DESCRIPTION DOCUMENT FOR WIFI EIGHT RELAY BOARD

HARDWARE REVISION 0.3

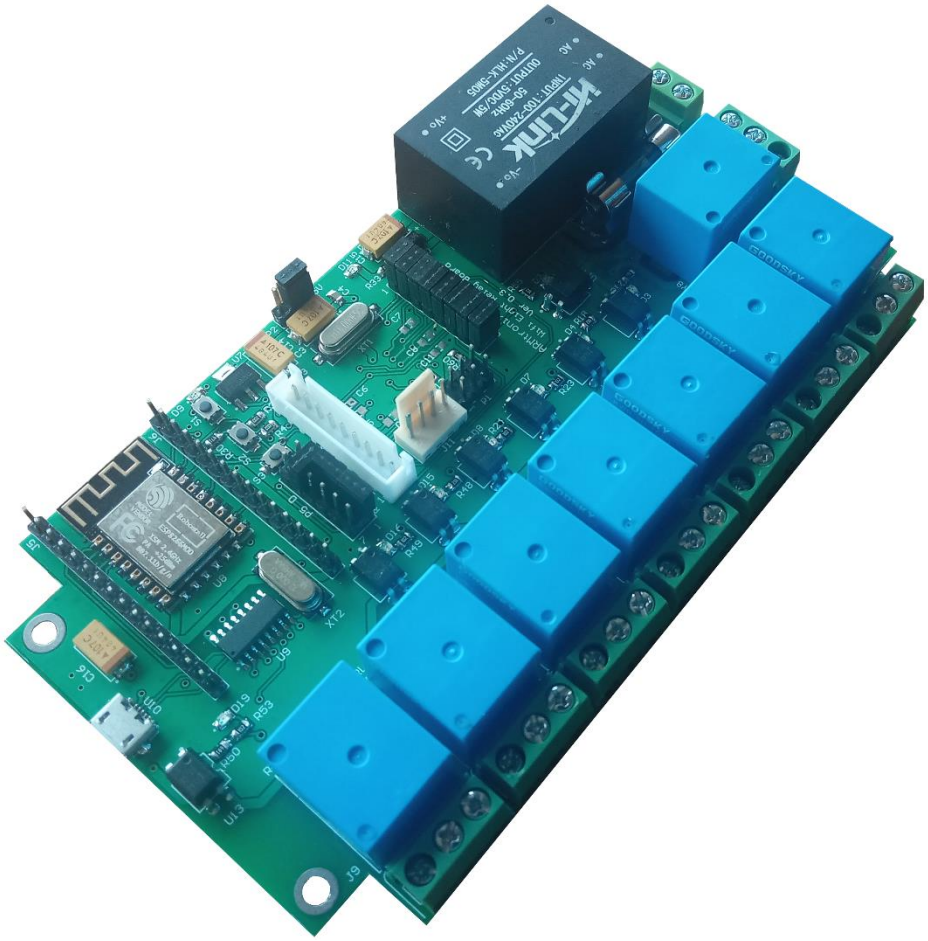
Department	Name	Signature	Date
Author			
Reviewer			
Approver			

Revision History

Rev	Description of Change	Effective Date
0.1	Initial Release	

ABSTRACT:

This document is a detailed product description that describes the effective features of the product. It includes a functional hardware description of the product with its internal block diagram and product images.



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1. ABBREVIATIONS

Term	Description
AC	Alternating Current
COM	Common
DC	Direct Current
HTTP	Hypertext Transfer Protocol
Hz	Hertz
MCU	Microcontroller Unit
MQTT	Message Queue Telemetry Transport
NC	Normally Closed
NO	Normally Open
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus

2. REFERENCES

Company Website link	https://www.armtronix.in
Youtube Weblink	https://www.youtube.com/watch?v=N6_aVWY1ezk
Github's Weblink	https://github.com/armtronix/Wifi_eight_relay_board
Android Mobile App .APK Weblink	https://github.com/armtronix/Wifi_eight_relay_board

3. PURPOSE

The purpose of this document is to outline the design description for the Wifi Eight Relay Board. It provides a high level summary of the product.

4. SCOPE

This document describes system architecture which includes Power supply, Relay, WiFi Module, Microcontroller and UART to USB converter.

5. SAFETY AND WARNING

Note that, this board to be powered with AC 230V with required current. Work and handle carefully with AC power as it is harmful and danger for living beings. Touching live wire or board when it is ON is danger and not advisable, it may cause to death, please avoid it.

Even a 50 V AC supply is sufficient to kill you. Please Switch off the mains before you make or change connections, be very careful. If you are not sure of anything related to the AC supply lines, please call an electrician ask and him to help you with it. Do not attempt to interface to mains unless you have adequate training and access to appropriate safety equipment. Never work on high voltages by yourself when you are alone. Always ensure that you have a friend/partner who can see and hear you and who knows how to quickly turn off power in case of an accident. Use a 2A Fuse in series with the input to the board as a safety measure. Basic Wiring diagram is available on our instructables and github page. Please refer them.

Fire Hazard: Making wrong connections, drawing more than rated power, contact with water or other conducting material, and other types of misuse/overuse/malfunction can all cause overheating and risk starting a fire. Test your circuit and the environment in which it is deployed thoroughly before leaving it switched on and unsupervised. Always follow all fire safety precautions.

6. PRODUCT FEATURES

- Works directly with AC power 100 - 240 V AC 50-60 Hz.
- Device firmware can be updated/reloaded/changed as per user application.
- Eight relay outputs with NO, NC and interconnector COM pin accessible to user.
- Board can handle up-to 4 Amps of current at relay output.
- WiFi with MQTT or HTTP protocol
- On board USB – UART converter to program WiFi Module and MCU.
- Basic Firmware* to enter SSID and password to connect to the router
- Basic firmware* is capable to control device through HTTP or MQTT mode.
- Push Button on board Provided to Reset the ESP.
- Board is compatible and configurable to Amazon Alexa.

** Firmware is basic and simple only to test the basic functionality of the hardware, which may not work as per your application. The basic test code is available in our github link given above and you can achieve your application by tweaking the same or developing your own and reloading the firmware to hardware.*

7. PRODUCT DESCRIPTION

a. PHYSICAL DESCRIPTION

- AC to DC Power supply module
- Electro-mechanical Relay – 8 numbers
- Wifi Module
- USB - UART converter
- Microcontroller

