

CAPSENSE BASED TOUCH PANEL CONTROLLED HOME AUTOMATION

An IoT based home

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Abstract: The development of a firmware for a Smart Switch, which can control the on-off of any electrical device at home by using internet. The Smart Switch is connected to internet via Wi-Fi, through a computer, smart phone, tablet or any device with internet access. In order to perform this connection it is necessary to write the IP pre-programmed into the Smart Switch in IoT Cloud with the purpose to load the Smart Switch server, which will open a configuration page to write the data of the user's network. Then, the user will select in manual or IoT mode through Blynk App in smart. Once these information is uploaded and saved, it is necessary to restart the Smart Switch in order to get access to internet, from which the user can control. The demand of touch screen gadgets is improving day by day and has proven reliability. A touch switches apparatus for detecting the presence of an object such as a human appendage, the apparatus having a switch and a local control circuit connected to the switch and to a controlled device. This technology is a unique type of device that allows the user to physically interface with the home appliance other electronic device by touching the screen.

Keywords – Internet of things (IoT), Blynk app, Node MCU, Touch Screen.

I. INTRODUCTION

Today in the headway of Automation innovation, life is getting simpler and less demanding in all spheres. Home automation is a modern technology that modifies your home to perform different sets of task automatically. Today Automatic frameworks are being favored over manual frameworks. No wonders, home automation in India is already the buzz word, especially as the wave of second generation home owners grows, they want more than shelter, water, and electricity. The first and most obvious advantage of Smart Homes is comfort and convenience, as more gadgets can deal with more operations (lighting, temperature, and so on) which in turn frees up the resident to perform other tasks. Smart homes filled with connected products are loaded with possibilities to make our lives easier, more convenient, and more comfortable. The requirement for Office and Home automation arises due to the advent of IoT, in a big way in homes and office space. The smart home/office gadgets interact, seamlessly and securely control, monitor and improve accessibility, from anywhere across the globe. These smart automation devices happen to have an interface with IoT. IoT automation will be the key to bridging the gap between human limitations and technology's capabilities.

The IoT based Home Automation will enable the user to use a Home Automation System based on Internet of Things (IoT). The modern homes are automated through the internet and the home appliances are controlled. The user commands over the internet will be obtained by the Wi-Fi modems. The Microcontroller has an interface with this modem. This is a typical IoT based Home Automation system, for controlling all your home appliances.

The beauty of the Home Automation system lies in the fact that the settings are manageable from your smart phones and other remote-control devices. Smart home IoT devices can help reduce costs and conserve energy. The Home Automation segment includes smart lighting, smart TVs and other appliances. Wearable's (Smart Watch, fitness brands, smart headphones, smart clothing) are also expected to witness the growth in the future. IoT is really the secret that makes this whole system work. Today in India, nearly 22.5 per cent of the consumers surveyed were familiar with the concept of IoT, with maximum awareness seen in the 36-55 age groups which clearly indicates that there is immense opportunity for increased adoption of such technologies.

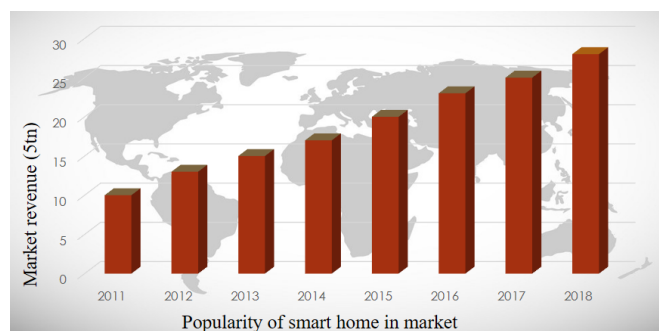


Figure 1 impact of home automation

II. BLOCK DIAGRAM

The block diagram of the capsense based touch panel home automation represents the components that are used and the connections which are made accordingly. The block diagram is depicted in the figure below.

