



WI-FI CONTROLLED UNIVERSAL REMOTE USING ESP8266

N. V. K. Ramesh, S. V. Tejesh Kumar, V. Vamsi and S. Akarsh

Department of Electronics and Computer Engineering, Koneru Lakshmaiah University, Vaddeswaram, Andhra Pradesh, India

E-Mail: nvkr@kluniversity.in

ABSTRACT

The aim of the project is to control IR based devices through Wi-Fi. Now a days many devices are based upon IR receiver like TV, setup box, air conditioner, DVD, home theater etc. and each device consists of independent IR blaster (remotes) which is very difficult to store remotes at all places. For every remote IR frequency is independent to others whereas for every device it need a remote to control. This is smart IR device by which it can control all applications like TV, setup box, air conditioner, DVD, Home theater etc. the entire application is based upon AVR microcontroller and Wi-Fi module and IR blaster. Where it can control multiple devices at a time and also used by multiple users .it can access through any device through mobiles, computers, android devices and internet based devices. It can also control through long distances. It is of low cost home automation.

Keywords: embedded systems, irremote control, home automation, mobile applications, smart home, esp8266, wi-fi, and internet-of-things.

1. INTRODUCTION

Now a day's home applicants are increasing enormously. Many of the devices mainly of home applicants are controlled by IR signals. Every device has its digitalized frequency it can be controlled by its unique remote. Due to increasing in number of devices it has great inconvenience to control every digital device and home applicants with its own remote having unique frequency. In this paper introducing a smart IR device where it can control all the home applicants which are enabled with IR blaster having its own IR protocols by using this device it can control dish box, stereo, television e.tc. This paper discusses about the how smart IR works and it contains the design of IR circuit how to build an IR circuit. It also explains about main issues like how to store different values in a remote and how to transmit these values through an IR blaster at a particular frequency delay such that it can turn this device into a smart universal remote. So it can fill the read and store values of any remote and new protocols. In day to day life there are various gadgets that can perform through IR device which are like DVD player home theater and mini FM's and it very clumsy and it is hard to maintain all remotes and very difficult to manage. Smart devices are simplify our lives from day to day where it can control all home applicants by at any constant place [1]. Due to some complexities it became difficult to build a universal remote having IRblaster where it can control the IR enabled gadgets of any device and of different manufactures. Now a days mobiles are increasing rapidly where they can change the people's style and the work. Smart applicants are rapidly using to control different applications and becoming complex and cost and with complicated functions [2], [10]. By using mobile communication it can contact anyone from anywhere in world but present people are connecting different types of devises to the mobile phones and contacting other devices and applications. In the present era mobile phones have capability of everything like mainly camera, storing contacts, music, and video player?

Major advantage in the smart phone in present is having Wi-Fi [1], [2] enabled and Bluetooth featured but most of the devices use IR based systems.

It can control the other applicants through mobile phones but it cannot control them directly. To control them it need some special hardware with a design of IR device which can connect with mobile phones such that it can perform automation of the environment such that it can increase the work efficiency the environment which have routine tasks they can be modified as automated. Such that designing of the IR device will come under home automation [3]. To control all applicants which are IR enabled gadget have to place the IR where it can be exposed to all the area such that device can control all the home applicants.

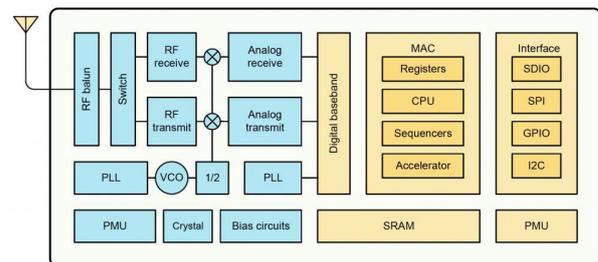


Figure-1. Functional diagram of ESP8266.

