire accidents against gas leakage. Some projects can inform the nearby fire station about the fire accident. The main approach of those projects is real-time leakage detection and updating.

Some projects are about controlling the energy usage of daily life. One of those projects can activate sleep mode when the system will not fetch any kind of data to save energy. Here also the majority of projects are about monitoring the electric usage and notify the user. One of those projects can use solar energy as its power supply rather than relying on the main power supply.

Some projects are about home security from intruders. Some of those are really interesting as a system can differentiate human behavior from any other motions and can inform any unnatural movement to the user, through the online app and also by activating the fire alarm. Some of those are about capturing the intruder through a camera module and sending it to the admin or storing it on the server. One system is password driven as 3 times the wrong password will lead to an alarm and also raise an alarm for the intruder who has bypassed the password system by destroying it or anything else.

The majority of those projects are about remotely controlling home appliances over the internet. Devices are controlled by a microcontroller, which is connected to the internet over WiFi and can be controlled by the user, remotely from all over the world. Some of those are sensor-based, and some of them are user control-based.

Some interesting papers present some unique features like automatic gas booking using a load sensor that is integrated into a smart home. One paper consists of an automatic system that only notifies and can do some basic work by itself. Some projects had a special feature of flexibility, that allows those projects to control any device that is configured by the user itself.

The proposed idea of the system

Our goal is to create a cost-effective, energy-saving, and useful automation system, that will be able to control all appliances(relays) autonomously by depending on sensor readings and also can be controlled through a user interface. The system will consist of a power saver mode that will be activated purposely by the user and this mode will let the total electrical system use only necessary power. The project will have a safety system to prevent fire accidents and will show real-time values of all sensors to the user through the interface. We are willing to use a motion sensor for automatic light and fan(depending on the environment temperature) control to save more energy. For security purposes, we are willing to use RFID for authorized users. The automatic system will reduce human dependency and will be safer for humans as the system will not forget to turn off the water pump or turn on the exhaust of the kitchen or control the daily tasks. The system will be able to work automatically when the user is out of network range. Automatic light and the control of an appliance will certainly reduce the chance of intruders. While the user is not reachable, the system will take immediate action about the situation and will try to inform the user through email service.

Progress made in the project

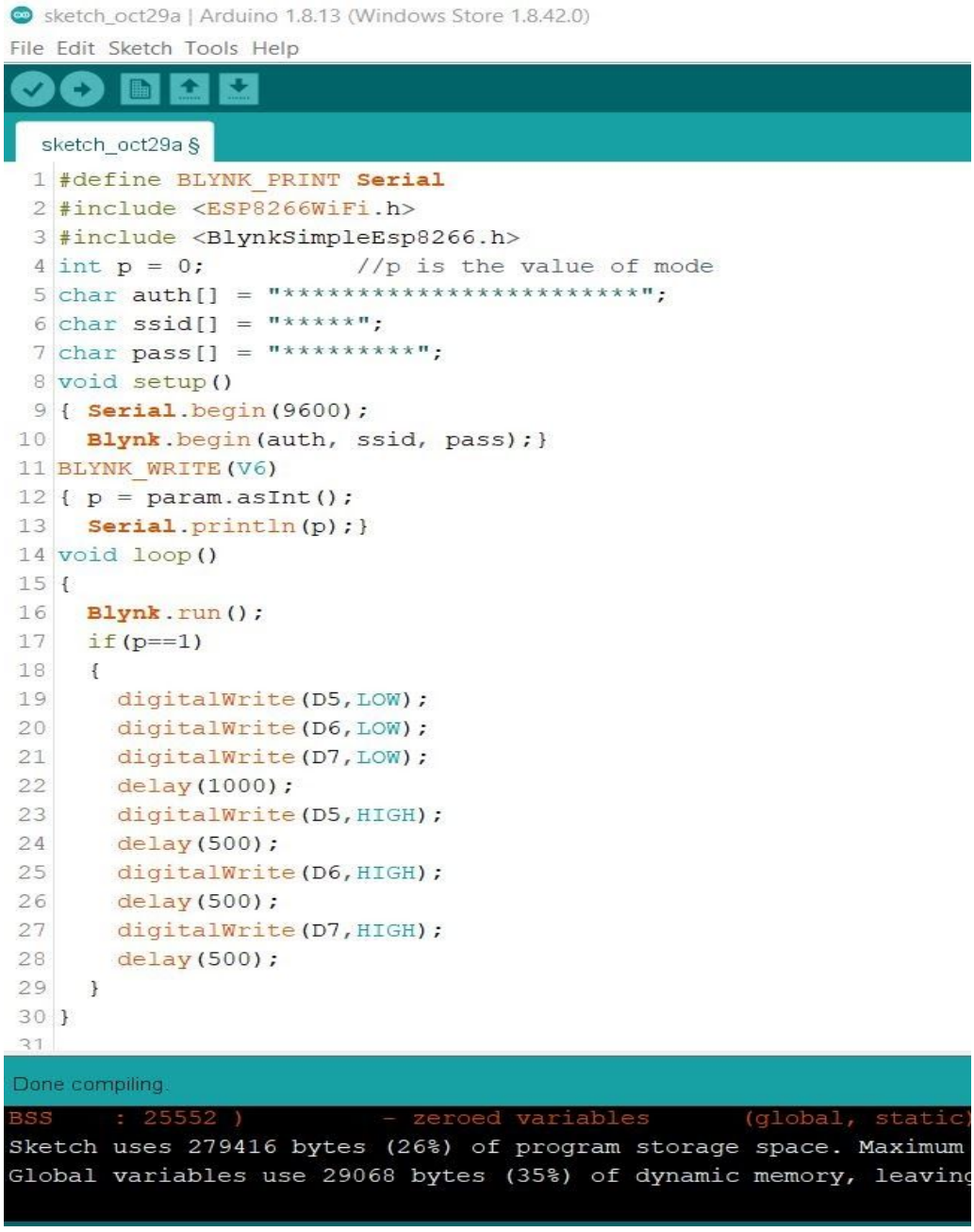
Till now research is going on over the idea and we are looking for any further modification over the project. Though the research is going on, the team is also working on the project on a mini scale. We got success in 2 objectives, and we are looking forward to inducting them together. objectives' progress is shown below.