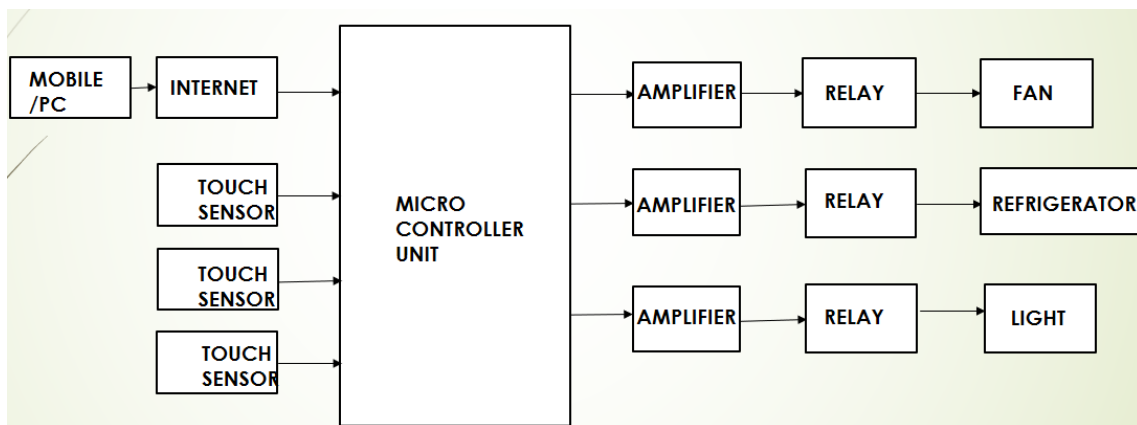


Figure 2 block diagram of capsense based touch panel controlled home automation

The above block diagram consists of the components like touch sensor, relay, nodemcu, amplifier (3.3v to 5v converter). Here touch sensor act as the inputs to the processing nodemcu unit. The power supply is used to supply the necessary power to make the board function. The relays help in automatic switching action which means turning on the home appliances.

2.1 TOUCH SENSOR:

When there is contact with the surface of the capacitive touch sensor, then there exist some change in capacitance in sensor and the circuit is closed inside the sensor and there is flow of current. The measurement circuit will detect the change in capacitance and convert it into a triggering signal.

2.2 NODEMCU:

NodeMCU is an open source 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 "NodeMCU" by default refers to the firmware rather than the development kits.

Memory: 128kBytes

Operating system: XTOS

Developer: ESP8266 Open source Community

Storage: 4Mbytes

2.3 RELAY:

A **relay** is an electromagnetic switch **operated** by a relatively small electric current that can turn on or off a much larger electric current. The heart of a **relay** is an electromagnet (a coil of wire that becomes a temporary magnet when electricity flows through it). The Coil Terminals control the switch. When voltage is applied across the coil it becomes an electromagnet. Its core attracts the switch armature and activates the switch. And diverts power supply to the home appliance connected at end terminal of relay.

2.4 3.3V TO 5V CONVERTER:

Node MCU is IoT ready module and it works on 3.3V only but controlling relay works on 5V so it was a challenges. In this project, 3.3V to 5V converter is designed. Here NodeMCU 5V supply is used to power 3.3-5V Converter from V_{in} pin and 3.3V Supply is used from 3.3V Pin. All GPIO Pins of NodeMCU provide 3.3V logic whenever it is high so it is provided to trigger the BC547 transistor.

