DESCRIPTION DOCUMENT FOR WIFI THREE DIMMER BOARD WITH POWER MONITOR

HARDWARE REVISION 0.1

Department	Name	Signature	Date
Author			
Reviewer			
Approver			

Revision History

Rev	Description of Change	Effective Date
A	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
A	Ampere
AC	Alternating Current
ASIC	Application Specific Integrated Circuit
COM	Communication
DC	Direct Current
GPIO	General Purpose Input Output
HTTP	Hypertext Transfer Protocol
Hz	Hertz
I2C	Inter Integrated Circuit
IDE	Integrated Development Environment
IP	Internet Protocol
LED	Light Emitting Diode
MCU	Microcontroller Unit
MQTT	Message Queue Telemetry Transport
PCB	Printed Circuit Board
PWM	Pulse Width Modulation
SPI	Serial Peripheral Interface
SSID	Service Set Identifier
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
V	Volts
ZCD	Zero Crossover Detection

2. REFERENCES

Company Website link	https://www.armtronix.in
Intractable's Weblink	
Github's Weblink	https://github.com/armtronix/Wifi_Three_Triac_Board

3. PURPOSE

The purpose of this document is to outline the design description for the Wifi_3-Dimmer 1A Board. It provides a high level summary of the product.

4. SCOPE

This document describes system architecture which includes Power supply, Microcontroller, WiFi Module and Triac.

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 human 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 page and github. Please refer it.

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. INTRODUCTION

Three Triac Dimmer board is a Wifi based remote control switch/dimming device. Designed and developed to control lights and/or fans. Using this board the lights and fans can be controlled through smart phone which you use regularly. This board is not just to switch ON/OFF light, you can also vary the intensity of light from 0 to 100%. You can connect and control two loads at an instant. It also has feature to connect potentiometer as virtual switch to vary the intensity of light or speed of fan in two way mode with respect to mobile phone.

7. PRODUCT FEATURES

- Works directly with AC power 100 - 240 V AC 50-60 Hz.
- Has power monitoring feature.
- Product firmware can be updated/reloaded/changed as per user requirement.
- Board is Arduino compatible.
- Three Triac outputs, to control the light/Fan.
- Triac output can handle up to 1 Amperes of current.
- WiFi with MQTT or HTTP protocol.
- Basic Firmware to enter SSID and password to connect to the router.
- Firmware has ability to control device through HTTP and MQTT mode.
- Tactile Switch on board Provided for Restart and configuration Reset function.
- Does not require external neutral for output.

8. PRODUCT DESCRIPTION

a. PHYSICAL DESCRIPTION

- AC to DC Power supply module
- Triac 3Nos.
- Wifi Module
- Microcontroller
- Power Monitoring