- Mode Shifting Through Blynk app

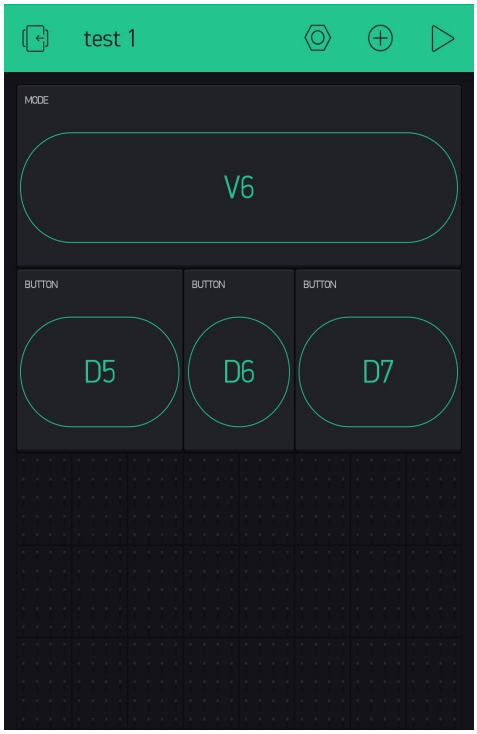
We have successfully tested the mode shifting between automatic and manual mode. The test was conducted over NodeMCU and with the help of Arduino Ide.

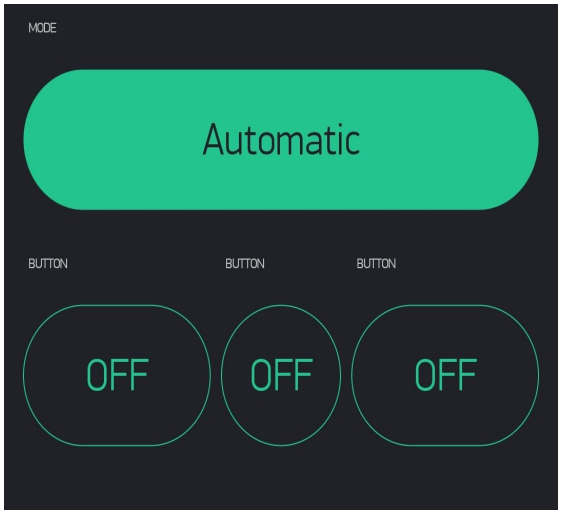
In the test, there are 3 LEDs, which are going to be turned on and off. We have used a virtual button from the Blynk app and assigned it to a variable with the help of the code, and used that value as the mode indicator. By the value of the variable, if the mode is automatic then the system will turn on every LED with a .5 second delay and turn off all once all are turned on and the cycle will continue. Else if the mode is manual then all LEDs will be controlled through the switches of the Blynk app.