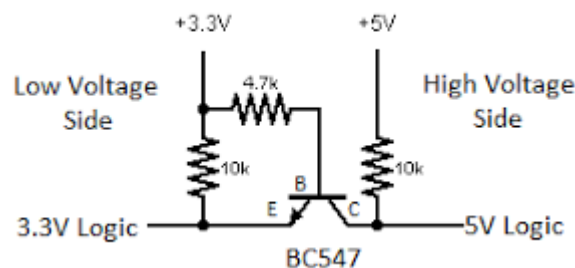


Figure 3 3.3v to 5v converter

III. METHODOLOGY

In this project, two features have been added to keep in mind elderly people who are not well verse with latest technologies like Internet, Wi-Fi and Smart Phones. They feel like old is gold and good but today’s generation can live without technologies because it is a integrated part of their life so they want to use technology everywhere they go. Smart Switch is designed to meet their requirements. Designed Smart Switch is blend of traditional and new technologies to meet the requirement of elders of family and new generation. In this design, One Physical Master Mode and IoT Master Mode are connected to switch board.

3.1 PHYSICAL MASTER MODE:

This mode is designed for elderly people so they can use tradition way to control the connected appliances and by default, Smart Switch board works as tradition switch board using touch sensor.

3.2 IOT MASTER MODE:

This mode is designed for today’s generation and by enabling IoT Mode through android App. Appliances can be controlled through smart phone using soft switches that are defined in App. There is a Master Relay that has been used for controlling the IoT master mode and there are some other relays are used for controlling the connected appliances through IoT.

The NodeMCU microcontroller using in this project has inbuilt Wireless Fidelity (Wi-Fi) shield named ESP8266 (ESpressif). Using this Wi-Fi shield microcontroller will connect to Wi-Fi through username and password specified in program. Through Wi-Fi microcontroller will connect to Blynk cloud using the authentication token specified in program. After this we can see the device online in our authentication token related project in Blynk app.

3.3 NODEMCU CONFIGURATION:

The NodeMCU (Node Microcontroller Unit) is an open source software and hardware development environment that is built around a very inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains all crucial elements of the modern computer: central processing unit (CPU), Random access memory (RAM), networking (Wi-Fi), and even a modern operating system and software development kit (SDK).

The most basic way to use the ESP8266 module is to use serial commands, as the chip is basically a Wi-Fi/Serial transceiver. It is recommended to use the very cool Arduino ESP8266 project, which is a modified version of the Arduino integrated development environment (IDE) that you need to install on your computer. This makes it very convenient to use the ESP8266 chip as we will be using the well-known Arduino IDE.