b. FUNCTIONAL DESCRIPTION

Block Diagram

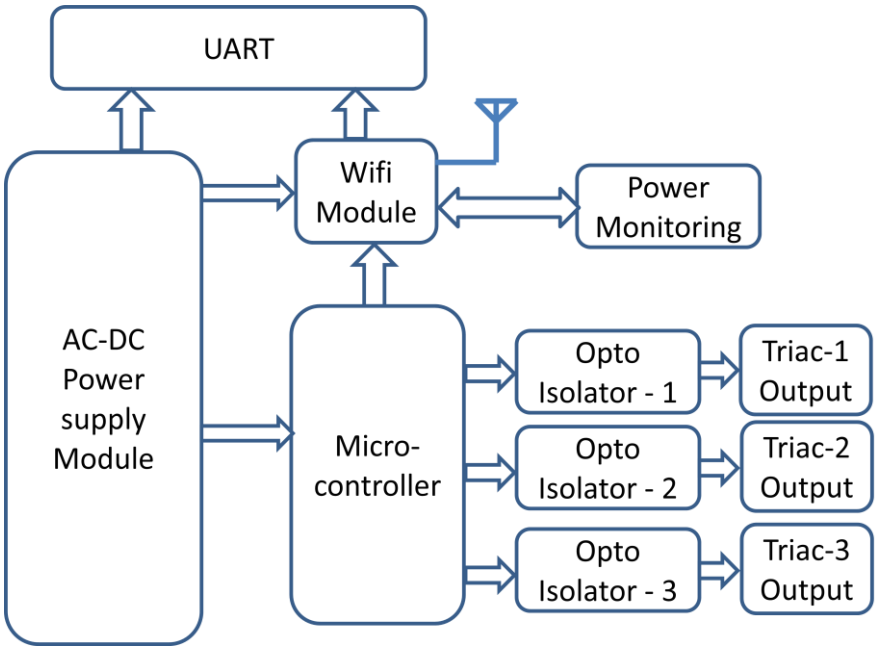

Figure 1: Block Diagram

Three Triac one Ampere board has an on-board power supply module which takes standard AC power as input and provides required DC power as output. The DC power is used to power-up microcontroller, Wifi module and power monitoring block incorporated on board to run a dimmer algorithm and to establish Wifi communication with mobile phones respectively. There are three Triacs used on board to control ON/OFF and dimming of light intensity from a mobile application using MQTT/HTTP protocol. It also has power monitoring block implemented, to monitor the power consumption of loads. It is compatible with Arduino and can reprogram using a dedicated header available on it through Arduino IDE.

9. SYSTEM OVERVIEW

1. AC to DC Power supply module

   AC to DC converter is power supply module manufactured from Hi-Link part number HLK-PM01. This power supply module rectifies and regulates voltage from 230 V AC to 5 V DC with output current capacity of 0.6A DC. The power of HLK-PM01 is at maximum of 3W. The 5V output can be accessed to connect any external sensors.

   The DC-DC converter on board is used to regulate voltage from 5 V DC to 3.3 V DC to supply power to complete digital part.

2. Wifi Module

   Wifi module used on the board is ESP12 with all its required GPIOs are easily accessible to user for their own application. Wifi module is powered by through 3.3 V DC. It works on both MQTT / HTTP protocol.

3. Zero Crossover Detection

   Zero cross over detection is used to detect the zero crossing of AC phase to fire the Triac

synchronously to get the smooth output. Optically isolated ZCD circuit is implemented to protect device from unwanted signals due t o AC lines.

4. Triac
   TRIAC is driven through optically isolated TRIAC drivers with reference to zero crossover detection. Synchronous switching method is used to regulate the power to loads. PWM signal will drive the TRIACs, and switches AC mains power from 0% to 100% of its total cycle. The PWM signal pulses can be configured in code with respect to AC mains frequency and voltage level. BT136 Triac is used in this board to act as dimmer or switch.

5. Microcontroller
   The Microcontroller executes the dimmer algorithm to drive the TRIAC switch, by receiving ZCD signal. Along with this, it has three LEDs to indicate the status of loads. Controller communicates with Wifi module through UART mode of communication to send and receive data to-and-from respectively with connected Wifi network. ATmega328P microcontroller is used in the product to execute the algorithm, which is manufactured by Atmel incorporation and is compatible with Arduino.

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

6. Power Monitoring
   Product has power monitoring feature on board. You can monitor power consumption of load instantly in terms of watts. HLW8012 is the power ASIC is used for power measurement, which is interfaced to ESP8266 12F. For GPIOs detail, please refer to Table 2.

10. TECHNICAL SPECIFICATION

a. ELECTRICAL SPECIFICATION

Input Specifications				
Description	**Min**	**Typ**	**Max**	**Unit**
Voltage AC	100	220	230	Volts
Current AC	0.6	2.6	-	Amps
Power AC	-	3	-	Watts
Frequency	50	-	60	Hz

Triac-1 Output Specifications (Maximum)				
Description	**Min**	**Typ**	**Max**	**Unit**
Voltage AC	-	-	240	Volts
Current AC	-	-	1	Amps
Power AC	-	-	480	Watts

Triac-2 Output Specifications (Maximum)				
Description	**Min**	**Typ**	**Max**	**Unit**
Voltage AC	-	-	240	Volts
Current AC	-	-	1	Amps
Power AC	-	-	240	Watts

Triac-3 Output Specifications (Maximum)				
Description	**Min**	**Typ**	**Max**	**Unit**
Voltage AC	-	-	240	Volts
Current AC	-	-	1	Amps
Power AC	-	-	240	Watts

b. MECHANICAL SPECIFICATION

- Mechanical Dimensions of PCB are 84 x 69 x 20 mm (Length x Width x Height)
- Mounting Holes M3 size.