The design of the circuit of the smart IR it require ESP8266 included with Wi-Fi module which performs the important role in the project. These are the upcoming generation in the embedded systems. By using the Wi-Fi module it can connect out smart mobile to the device and it can control IR device. Wi-Fi module is based on 802.11 and together esp8266 are explored on same chip called node MCU. It is arduino like hardware and it is low power consumption. It is 1MB of storage. It having GPIO pins and data pins from D0 to D8 on the board have PWM functionality and it has IIC and SPI communications and



frequency of 80 or 160 MHz and ADC wire all in one board. It has Wi-Fi networking which can be used as a station or access point and as a host for web server and it can fetch the data, upload the data through internet connection. This board is used for IOT projects. The ESP8266 requires 3.3 volts power supply. So node MCU is connected to 5 volts micro USB cable or direct 5 volts to Vin pin available on the board. The ESP8266 I/O pins communicate each other either as input or output with a max supply of 3.3 volts.

1.1 Background

IR remote works with the help of IR led by sequential on and off in a particular pattern. Interference for IR led is radiation occurred from sunlight and nearby lights, such that frequency of the command is detected by the receiver and led is should not turned on steadily. To transmit the remote frequency for turn on and turn off there are 3 modes of frequency they are hardly 36 KHz, 38 KHz, and 40 KHz. When led is on then it is called mark, when led is off it is called space.

For a particular remote for each key the code will be decoded and the length of the code is typically from 12 to 32 bits including start bit and stop bit. And entire code will be sent at a time when the key is pressed and when until the key is pressed the code will be broadcasts repeatedly. To send the codes there are 4 protocols for broadcasting the code from IR hardware.

- I. NEC
- II. RC5
- III. RC6
- IV. SONY

Using NEC protocol it can transmit 32 bits including start bit first bit will be MSB. Using RC5 protocol it can broadcast 12 bits and it have 2 start bits and it not included in the code. Using RC6 typically it can transmit 20 bits it will be broadcast the code with a start bit and a leader bit includes within the code and it will transmit the 4th bit double-wide because it is trailer bit. Sony different from other protocols it can transmit code length of 12 bits or 20 bits in this protocol first bit is the LSB. For Sony, RC5, RC6 protocols the transmission will be repeated 3 times and it not implement the RC5 and RC6 toggle bit it depends upon the caller. Still there are new protocols are adding by the manufactures by library supports.

1.2 Literature survey

Jianjun Lv *et al* in 2010 has discussed about the IR remote control device which it can't able to control all the home appliances in a house and it can't manipulate a remote to control all devices and increase in remote controls leads to increase in wastage of resources by using

this theory we got an idea to make a device which can control all home appliances [7].

Jinsoo Han *et al* in 2008 has discussed that IR based devices without the line of sight regarding legacy customer devices. In this paper the author done IR controller with ZigBee based and it is attached with legacy customer device IR receiving part. When message was sent to the ZigBee through smart phone. Then ZigBee will receive message through ZigBee protocol and it decodes the control message into required IR code and it transmits the code to the nearby IR receiver of a legacy customer device [8].

Sachin Kishor Khadke in 2014 has discussed about the control of IR devices through smartphone interface by logging into the app and sending commands to the IR transceiver through Bluetooth module by pressing buttons gently on phone. Smartphone sends commands through Bluetooth where in day to day life people are using Bluetooth for many applications so that we can understand the functionality of Bluetooth will understand [9].

Pandu Ranga Sai *et al* in 2016 have proposed a paper where he implemented an IR device such that he can control IR devices through smartphone interface by using microcontroller and makes smart IR system using Bluetooth module such that IR devices can control the IR enabled devices without in the line of sight and with long distance and more accurate. Command message will be sent through the smart phone within the Bluetooth range of microcontroller and it receives the message and it will be decoded for the transmission of signal through IR blaster which was directly in sight of the IR receiver [11].

Sai Chaitanya *et al* in 2016 have implemented the circuit with CC3200 Wi-Fi module such that IR blaster is connected with circuit and CC3200 module. Command messages for the device is sent through the browser or any app which connected to the hotspot of the device and it have advantage that the device can be controlled through long range based upon the Wi-Fi range the device is placed at line in sight of the IR receiver and it is controlled by the smart phone at distance [10].

Abdulaleem A. Rasheed *et al* in 2012 have proposed the paper that to detect different infrared signals from a remote from all push buttons in home appliances. The signal transmitted from a remote is received by the IR receiver and using microcontroller unit it will decode the signal which is transmitted by the remote and stored for further operations [12].