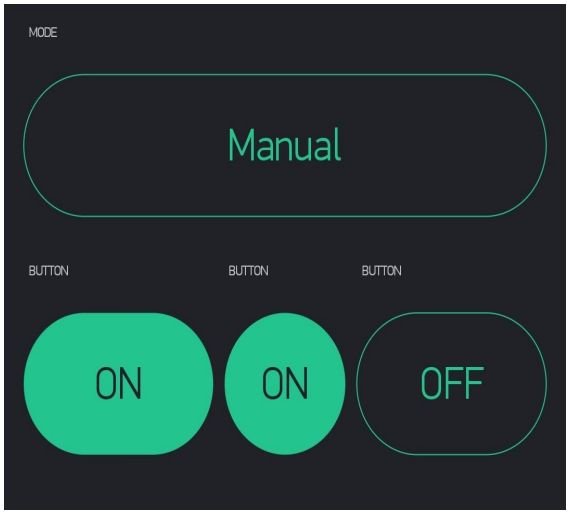
The code is given below.



Blynk app interface and configuration.







- Feeding back the real-time relay status to Blynk app

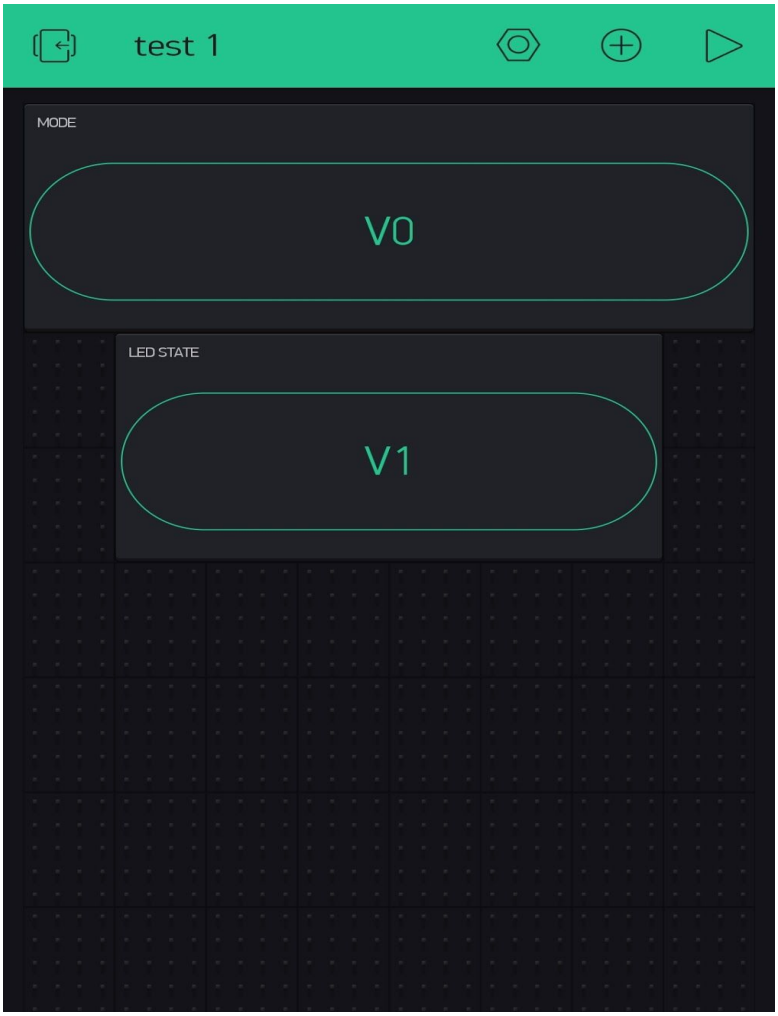
We have also successfully tested the feedback to the Blynk app from the physical circuits. All the switches are assigned over virtual pins from the app. A physical push-button is used to control the LED physically. After failing several times we have fused the idea with the mode shifting idea. We made the feedback active in automatic mode when the Relays(LEDs) are controlled autonomously over the sensors(physical push-button for the test). Though, in manual mode, all the LEDs will be controlled from the switches of the Blynk app.