11. ELECTRICAL CONNECTIONS

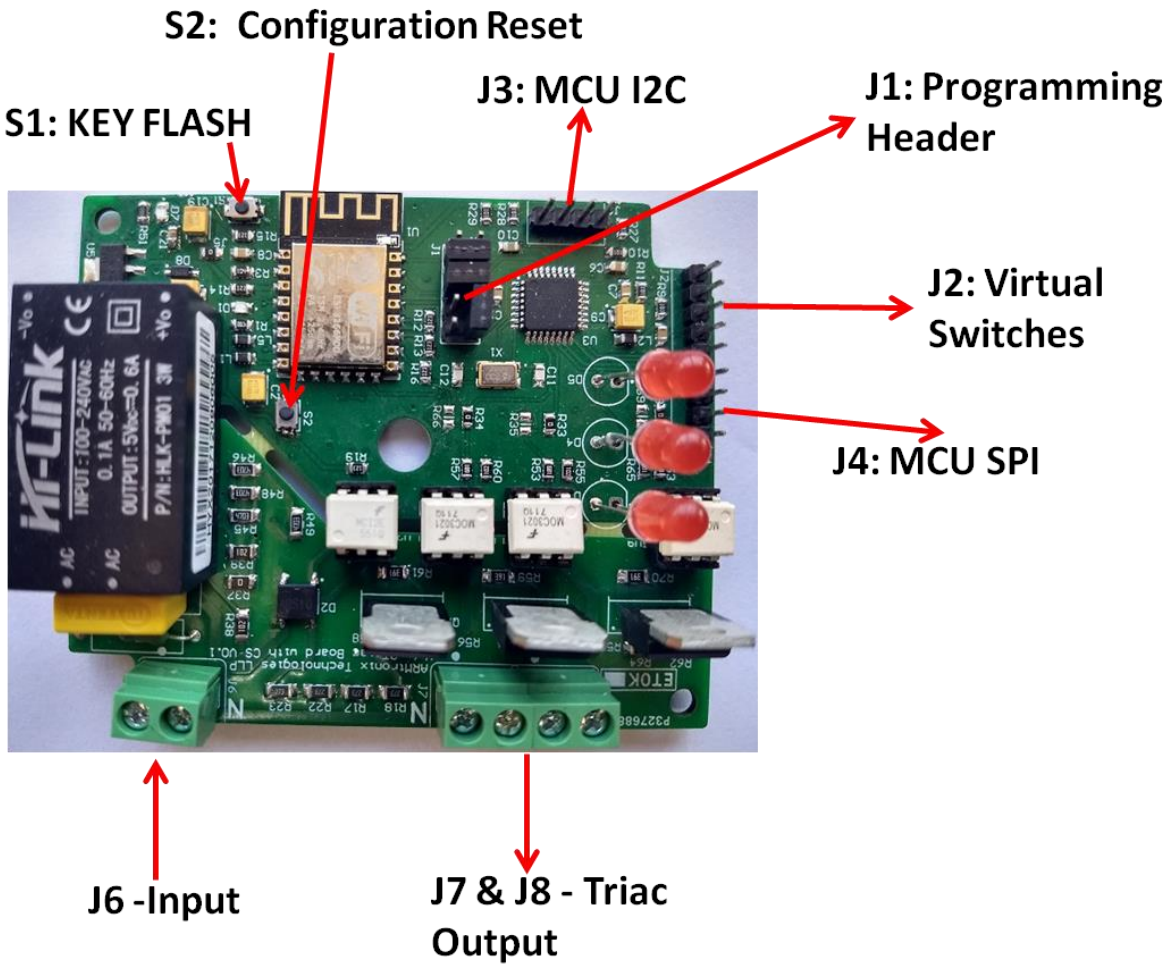

Figure 2: Header and Switch Details

Description of Header and Switches shown in Figure 2:

1. S1 Button is for Key Flash of ESP
2. S2 Button is for configuration reset
3. J1 Header is Programming
4. J2 Headers for virtual switches (DC)
5. J3 Header of MCU I2C
6. J4 Header of MCU SPI

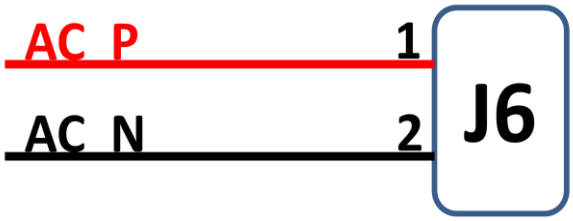

Figure 3: AC Input connection

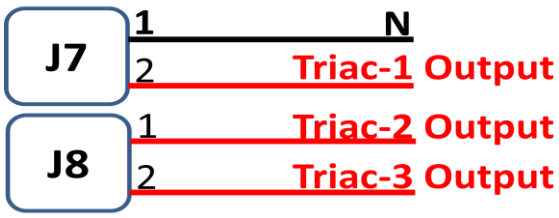

Figure 4: Triac output

Figure 3, shows pinout and connection of AC Phase and Neutral connection to J6 input connector.