Muthaiah *et al* in 2016 has proposed a paper that low cost gesture recognition which acts as universal remote. Some of the gestures loaded in the master unit of the glove when fingers are tapped the signals will send to the master unit and it transmits the radio frequency to the IR circuit and the similar signals will be transmit to the IR receiver with a required IR code [4].



2. EXPERIMENTATION

Esp8266-12E

ESP8266-12E is some of the most integrated Wi-Fi chips inside the agency. Measuring virtually 5mm x 5mm, ESP8266EX requires minimum outside circuitry and integrates a 32-bit Tensilica MCU, giant digital peripheral interfaces, antenna switches, RF, power amplifier, low noise accumulate amplifier, filters and electricity control modules - multi feature small package.

The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack which can deliver any microcontroller access on your Wi-Fi community. The ESP8266 is able to either web hosting a utility or offloading all Wi-Fi networking features from each other application processor. each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can without a doubt hook this up for your Arduino tool and get about as heaps Wi-Fi-capacity as a Wi-Fi defend offers (and that's without a doubt out of the box)! The ESP8266 module is a without a doubt charge powerful board with a massive, and ever developing, network.

This module has a powerful sufficient on-board processing and garage functionality that allows it to be included with the sensors and different software unique devices through its GPIOs with minimum improvement up-the front and minimal loading within the route of runtime. Its excessive degree of on-chip integration permits for minimal outdoor circuitry, such as the front-surrender module, is designed to occupy minimum PCB location. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces; it includes a self-calibrated RF permitting it to artwork beneath all running conditions, and requires no outdoor RF additives. There may be an almost limitless fountain of facts to be had for the ESP8266, all of which has been supplied via terrific network help. There are many sources to useful aid you within the use of the ESP8266, even instructions on how to transforming this module into an IOT solution.

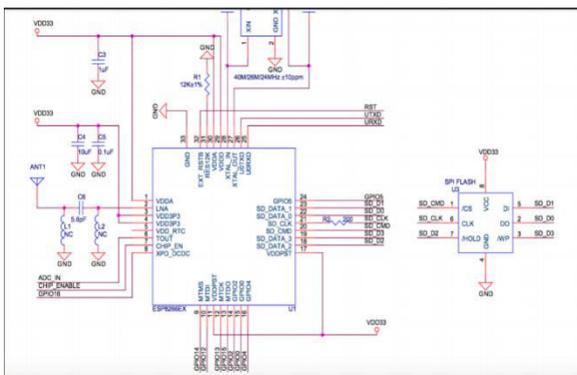


Figure-2. Pinout diagram for ESP8266 Wi-Fi module.

IR blaster

An infrared blaster (IR sounds better and less techy) is a gadget that accepts some sort of input from your remote and "blasts" it via infrared to the IR-compatible device you're trying to control. One common example is with some smart remotes. This remote doesn't have to communicate directly with your device. Instead, the remote talks with the Harmony Hub. You can attach mini IR blasters to the hub and these blasters can then send your commands to devices like your cable box, stereo receiver, or Blu-ray player. The main reason you'd something like this is you don't have to have line-of-sight with the device you're controlling; only the IR blasters and the hub they're attached to have to be near your boxes. This means you can place boxes out of the way (or even sometimes hidden in an AV closet) and still control everything like they were out in the open.

To perform this experiment it require hard equipment which is used to send IR code through IR led andit require IR led it is used to broadcast the code. NPN diode 2N2222 is placed with the circuit where IR led is connected to collector, base pin is connected to data pin of board, andemitter is connected to ground.

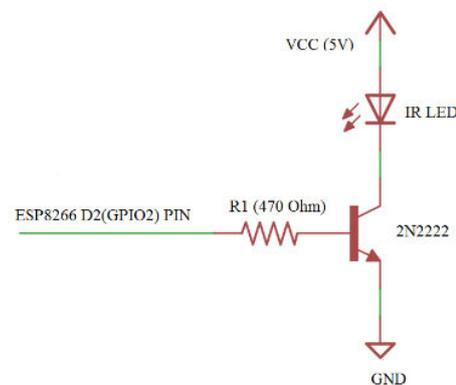


Figure-3. IR transmitter circuit.