b. FUNCTIONAL DESCRIPTION

Block Diagram

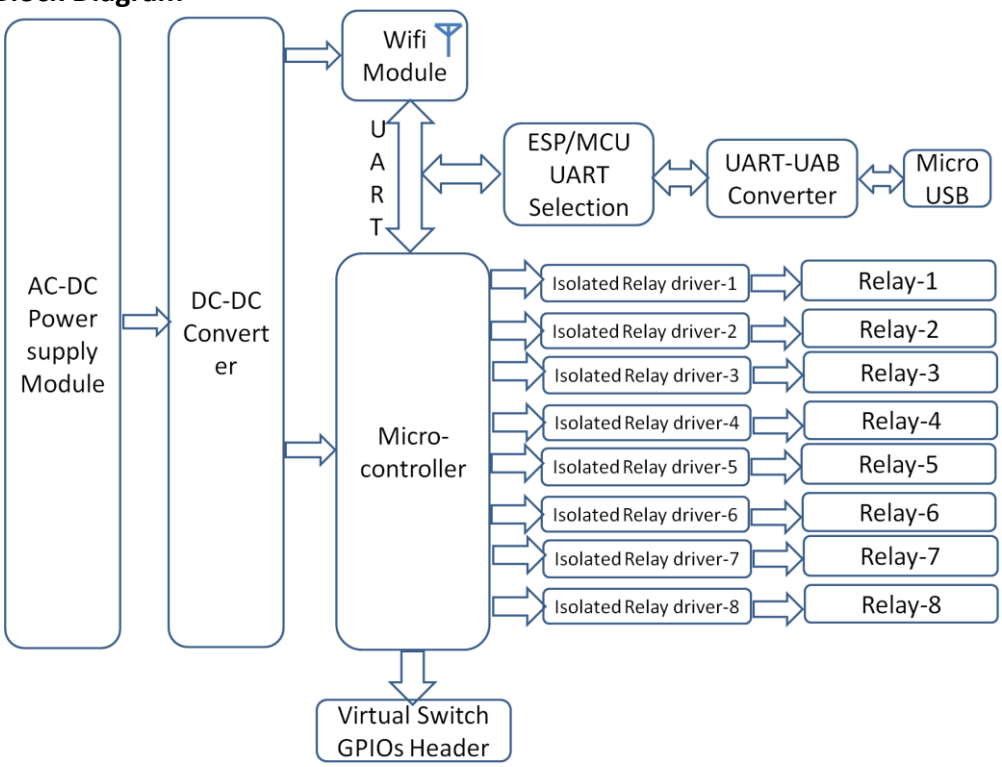

Figure 1: Block Diagram

Eight relay board has on-board power supply module which takes standard AC voltage as input and provides required DC voltage as output. The DC voltage is used to power-up Wifi module and Microcontroller Unit used on-board to establish Wifi communication with smart phones and control relays respectively. There are eight relays mounted on board with potential free contacts to control (ON/OFF) eight external electrical AC/DC loads independently from a smart phone application using MQTT/HTTP protocol. Where the COM pin of all the relays are connected to each other to make the connection easy.

8. SYSTEM OVERVIEW

1. AC to DC Power supply module

AC to DC converter is power supply module manufactured from Hi-Link part number HLK-PM05. This power supply module rectifies and regulates voltage from 230 V AC to 5 V DC with output current capacity of 1A DC. The power of HLK-PM05 is at maximum of 5W.

The 5V supply is used to power relays and USB-UART converter. There is a DC-DC converter on board to regulate voltage from 5 V DC to 3.3 V DC to supply power to Wifi module.

2. Wifi Module

Wifi module used on the board is ESP8266-12 with all its required GPIOs are easily accessible to user for their own application. Wifi module is powered on through 3.3 V DC. It works on both MQTT / HTTP protocol.

3. Microcontroller

The Microcontroller contains the relay-control algorithm to switch ON/OFF the relay, by receiving commands from ESP8266-12. Controller communicates with Wifi module through UART mode of communication to send and receive data to-and-from in connected Wifi network. ATmega328P microcontroller is used on the board to execute the algorithm, which is manufactured by Atmel incorporation and is compatible with Arduino IDE.

Controller has the capability for software up-gradation through Arduino and contains enough memory to upgrade and store the software for its own application.

4. Mechanical Relay – 8 Numbers

All relays are powered by 5 V DC. The three load terminals (COM, NO and NC) of all relays are given accessible to user to control loads independently. An opto-isolator based relay-driver circuit is used to drive the relay. All the common pins of the relay are interconnected to each other, to make ease of installation in similar load switching application.

5. USB-UART converter

USB-UART converter is an integrated chip used to convert serial UART data to high speed USB to program the Wifi module and MCU using Arduino IDE. This is much user friendly to customize the code and reload it. A micro USB connector given on board to make hassle free connection between computer and Wifi Eight relay board for programming purpose.

The same port can also be used to push messages to serial port of PC from MCU or ESP by selecting the respective one by configuring header P5. Note that you can connect only of them at an instant of time to serial port.

9. TECHNICAL SPECIFICATION

a. ELECTRICAL SPECIFICATION

Input Specifications				
Description	**Min**	**Typ**	**Max**	**Unit**
Voltage AC	100	220	230	Volts
Current AC	-	0.3	-	Amps
Power AC	-	3	-	Watts
Frequency	50	-	60	Hz

Relays Output Specifications (Maximum)				
Description	**Min**	**Typ**	**Max**	**Unit**
Voltage AC	-	-	240	Volts
Current AC	-	-	4	Amps
Power AC	-	-	980	Watts
Voltage DC	-	-	24	Volts
Current DC	-	-	4	Amps

b. MECHANICAL SPECIFICATION

- Mechanical Dimensions of PCB are 140 x 80 x 23 mm (Length x Width x Height)