Figure 4, shows output load connection of J7 and J8.

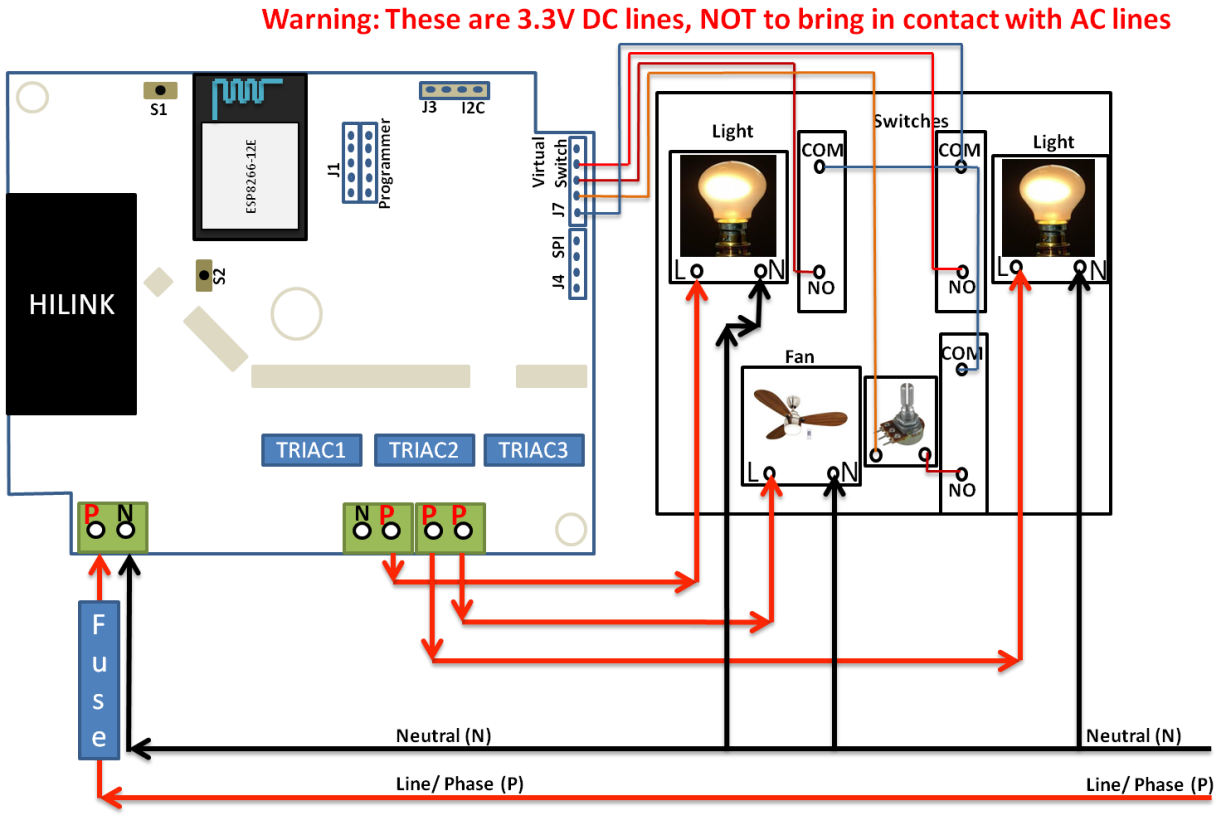

Figure 5: Load connection

Figure 5, shows the connection of two light and one fan as load with board. All the three traic output's Phase is available in output connectors J7 and J8 along with one Neutral connection. In the above case, Triac-1 and Triac-2 are configured as switch to ON/OFF light and Triac-3 is configured as dimmer to vary the speed of fan using though Smartphone and also you can connect potentiometer for 2-way switch application.

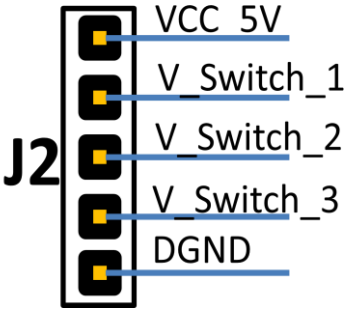

Figure 6: Virtual Switch Connector

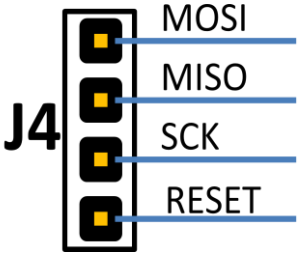

Figure 7: MCU SPI Connector

Figure 6 and Figure 7, shows the J2 and J4 headers above are Virtual switch connector and MCU SPI connector respectively, can be used for user application.