3. METHODOLOGY

To run this code and to perform the hardware execution it require Arduino software. Firstly we have to store the raw values or hex digital values of the remote by using IR receiver sensor. It will store the digital data in the form of 32 bits with including start and stop bit. Sometimes the data may be 12 bits based upon remote and its design. Basic frequency of the remote signals is 38 KHz it can be tested by using radio shack. To decode this frequency into digital form we require IR library which decodes the IR signal input signal not only receiving and it can transmit through IR led. This library is used to control home applicants like DVD, TV and IR enabled devices.

Firstly, code will be uploaded to the ESP8266and the code will connect to the hotspot or Wi-Fi as per the name and password given. On the com port it shows the status of the device and it displays the ip address. This ip address can be access through any device which is connected to the same hotspot and the device acts as



client. Request will be sent through the client and process the results in the device and it checks the weather request is 0. If request is 0 it will disconnect the client if request is not 0 it execute the command and broadcast the code under that command and the execution continues until the request is 0 or until the client is connected to the device.

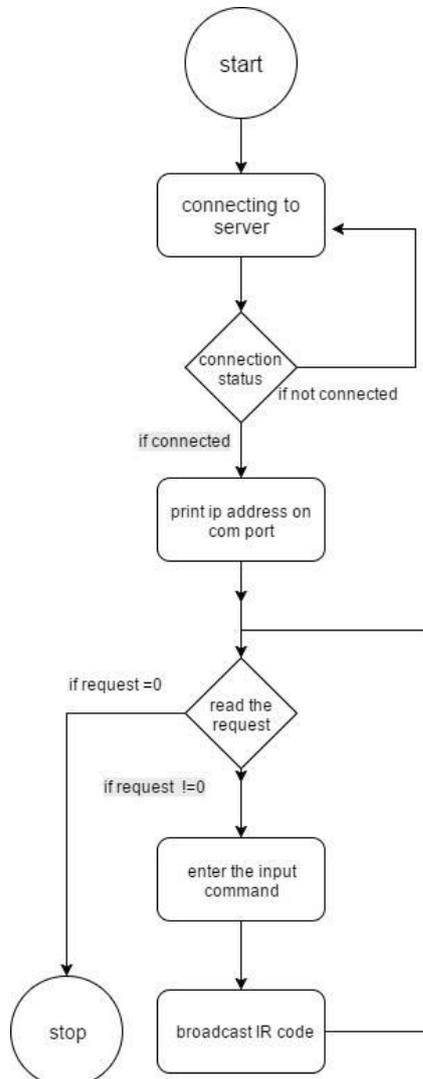


Figure-4. Flow chart for the execution of IR code.

4. RESULTS

Firstly hardware is connected as per the requirements for receiving the data and sending the data. For the hardware device it require the IR blaster, IR receiver, 2n2222 transistor and the resistor based on requirement it will depends upon the voltage supply. Make sure the connections for data pins, vcc and ground pins is correct. Transistor is used to make flow through the IR transmitter when the data pin is high and it blocks the flow when the data pin is low.

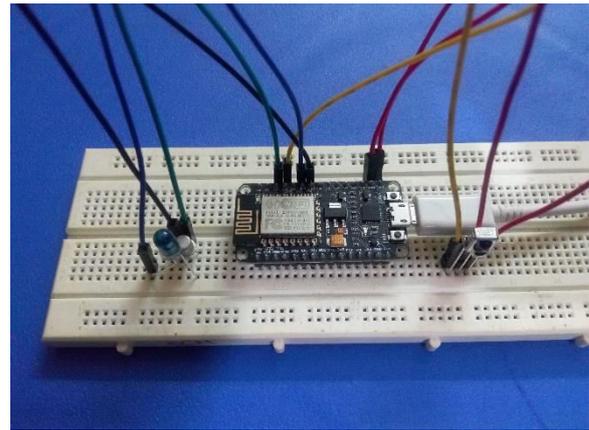


Figure-5. Hardware circuits for transmitting IR code.

Com port is connected to the MCU driver and fill the settings with the requirements. Make the code and compile it for errors after successful compilation upload the code. After uploading complete the code will execute itself in the board and it will enable the Wi-Fi driver for the connecting to the hotspot. During the uploading the code we have to make sure the username and hotspot details should be correct and it should contain library files for supporting hardware. After connecting to hotspot it will displays the status of the device on the com port. Connection loop will repeat until Wi-Fi is connected then it will start the server and wait for the client. It creates the ip address for access of the device such that the device will be controlled if smart phone is connected to the same hotspot.