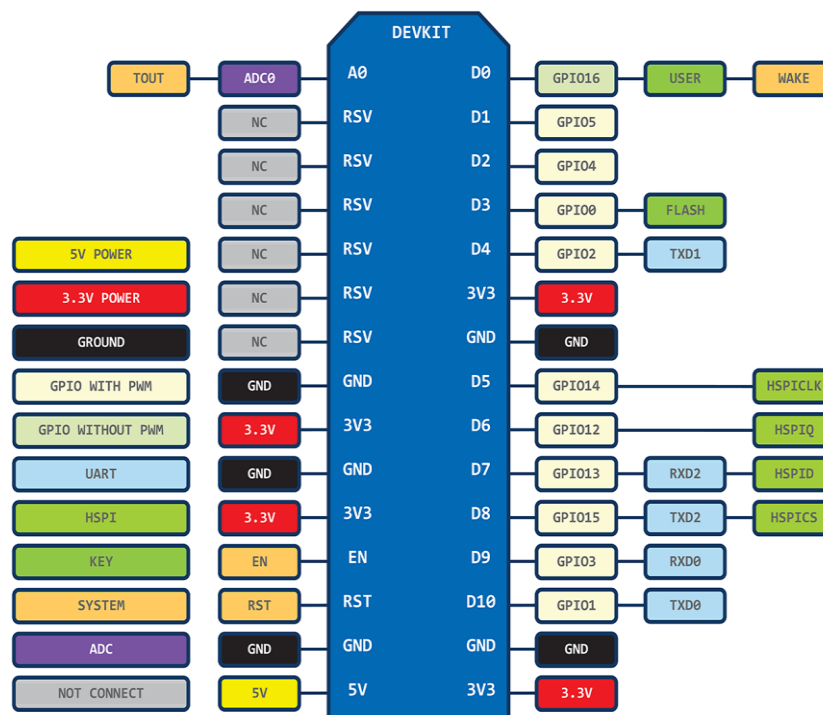


Figure 4 nodemcu pin details

The above diagram shows the general purpose input-output pins analogous to the digital pins. This helps while configuring the input and output digital pins in the Arduino program. A board that incorporates the ESP8266 chip on a standard circuit board. The board has a built-in USB port that is already wired up with the chip, a hardware reset button, Wi-Fi antenna, LED lights, and standard-sized GPIO (General Purpose Input Output) pins that can plug into a bread board. An open source ESP8266 firmware that

is built on top of the chip manufacturer's proprietary SDK. The firmware provides a simple programming environment based on eLua (embedded Lua), which is a very simple and fast scripting language with an established developer community. For newcomers, the Lua scripting language is easy to learn.

IV. IOT CLOUD ARCHITECTURE

The Internet of Things (IoT) is one of the most exciting and most dynamic areas of Information Technology (IT) at the present time. IoT involves the linking of physical entities (things) with IT systems that derive information about or from those things which can be used to drive a wide variety of applications and services which may be directly or indirectly connected or related to those things. IoT covers a very wide spectrum of applications, spanning enterprises, governments and consumers and represents the integration of systems from traditionally different communities: Information Technology and Operational Technology. As a result, it is important for IoT systems to have architectures, systems principles, and operations that can accommodate the interesting scale, safety, reliability, and privacy requirements.

The cloud components of IoT architecture are positioned within a three-tier architecture pattern comprising edge, platform and enterprise tiers, as described in the Industrial Internet Consortium Reference Architecture. The edge-tier includes Proximity Networks and Public Networks where data is collected from devices and transmitted to devices. Data flows through the IoT gateway or optionally directly from/to the device then through edge services into the cloud provider via IoT transformation and connectivity. The Platform tier is the provider cloud, which receives, processes and analyzes data flows from the edge tier and provides API Management and Visualization. It provides the capability to initiate control commands from the enterprise network to the public network as well. The Enterprise tier is represented by the Enterprise Network comprised of Enterprise Data, Enterprise User Directory, and Enterprise Applications. The data flow to and from the enterprise network takes place via a Transformation and Connectivity component. The data collected from structured and non-structured data sources, including real-time data from stream computing, can be stored in the enterprise data.

IOT gateway acts as a means for connecting one or more devices to the public network (typically the Internet). It is commonly the case that devices have limited network connectivity – they may not be able to connect directly to the Internet. This can be for a number of reasons, including the limitation of power on the device, which can restrict the device to using a low-power local network. The local network enables the devices to communicate with a local IoT Gateway, which is then able to communicate with the public network. The IoT Gateway often has other capabilities, including the ability to filter and intelligently react to data, the ability to send and receive data or commands to and from the Internet, the ability to run application or service logic locally (processing data and executing control logic without the need to communicate to a central location). It can also provide operational efficiency by allowing multiple devices to share a common connection.

A cloud computing environment provides scalability and elasticity to cope with varying data volume, velocity and related processing requirements. Experimentation and iteration using different cloud service configurations is a good way to evolve the IoT system, without upfront capital investment. It provides core IoT applications and associated services including storage of device data, analytics and process management for the IoT system, creates visualizations of data and also hosts components for device management including a device registry.

V. BLYNK CONFIGURATION

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.

There are three major components in the platform:

Blynk Application –It allows to you create amazing interfaces for your projects using various widgets we provide.

Blynk Server –This is responsible for all the communications between the smartphone and hardware. You can use our Blynk Cloud or run your private Blynk server locally. Its open-source, could easily handle thousands of devices and can even be launched on a Raspberry Pi.

Blynk Libraries –It is for all the popular hardware platforms - enable communication with the server and process all the incoming and out coming commands.