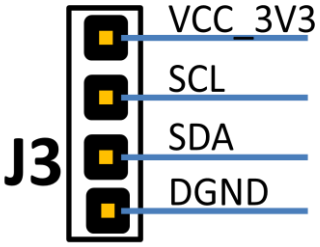

Figure 8: MCU I2C Connector

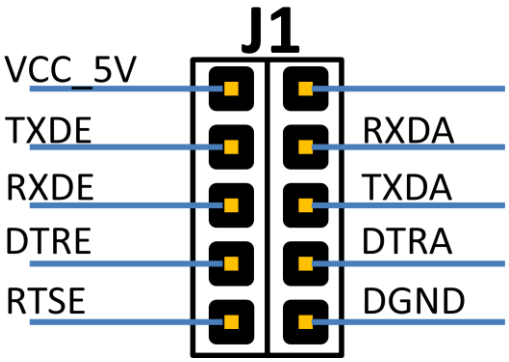

Figure 9: Programming Header

Figure 8 and Figure 9, shows the J3 and J1 headers above are MCU I2C connector and programming header respectively. MCU I2C header can be used for any peripheral device and expansion.

a. ATmega328P GPIO DETAILS:

MCU GPIO	MCU Pin No.	Arduino Pin No	Type	Purpose
PB0	12	8	PWM OUTPUT	DIMMER_TRIAC-1
PB1	13	9	PWM OUTPUT	DIMMER_TRIAC-2
PB2	14	10	PWM OUTPUT	DIMMER_TRIAC-3
PB3/MOSI	15	11	-	GPIO/SPI
PB4/MISO	16	12	-	GPIO/SPI
PB5/SCK	17	13	-	GPIO/SPI
PC0	23	A0	INPUT	V_Switch_1
PC1	24	A1	INPUT	V_Switch_2
PC2	25	A2	INPUT	V_Switch_3
PC4/SDA	27	A4	-	GPIO/I2C
PC5/SCL	28	A5	-	GPIO/I2C
PC6/RESET	29	A6	-	GPIO/RESET
PD0/RXD	30	0	-	GPIO/UART

PD1/TXD	31	1	-	GPIO/UART
PD2/INT0	32	2	INTERRUPUT INPUT	ZCD

Table 1: MCU GPIO Details

b. ESP8266 12F GPIO DETAILS:

ESP GPIO	ESP Pin No.	Type	Purpose
GPIO1/TXDE	22	-	UART
GPIO2/RXDE	21	-	UART
GPIO5	20	OUTPUT	POWER MONITOR-SEL
GPIO13	7	INPUT	POWER MONITOR-CF1
GPIO14	5	INPUT	POWER MONITOR-CF