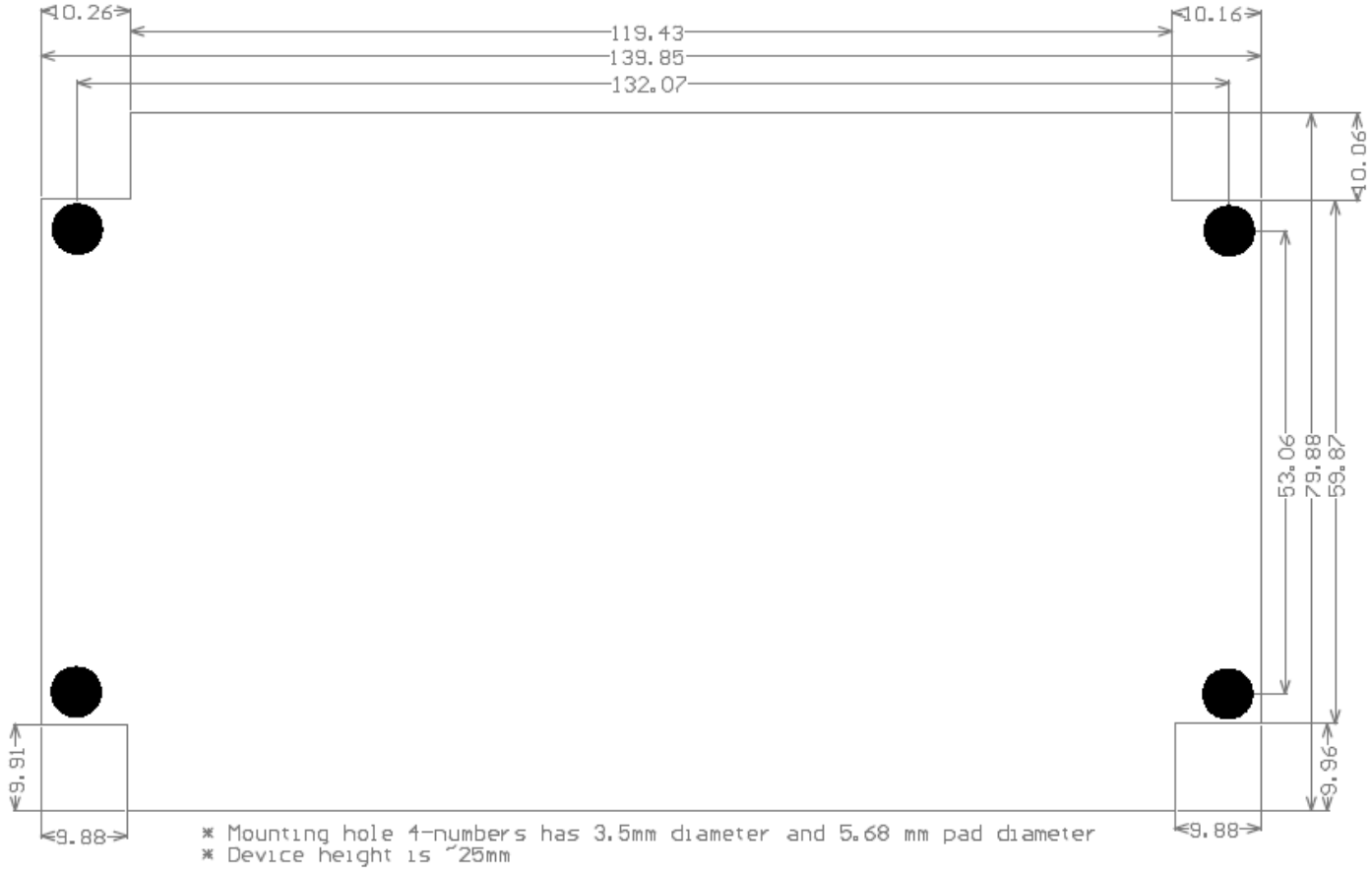

Figure 2: Mechanical dimensions of PCB

10. ELECTRICAL CONNECTIONS

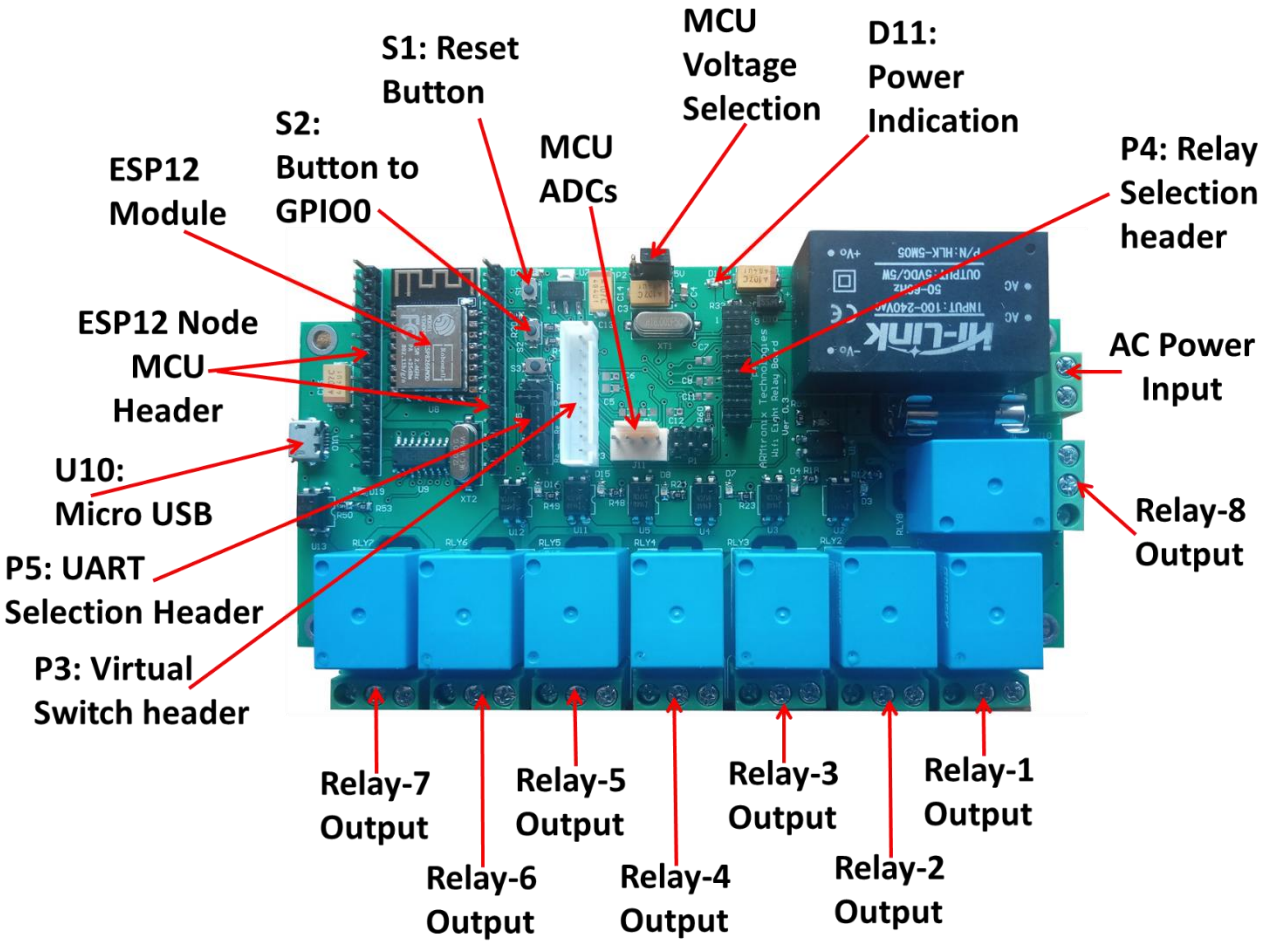

Figure 3: Header and Switch Details

Description of Header and Switches shown in Figure 3

1. S1 Button is to reset the ESP.
2. AC_IN AC power input terminal block.
3. F1 Protection replaceable glass tube fuse.
4. P4 Relay Selection Header.
5. J5 and J6 Headers are compatible to standard NodeMCU headers.
6. U10 Micro USB for programming.
7. P3 Virtual switch GPIOs header.
8. P5 UART configuration header.
9. P2 MCU Power selection header.
10. J11 MCU ADCs and I2C