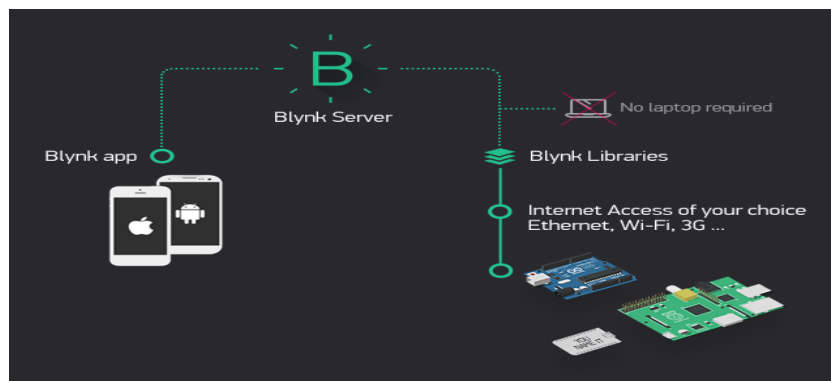


Figure 5 blynk cloud architecture

5.1 BLYNK WIDGETS:

Widgets are interface modules. Each of them performs a specific input/ output function when communicating with the hardware. There are 4 types of Widgets:

- **Controllers** - they send commands to hardware. Use them to control your stuff
- **Displays** - used for various visualizations of data that comes from hardware to the smartphone
- **Notifications** - are various widgets to send messages and notifications
- **Interface** - are various widgets to make your UI look better
- **Others** - widgets that don't belong to any category

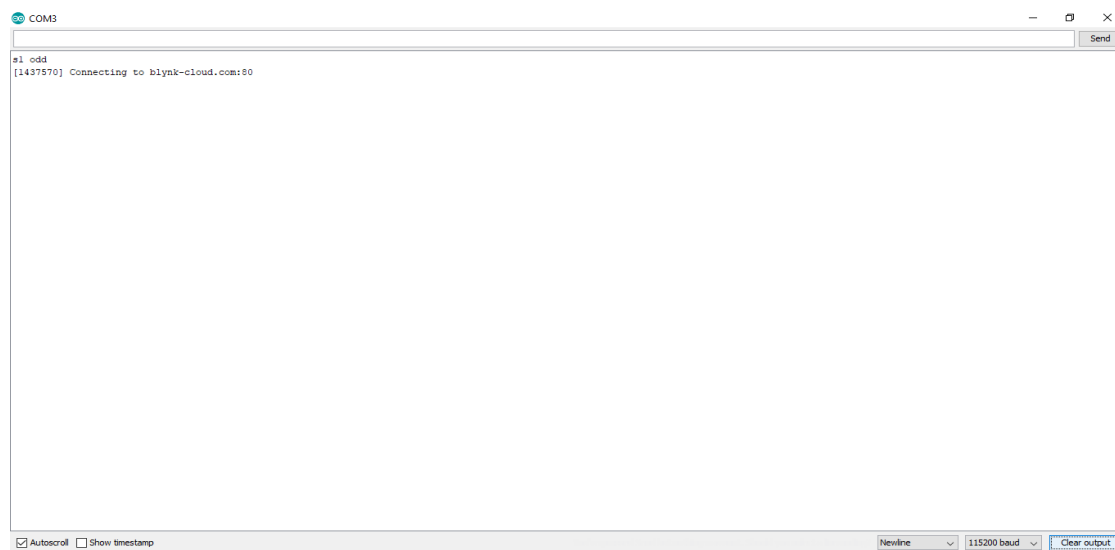
Each widget has its own settings. Some of the Widgets (e.g. Bridge Widget) are used to enable some functionality and they don't have any settings.