Table 2: ESP GPIO DETAILS

12. TYPICAL APPLICATION WIRING DIAGRAM

a. Output: 2-Light, 1-Fan, Virtual Switch and Pot Wiring

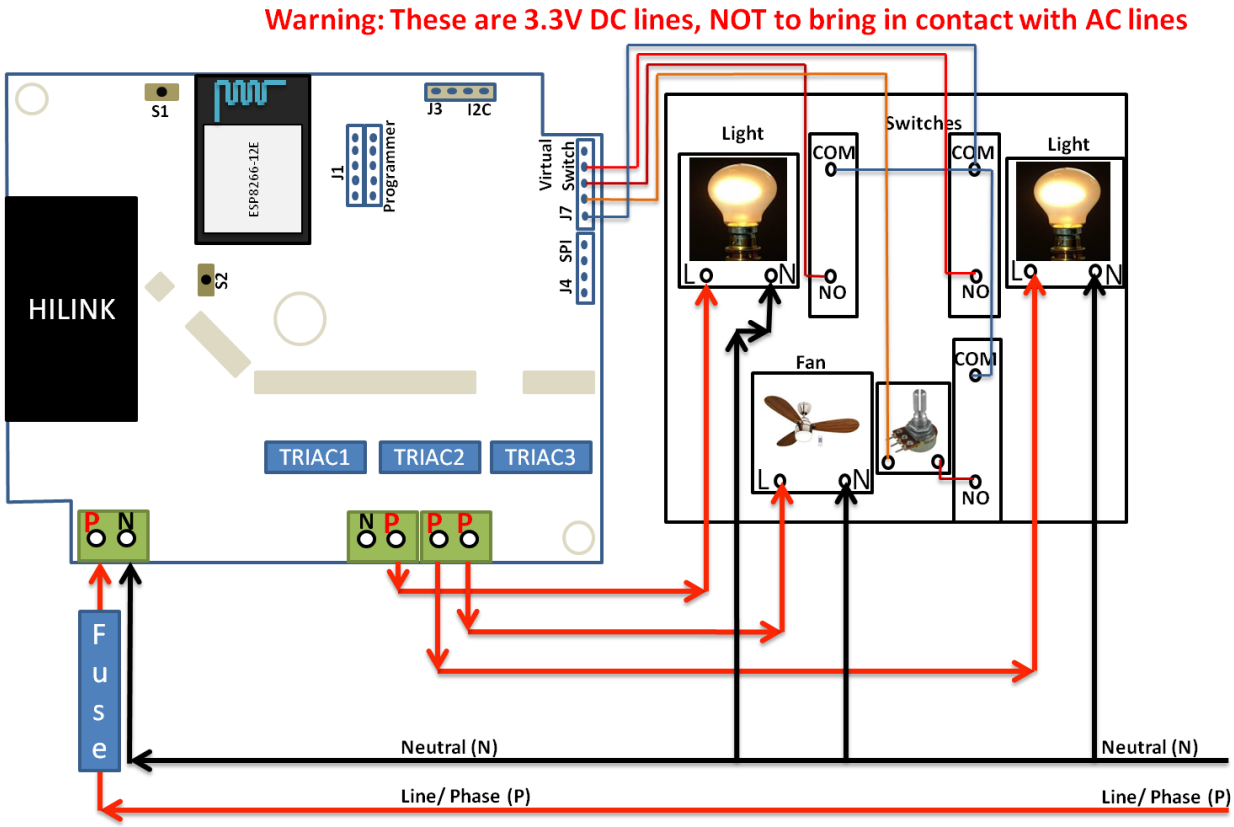

Figure 10: 2-LIght, 1-Fan, Virtual Switch ad POT wiring

13. HOW TO USE THE PRODUCT

Power ON the device, so that, it will host the access point as shown in Figure 11,

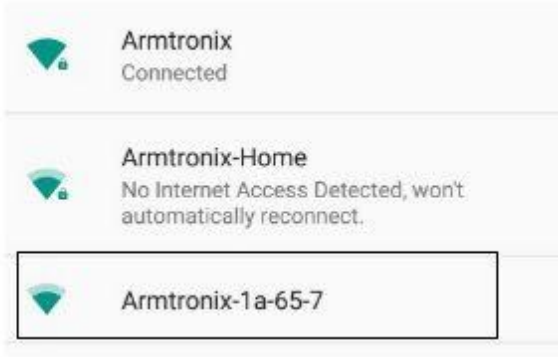

Figure 11: Device hosting Access point

Connect the mobile to access point with Armtronix-(MAC ID). EX: Armtronix-1a-65-7 as shown in Figure 12.

Figure 12: 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 13,

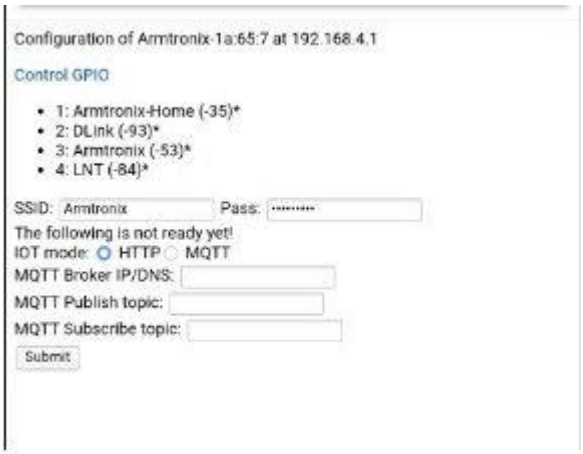

Figure 13: Web server

Enter SSID and password and select HTTP, if user wants to connect to MQTT then he 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.

14. 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. Connect VCC of converter to “Pin-1.VCC_5V” of J1.
3. Connect RX pin of converter to “Pin-3.TXDE” of J1.
4. Connect TX pin of converter to “Pin-5.RXDE” of J1.
5. Connect DTR pin of converter to “Pin-7.DTRE” of J1.
6. Connect RTS pin of converter to “Pin-9.RTSE” of J1.
7. Connect GND of converter to “Pin-10.DGND” of J1.
8. Open your code in Arduino IDE as shown.
9. Click on Tools Tab, move mouse pointer on “Board: xxxxxxxxxx” and click on “NodeMCU0.9 (ESP-12 Module)” as shown in figure 14.