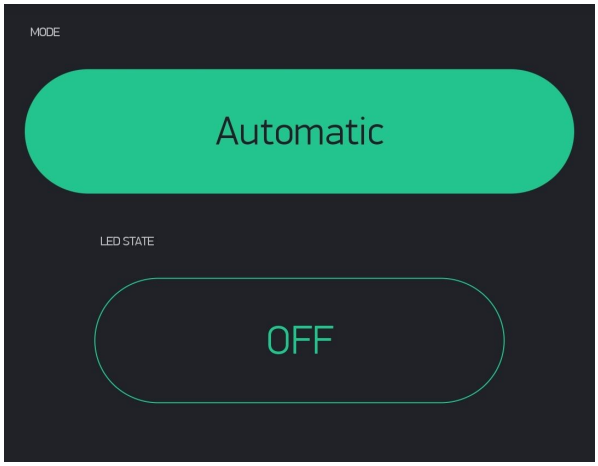
The code is given below.

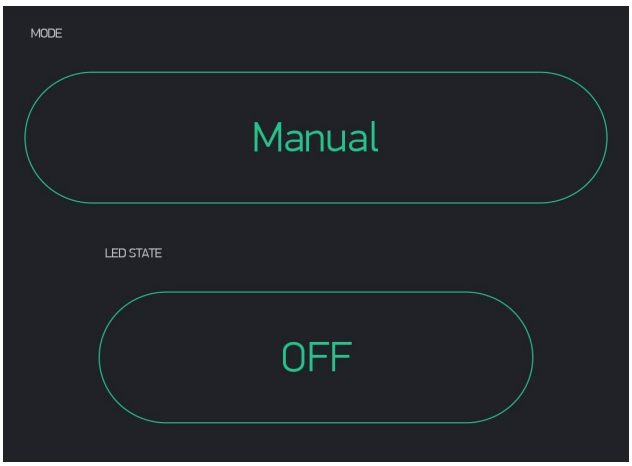
feedback_test_success_1 §

```
#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>

char auth[] = "**********************";
char ssid[] = "******";
char pass[] = "**********";

const int button = D2;
const int led = D5;
int m = 0;       // value of mode
int p = 0;       // value of LED's state
#define vbutton V1

BLYNK_WRITE(V0)
{
  m = param.asInt();
  Serial.println(m);
}

BLYNK_WRITE(V1)
{
  p = param.asInt();
  Serial.println(p);
}

void setup()
{
  Serial.begin(9600);
  Blynk.begin(auth, ssid, pass);
  pinMode(button, INPUT);
  pinMode(led, OUTPUT);
}

void loop()
{
  int b = digitalRead(button);
  Blynk.run();
  Serial.println(b);
  if(m==1)
  {
    digitalWrite(led, digitalRead(button));
    Blynk.virtualWrite(vbutton, digitalRead(led));
  }
  else
  {
    digitalWrite(led, p);
  }
}
```

Blynk app interface and configuration.







- Establishing communication between two microcontrollers

Now we are trying to establish communication between microcontrollers, so that a single sensor can be used to read environmental conditions and the total project can be made more cost efficient and maintenance easy.

To establish the communication we are trying to use the virtual pins of the Blynk app. One microcontroller can be dedicated to all types of sensors, then the sensor data can be uploaded to Blynk server. Through the virtual pin configuration, other microcontrollers should be able to read the data from the Blynk server. Thus the project will be more cost efficient and the maintenance will be easier as, to solve any problem regarding sensor data we have to consider only one sensor.

Future planning

In the future, we are willing to integrate some more advanced systems that will help the user to track their daily health and keep a look at their last one-week health conditions. Heart rate, blood oxygen, blood pressure, and blood glucose are in our plan. This system will be connected to the main automation system to make an all-rounder futuristic home automation and will be very useful for daily life as well as emergency conditions. If needed, the system will be able to call for help. We are also planning to add a camera-based face recognition security system for more advanced security. We are also planning to integrate more advanced microprocessors (Like, Raspberry Pi) to the system for better scope of upgrades like integration of machine learning for more advanced Automation and better connectivity with the world. We are interested in upgrading the system to communicate with the users smartphone, smart watch etc for better understanding of the user's needs.

Conclusion

The project is helping us to develop our knowledge regarding IoT and connectivity. IoT is going to be the future of technology and this project is leading us towards the future. This project will let us experience the future but in an affordable way. We will be able to perform our daily works with more efficiency. More secure and easy lifestyle will give us more time to work for our creativity and mental health while attending all of the daily activities.

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