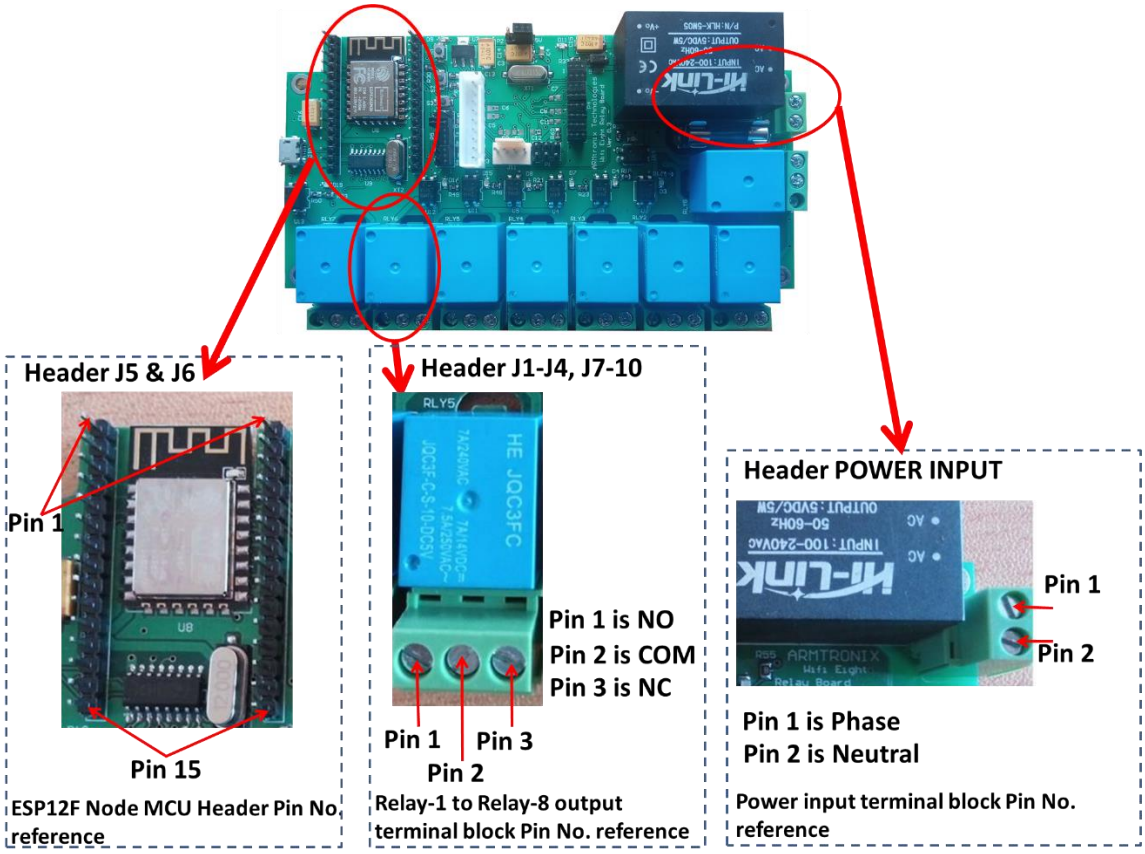

Figure 4: Header Pin number references – 1

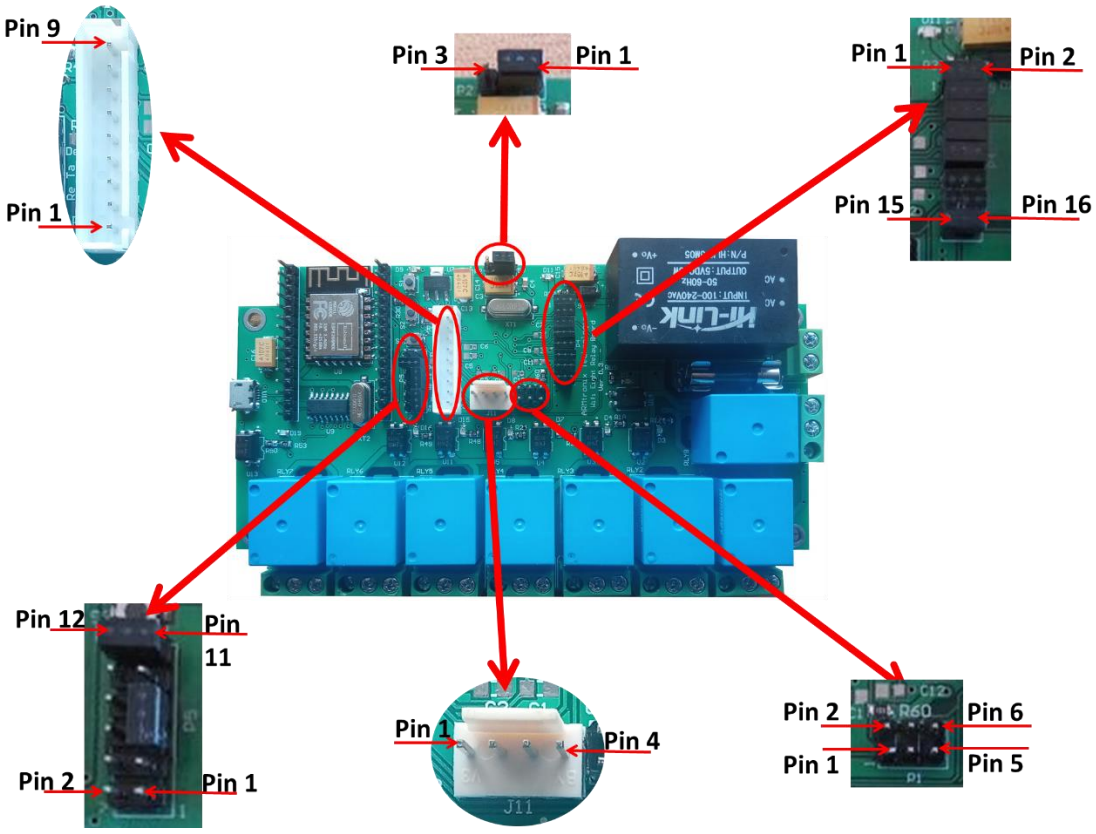

Figure 5: Header Pin number references - 2

a. HEADER PIN CONFIGURATION

i. HEADER J5

J5				
Header Pin #	**ESP Pin #**	**Arduino Port #**	**Designation**	**Description**
1	-	A0	ADC_EX	External ADC input up to 3.3Vdc
2	2	-	ADC	ADC input up-to 1.1Vdc
3	-	-	RESV	Reserved by ESP
4	-	-	SD_D3	Reserved by ESP
5	-	-	SD_D2	Reserved by ESP
6	-	-	SD_D1	Reserved by ESP
7	-	-	SD_CMD	Reserved by ESP
8	-	-	SD_D0	Reserved by ESP
9	-	-	SD_CLK	Reserved by ESP
10	-	-	GND	Ground reference
11	-	-	VCC_3V3	3.3V DC Input/output
12	3	-	EN	Enable of ESP
13	1	-	nRST	Negative of Reset
14	-	-	GND	Ground reference
15	-	-	VCC_5V	5V DC Input/output

Table 1: Header J5 Pin Configuration

ii. HEADER J6

J6				
Header Pin #	**ESP Pin #**	**Arduino Port #**	**Designation**	**Description**
1	4	D0	GPIO16	GPIO16 of ESP
2	20	D1	GPIO5	GPIO5 of ESP
3	19	D2	GPIO4	GPIO4 of ESP
4	18	D3	GPIO0	GPIO0 of ESP
5	17	D4	GPIO2	GPIO2 of ESP
6	-	-	VCC_3V3	3.3V DC Input/output
7	-	-	GND	Ground reference
8	5	D5	GPIO14	GPIO14 of ESP
9	6	D6	GPIO12	GPIO12 of ESP
10	7	D7	GPIO13	GPIO13 of ESP
11	16	D8	GPIO15	GPIO15 of ESP
12	22	D9	RXD0	UART Tx ESP
13	21	D10	TXD0	UART Rx ESP
14	-	-	GND	Ground reference
15	-	-	VCC_3V3	3.3V DC Input/output

Table 2: Header J6 Pin configuration

Table 2 and 3, shows the header J5 and J6 which are in-compatible with Node MCU headers. Freely available GPIOs are also shown in connector, can be used for user application.

iii. HEADER J4: Relay selection

J4						
Header Pin #	**MCU Pin #**	**Arduino Port #**	**Designator**		**Header Pin #**	**Description**
1	9	5	MCU_PD5		9	RELAY-1
2	10	6	MCU_PD6		10	RELAY-2
3	12	8	MCU_PB0		11	RELAY-3
4	13	9	MCU_PB1		12	RELAY-4
5	14	10	MCU_PB2		13	RELAY-5
6	32	2	MCU_PD2		14	RELAY-6
7	1	3	MCU_PD3		15	RELAY-7
8	2	4	MCU_PD4		16	RELAY-8

Table 3: Header J4 Pin Configuration

iv. HEADER P3: Virtual Switch MCU GPIOs

P3				
Header Pin #	**MCU Pin #**	**Arduino Port #**	**Designation**	**Description**
1	11	7	MCU_PD7	Can be used for virtual switch
2	15	11	MCU_PB3	Can be used for virtual switch
3	16	12	MCU_PB4	Can be used for virtual switch
4	17	13	MCU_PB5	Can be used for virtual switch
5	23	A0	MCU_PC0	Can be used for virtual switch
6	24	A1	MCU_PC1	Can be used for virtual switch
7	25	A2	MCU_PC2	Can be used for virtual switch
8	26	A3	MCU_PC3	Can be used for virtual switch
9	-	GND	GND	Ground reference

Table 4: Header P3 Pin Configuration

v. HEADER P5: UART selection for programming.