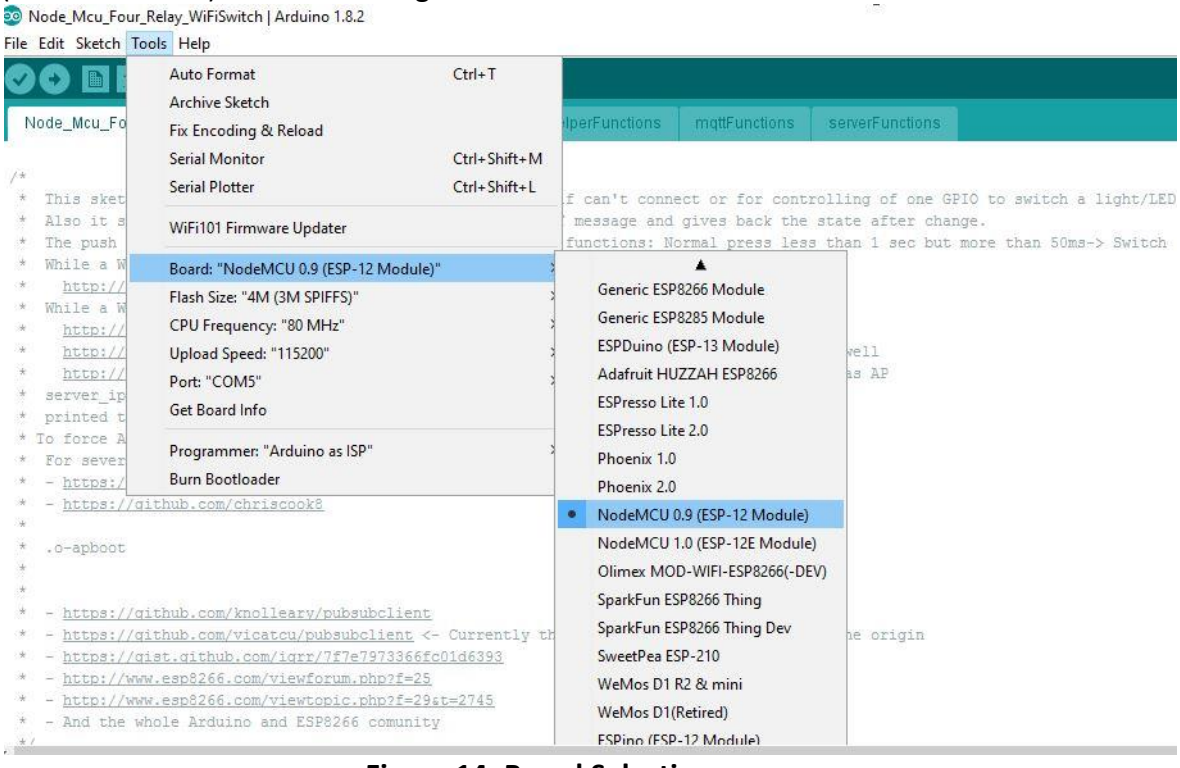

Figure 14: Board Selection

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 15.