5.2 AUTHENTICATION TOKEN:

Authentication token is a unique identifier which is needed to connect your hardware to your smartphone. Every new project you create will have its own authentication token. You'll get authentication token automatically on your email after project creation. It's very convenient to send it over e-mail. Press the e-mail button and the token will be sent to the e-mail address you used for registration. You can also tap on the Token line and it will be copied to the clipboard.

VI. RESULTS AND DISCUSSION

Capsense based touch panel controlled home automation is used to control all the home appliances with the help of both touch sensor and mobile app. The result of our project is explained with help of different screenshots.

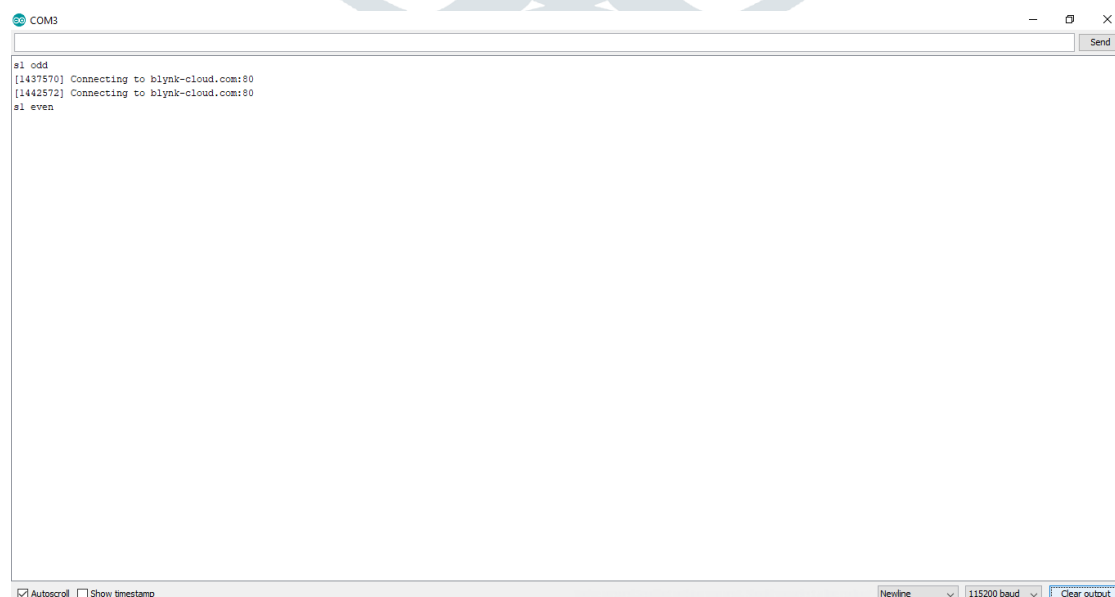


```

COM3
s1 odd
[1437570] Connecting to blynk-cloud.com:80
Autoscroll Show timestamp
Newline 115200 baud Clear output
  
```

Figure 6 serial monitor result 1

In this screenshot we are seeing the output in serial monitor. "S1 odd" in the serial monitor is referred to sensor1 is in OFF state. So the home appliance connected to the sensor1 is in OFF state.



```

COM3
s1 odd
[1437570] Connecting to blynk-cloud.com:80
[1442572] Connecting to blynk-cloud.com:80
s1 even
Autoscroll Show timestamp
Newline 115200 baud Clear output
  
```

Figure 7 serial monitor result 2

In this screenshot we are seeing the output in serial monitor. “S1 even” in the serial monitor is referred to sensor1 is in ON state. So the home appliance connected to the sensor1 is in ON state.

| Serial number | Sensor name | Sensor indication in serial monitor | Status |
|---------------|-------------|-------------------------------------|--------|
| 1 | S1 | Odd | Off |
| 2 | S1 | Even | On |
| 3 | S2 | Odd | Off |
| 4 | S2 | Even | On |