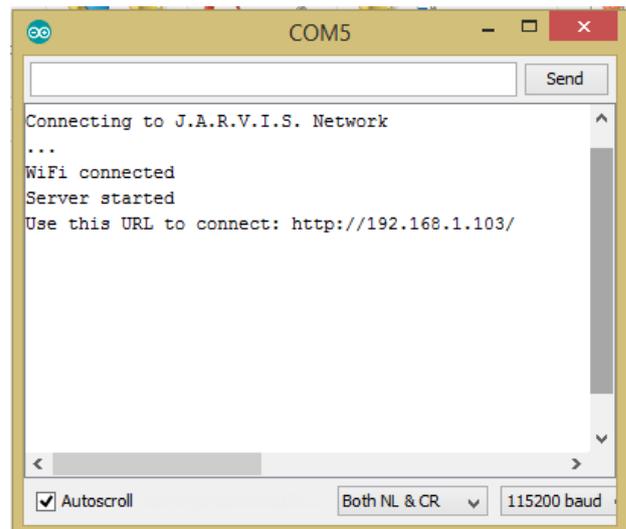


Figure-6. Connection to hotspot

After connection complete it can accessed through any device which is connected to the same hotspot. Collect all the remote controls which we require for access and gently press the required buttons on the remote in sight of IR receiver such that it will receive the different codes which are transmitted by the remote



```

COM5
new client
received code
code received : 20DF10EF
new client
received code
code received : 20DF10EF
new client
received code
code received : 20DF40BF
new client
received code
code received : 11D9D02F
Autoscroll Both NL & CR 115200 baud
  
```

Figure-7. Code received through remote controller.

After connection of client and server. Different requests are sent through the http address and process the requests validity and if it is valid it checks the command under the request and perform home automation. If the request is valid it will check the code and send the particular command which is requested through client. Any no of clients can connect to the server so it will execute the every client request at every request it will display the requested data and status of the data on the com port.

```

COM5
new client
GET /tvpw HTTP/1.1
request for tv power on/off
code sent : 20DF10EF
new client
GET /tvvolup HTTP/1.1
request for tv volume up
code sent : 20DF40BF
new client
GET /dishon HTTP/1.1
request for dish on/off
code sent : 11D9D02F
Autoscroll Both NL & CR 115200 baud
  
```

Figure-8. Processing request and sending IR codes through circuit.

ESP8266 can connect to mobile phones and other applicant's ip known to us we can access the ESP8266 from any device within the connection of that hotspot by entering ip address in URL address. in the code there is html code such that after browsing the ip address acquired from com port. Then the page will show the different buttons on the screen when we press the required button on the page it will send the request to the server and

performs the operations and it will continue until server disconnect

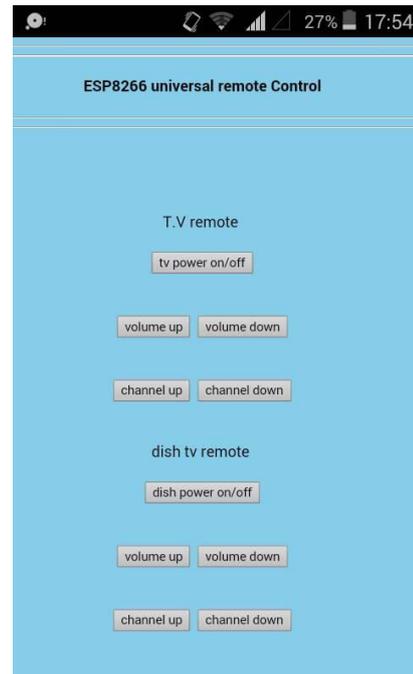


Figure-9. Web page through smartphone.

5. CONCLUSIONS

In this paper, we have discussed about the ESP8266 and its implementation and how to perform the universal remote through wireless which means by using IR protocols and connection between client and server if both are connected to same hotspot. Firstly we have to maintain the data of the required remotes and store the libraries and the protocols required for the implementation. And we require some special hardware where it can control the IR enabled devices and perform home automation. The idea of the paper is to store the required data of the remote and its independent protocols in a memory. Usage of remotes and batteries are reduced.

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