P5						
Header Pin #	**Designator**	**Description**		**Header Pin #**	**Designator**	**Description**
1	RXDA	UART_Rx_MCU		7	TXD0	Programmer UART_Tx
2	TDXE	UART_Tx_ESP		8	RXD0	Programmer UART_Rx
3	RXDE	UART_Rx_ESP		9	TXD0	Programmer UART_Tx
4	TXDA	UART_Tx_MCU		10	RXD0	Programmer UART_Rx
5	DTR_E	UART_DTR_ESP		11	DTR	Programmer UART_DTR
6	RESET	MCU Reset		12	DTR	Programmer UART_DTR

Table 5: Header P5 Pin Configuration

vi. HEADER P1: ISP/SPI Header

P1							
Header Pin #	**MCU Pin #**	**Arduino Port #**	**Designator**		**Header Pin #**	**MCU Pin #**	**Arduino Port #**	**Designator**
1	16	12	MCU_MISO		2	-	-	MCU_VCC
3	17	13	MCU_SCK		4	15	11	MCU_MOSI
5	29	-	MCU_RESET		6	-	-	MCU_GND

Table 6: ISP Programmer / SPI Header

vii. HEADER J11: MCU ADCs and I2C

J11				
Header Pin #	**MCU Pin #**	**Arduino Port #**	**Designation**	**Description**
1	27	A4	MCU_PC4_SDA	Can be used as GPIO or I2C or ADC
2	28	A5	MCU_PC5_SCL	Can be used as GPIO or I2C or ADC
3	22	A7	MCU_ADC7	Can be used only as ADC
4	19	A6	MCU_ADC6	Can be used only as ADC

Table 7: MCU ADCs and I2C

viii. HEADER P2: MCU Power selection header

P2		
Header Pin #	**Designator**	**Description**
1	VCC_5V	5VDC
2	VCC_MCU	MCU voltage selection either 5V/3.3V
3	VCC_3V3	3.3VDC

Table 8: MCU Power selection Header

b. APPLICATION WIRING DIAGRAM

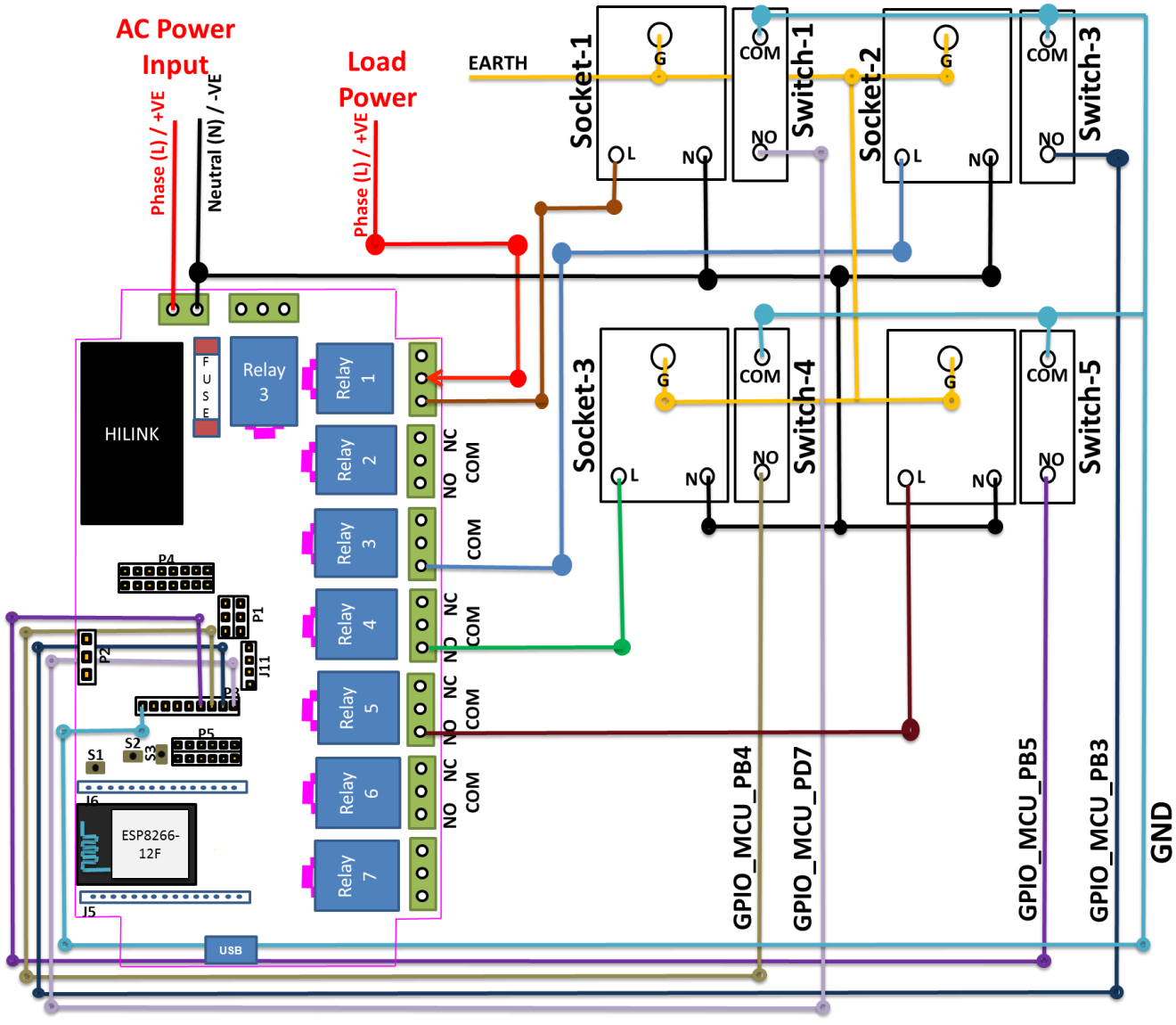

Figure 6: Application wiring example

Figure 6 represents about connection between load and relay output (J1-J4, J7-J10) connectors. Phase is given to Common terminal and load shall be connected to the NO/NC terminal of the relay.

Output of relay-1, 3, 4, 5 are used to represent example application connection diagram. In an above wiring diagram, an output of relays are connected to Three-pin sockets respectively through NO pin of relay. That means the socket will get power only when the relay is triggered.

If the socket connected by NC, then socket will get power by default and disconnects power when the relay is triggered.