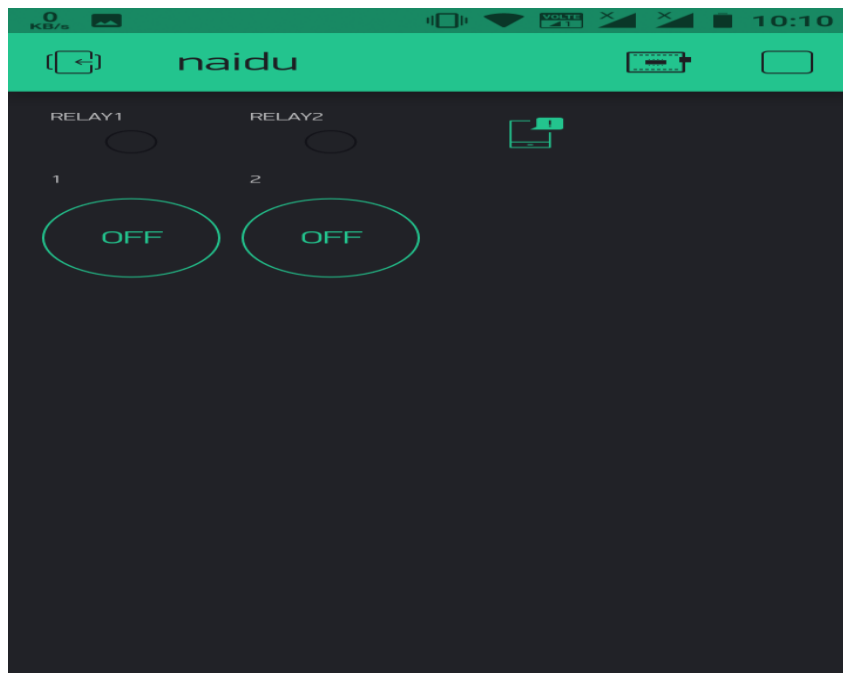


Figure 8 blynk app result 1

By using blynk app through mobile also we control home appliances. Above screenshot shows the view of blynk app, here switch1 is in OFF state .so home appliance connected to this switch is in OFF state.

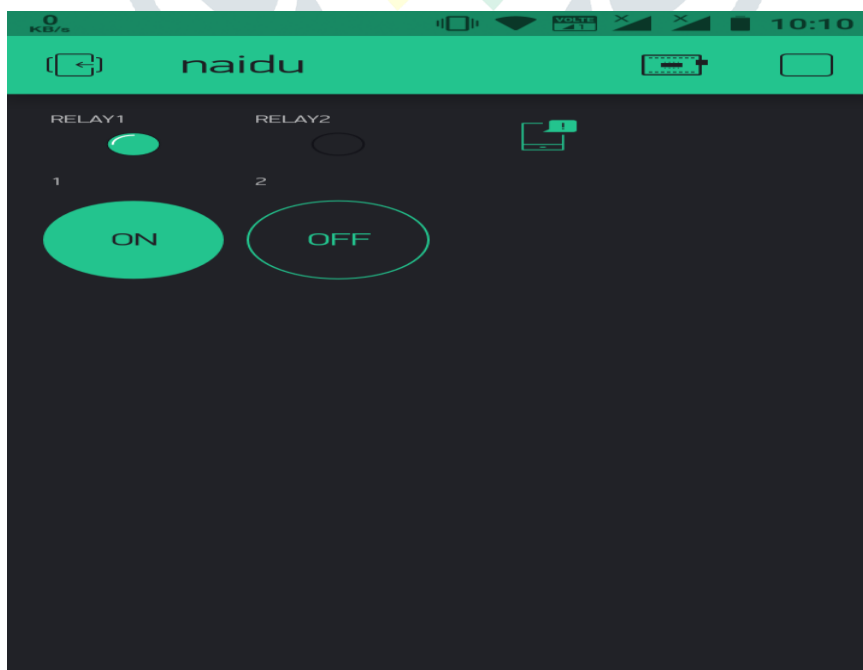


Figure 9 blynk app result 2

Above screenshot shows the view of blynk app, here switch1 is in on state .so home appliance connected to this switch is in ON state.