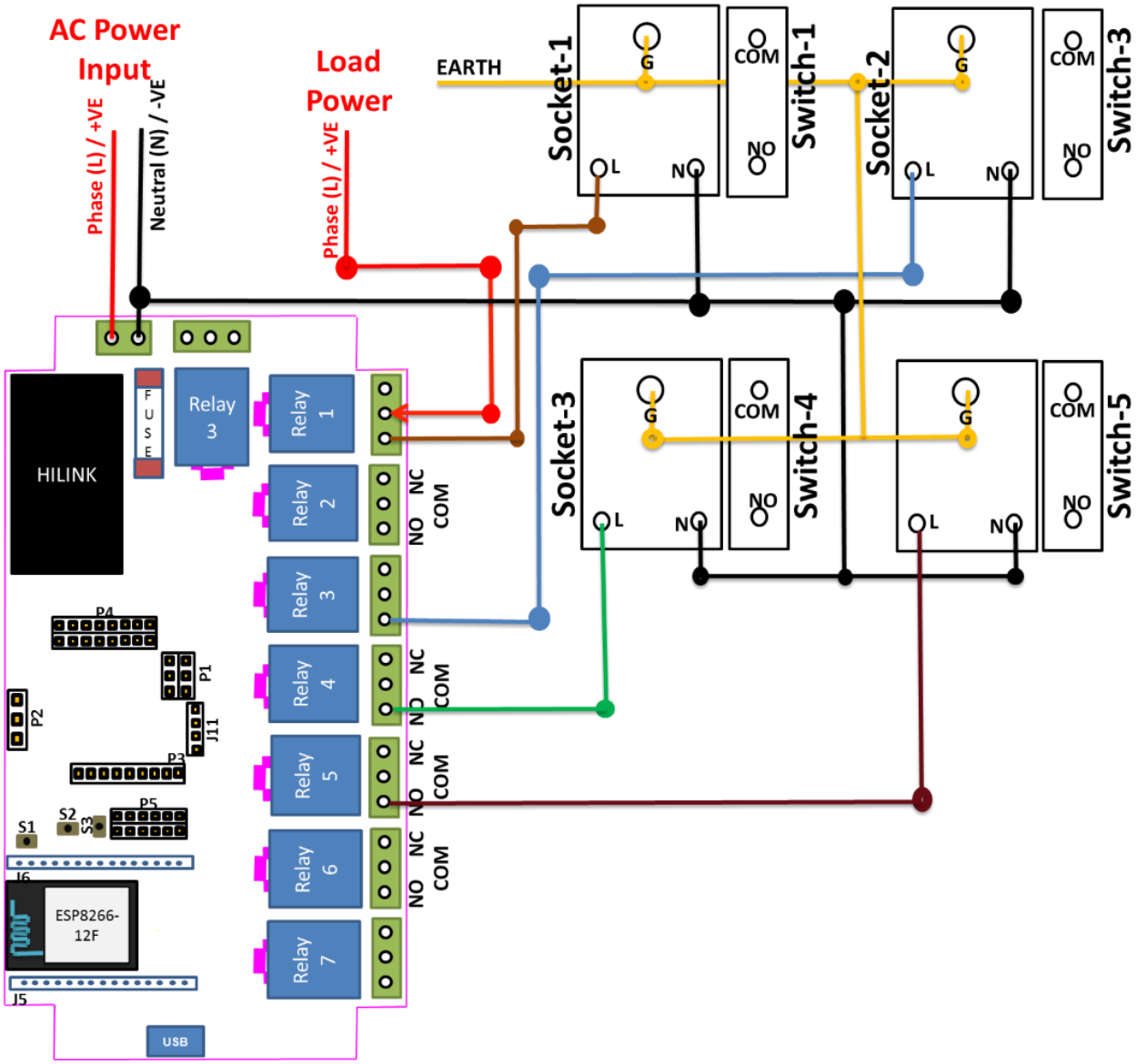

Figure 7: Relay output Connections diagram

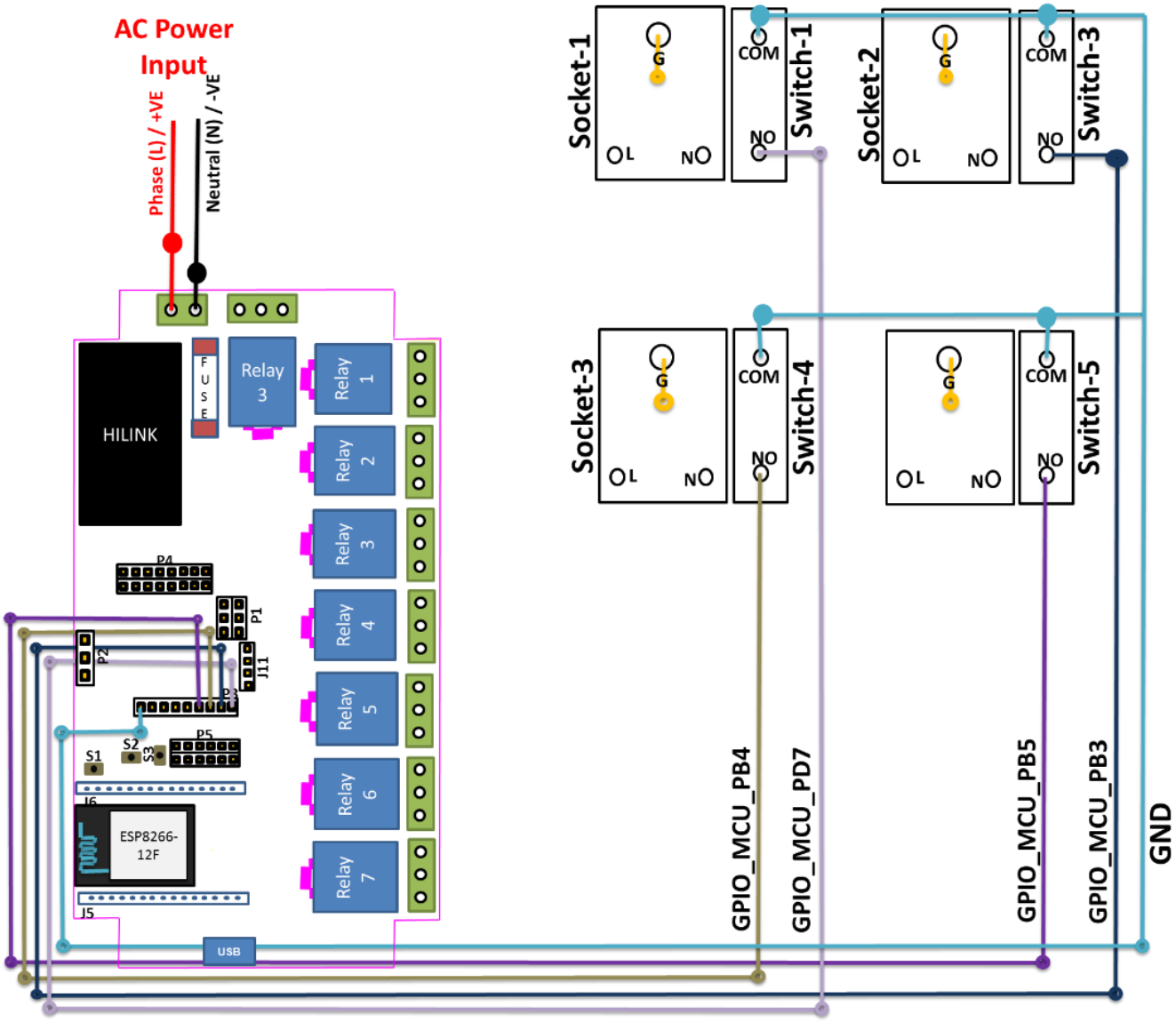

Figure 8: Virtual Connections.

11. HOW TO USE THE PRODUCT

Power ON the device, so that, it will host the access point as shown in Figure 9,

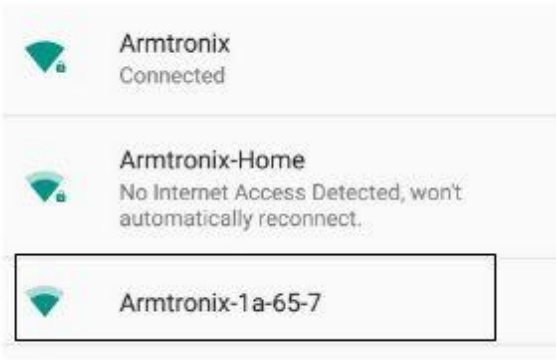

Figure 9: Device hosting Access point

Connect the mobile to access point with Armtronix-(MAC ID). EX: Armtronix-1a-65-7 as shown in Figure 10.

Figure 10: Access point name

After connecting, open browser and enter 192.168.4.1 IP address, it will open the web server as shown in the Figure 11,

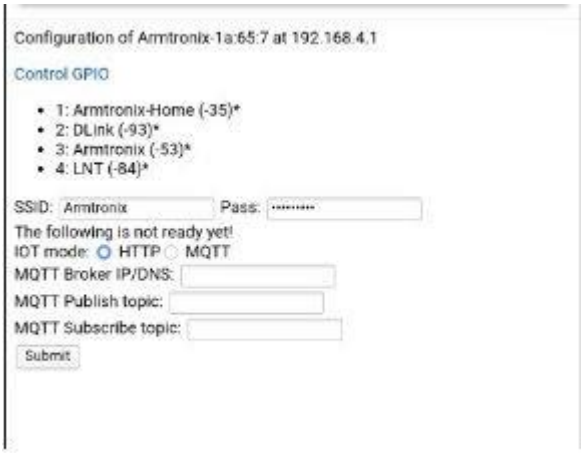

Figure 11: Web server

fill the SSID and password and select HTTP, if user wants to connect to MQTT then user has to

select MQTT radio button, enter MQTT broker IP address, enter MQTT publish topic then MQTT subscribe topic and submit.

After submitting configuration, the ESP 8266 will connect to the router and router assigns IP address to the ESP. Open that IP address in the browser to control the switch (Relay).

Without configuring the SSID and Password we can control the Wifi Switch by connecting to the access point of the device and open the IP address of device i.e 192.168.4.1 the web server page will show the link with the name Control GPIO as shown in the Figure 8, by clicking this link we can control the Wifi Switch board but the response will be slow.

12. HOW TO CUSTOMISE FIRMWARE

You can program this board using Arduino IDE. Please follow the below steps to program the board by yourself with easy steps as mentioned below:

a. STEPS TO LOAD PROGRAM TO ESP8266:

1. Use external USB-UART converter between computer and this board.
2. Short Pin-2 and Pin-8 of bergstick-header P3 using removable jumper.
3. Short Pin-3 and Pin-9 of bergstick-header P3 using removable jumper.
4. Connect Micro USB cable between your computer and U5 of “Wifi Eight Relay Board”.
5. Open your code in Arduino IDE as shown.
6. Click on Tools Tab, move mouse pointer on “Board: xxxxxxxxxx” and click on “NodeMCU0.9 (ESP-12 Module)” as shown in figure 12.

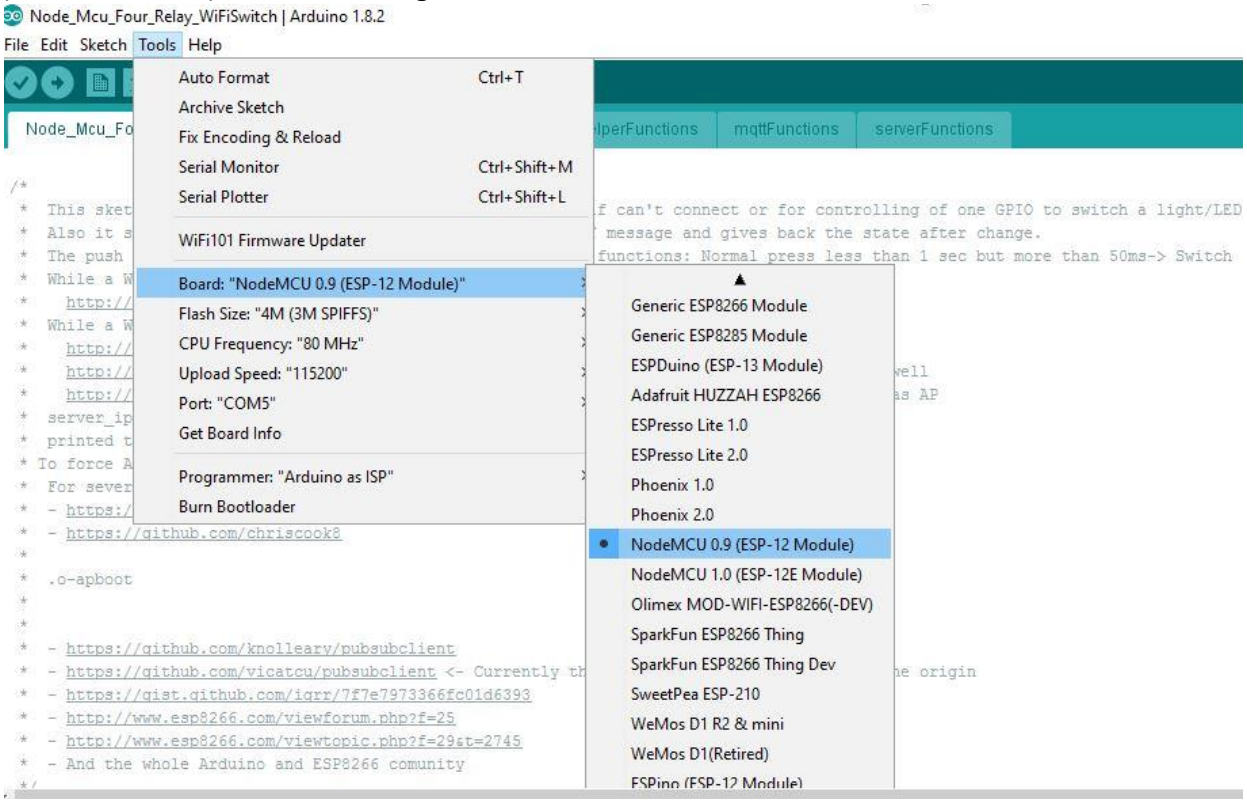

Figure 12: Board Selection

7. Select Upload Speed as “115200”.
8. Select flash size as “4M (SPIFFS)”
9. Select CPU Frequency as “80Mhz”.

10. Click on tools tab, move mouse pointer to “Programmer: “Arduino as ISP’”, under this click on “Arduino as ISP” to select. Refer to figure 13.

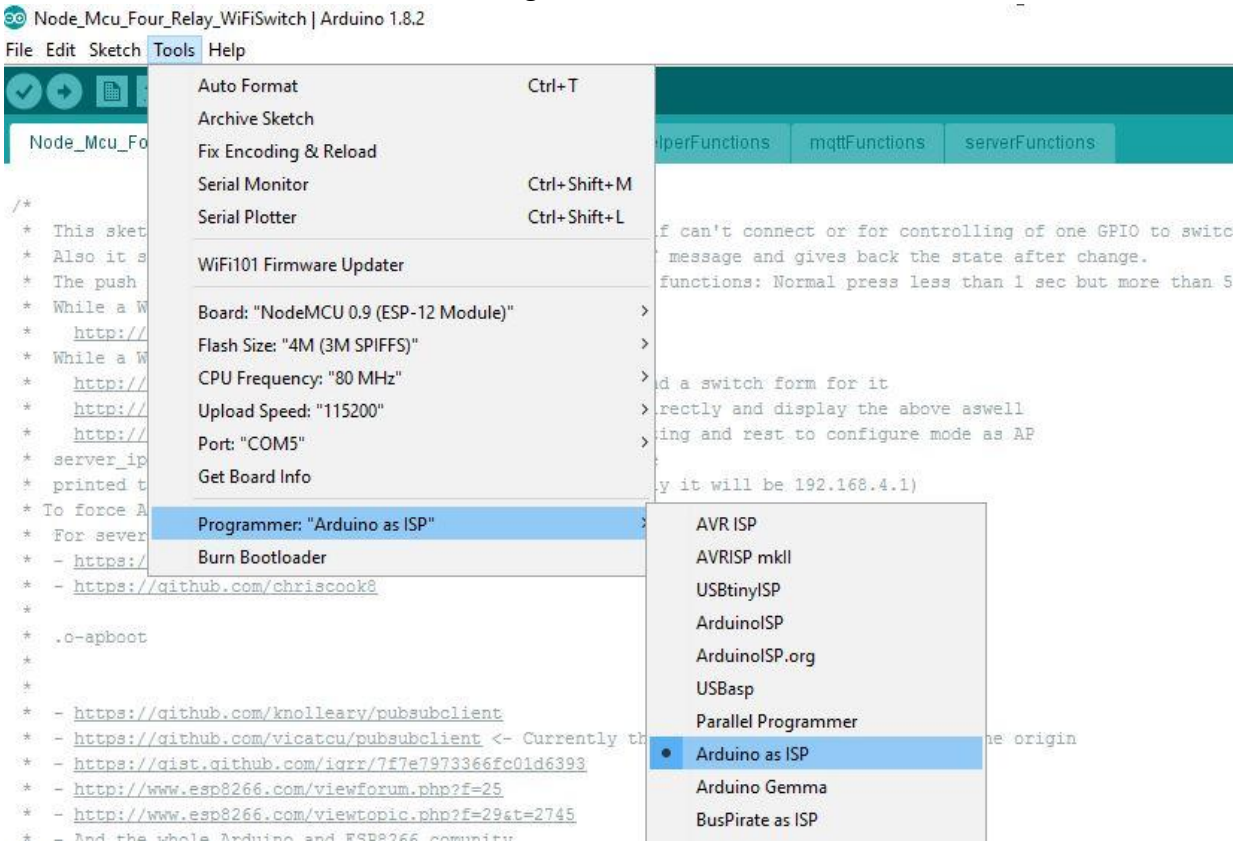

Figure 13: IDE Selection

11. Click on tools tab, move mouse pointer to “Port: “COMx”, under this click on “COMx” to select. (“x” refers to port number available in your computer) Refer to figure 14.