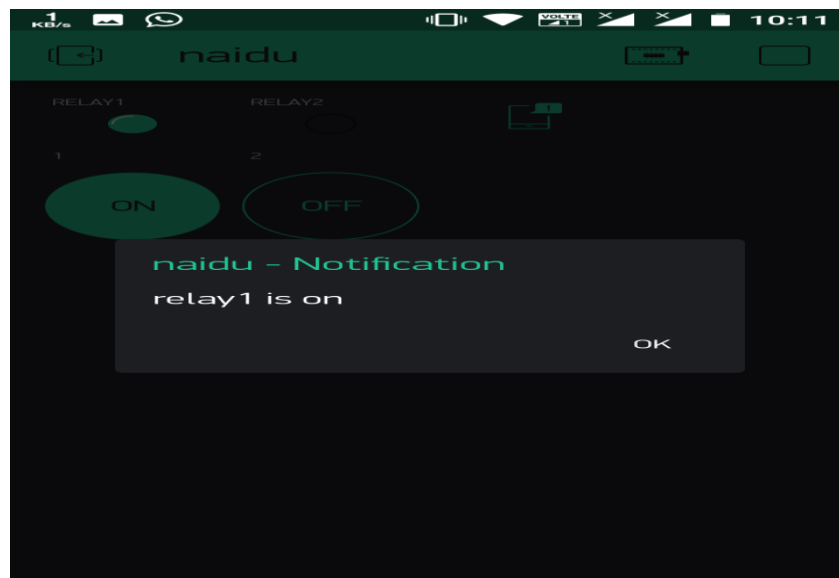


Figure 10 blynk notification result 1

When the home appliance connected to the relay1 is ON then it notify you immediately through notification in blynk app. Which is shown on above screenshot.

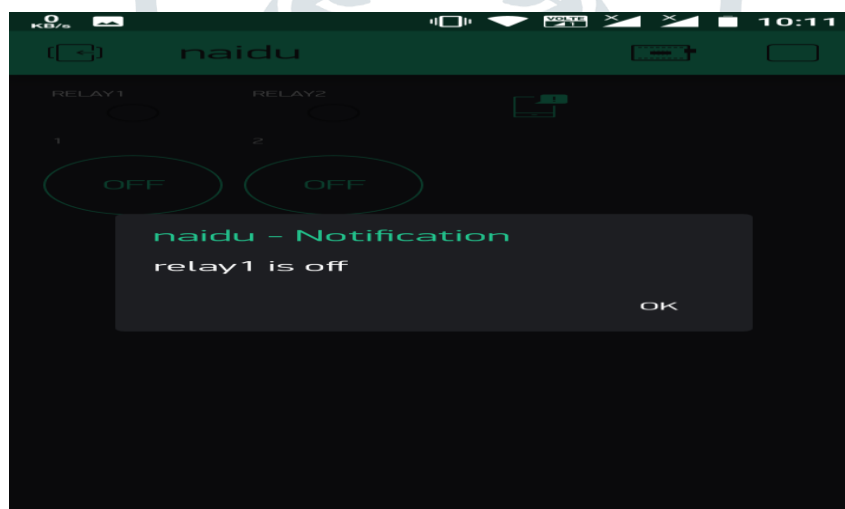


Figure 11 blynk notification result 2

When the home appliance connected to the relay1 is OFF then it notify you immediately through notification in blynk app. Which is shown on above screenshot.

So the main advantage of “Home automation through mobile” is that used for the “Physically Challenged and Disabled People”. It can be used as a replacement of the existing switches in home which produces sparks and also results in fire accidents in few situations. We can operate home appliance at whenever and wherever, thus it gives ease of access. The loss of power can be reduced and manpower required for home automation is very less compared to conventional methods. Faster operation and efficient.

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