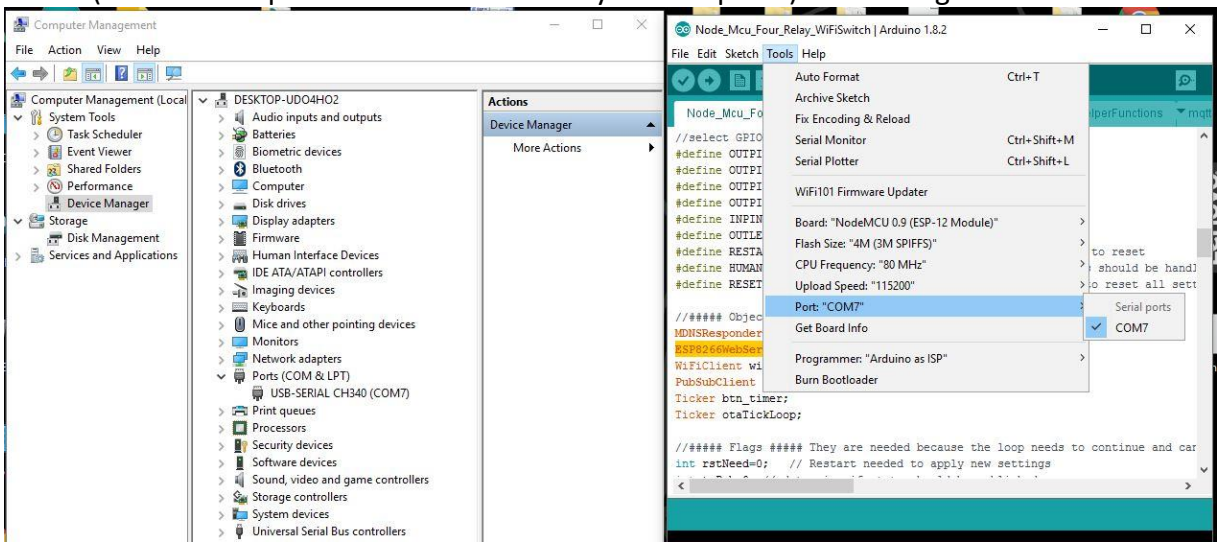

Figure 14: COM port selection.

12. Run the program. Refer to Figure 15.

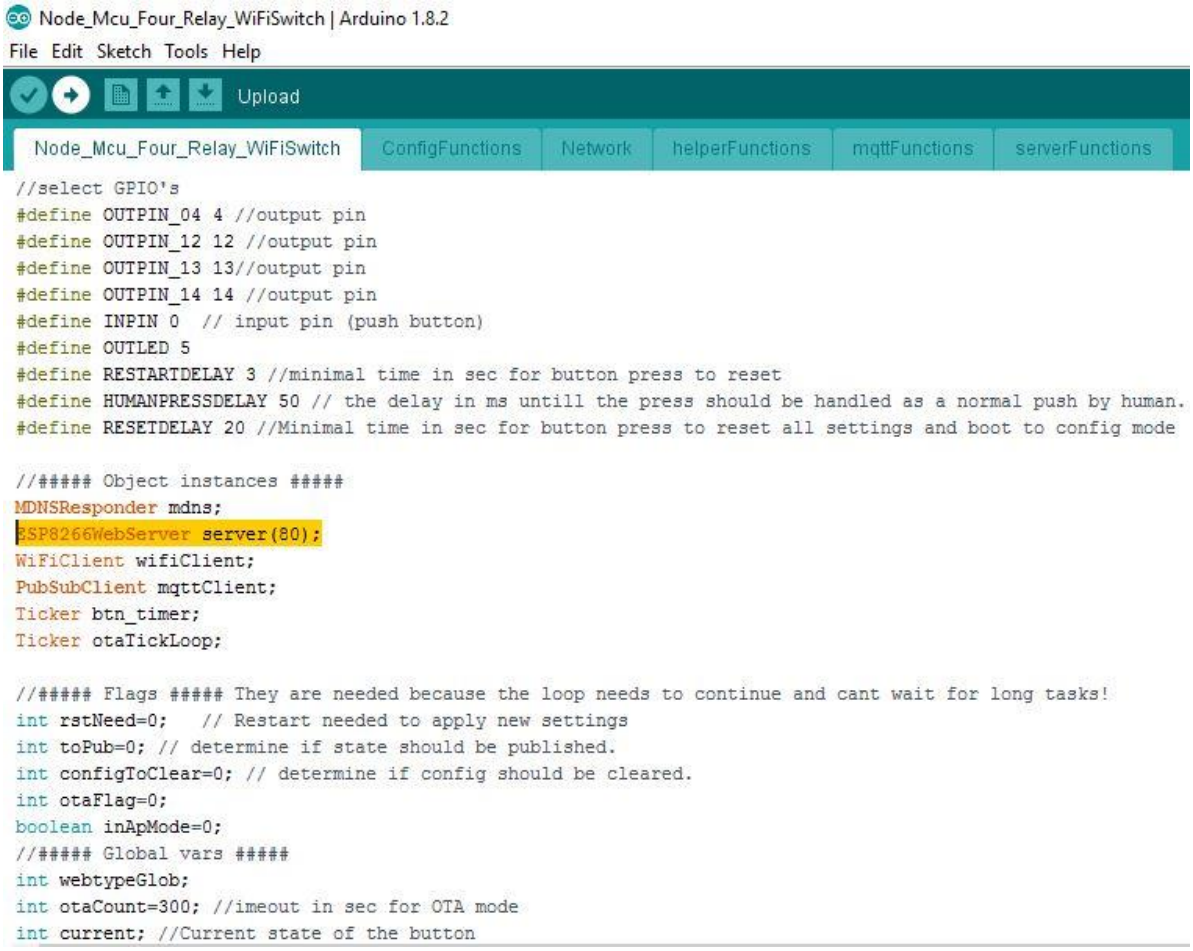

Figure 15: Executing code

a. STEPS TO LOAD PROGRAM TO ATMEGA328P:

1. Use external USB-UART converter between computer and this board.
2. Short Pin-1 and Pin-7 of bergstick-header P3 using removable jumper.
3. Short Pin-4 and Pin-10 of bergstick-s header P3 using removable jumper.
4. Connect Micro USB cable between your computer and U5 of “Wifi Eight Relay Board”.
5. Open your code in Arduino IDE as shown.
6. Click on Tools Tab, move mouse pointer on “Board: xxxxxxxxxx” and click on “Arduino Uno” as shown in figure 10.
7. Select Upload Speed as “115200”.
8. Click on tools tab, move mouse pointer to “Programmer: “Arduino as ISP’”, under this click on “Arduino as ISP”
9. Click on tools tab, move mouse pointer to “Port: “COMx”, under this click on “COMx” to select. (“x” refers to port number available in your computer).
10. Run the program.

Once your loading of program is completed, switch OFF the board and disconnect converter from it and short Pin-1.RXDA to Pin-2.TXDE, short Pin-3.RXDE to Pin-4.TXDA, to check the board functionality and use. If the board is working as per your code, then you can install it for your application.

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