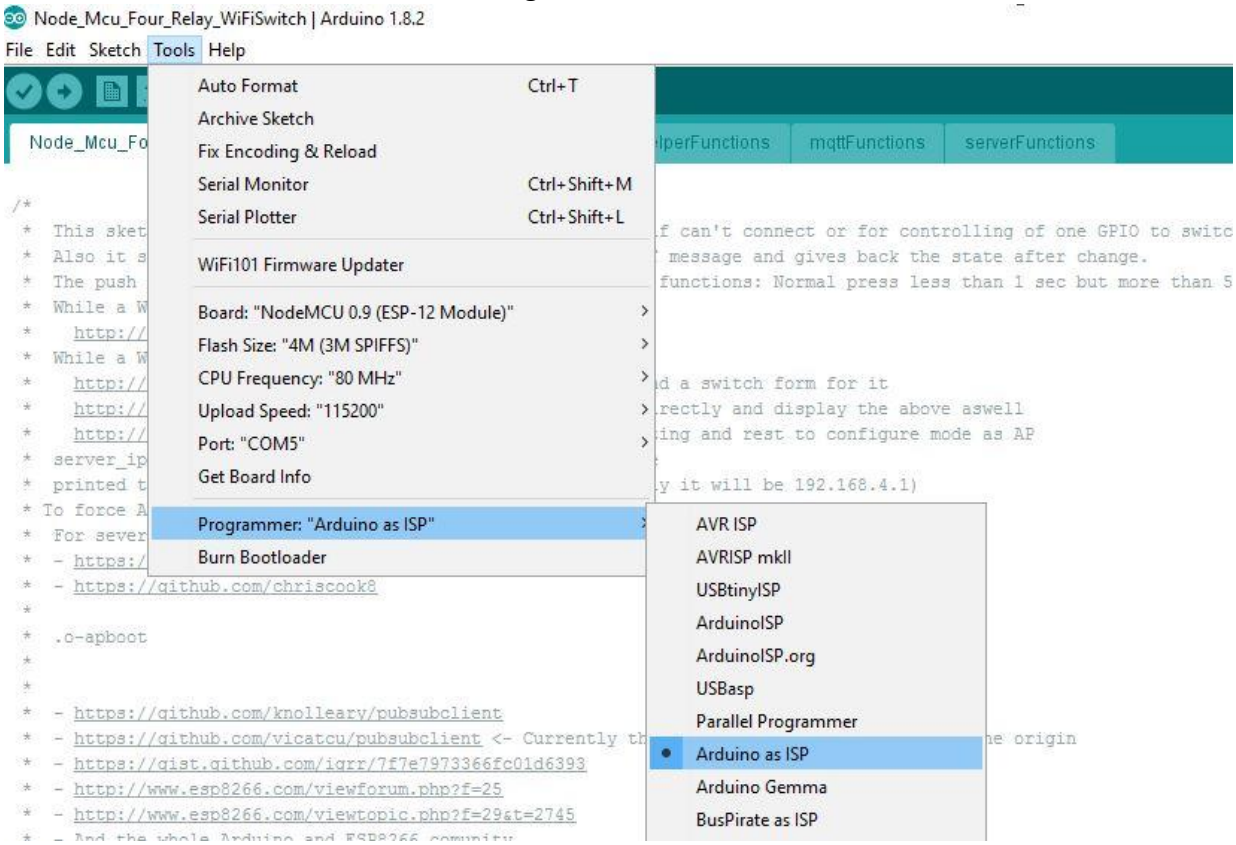

Figure 15: IDE Selection

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 16.

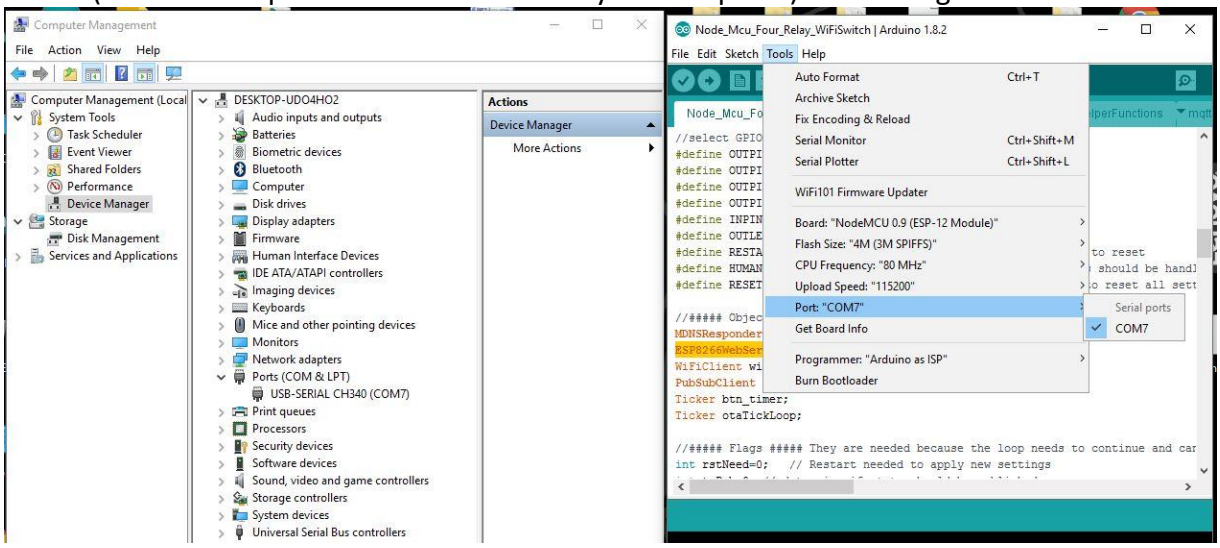

Figure 16: COM port selection.

12. Run the program. Refer to Figure 17.

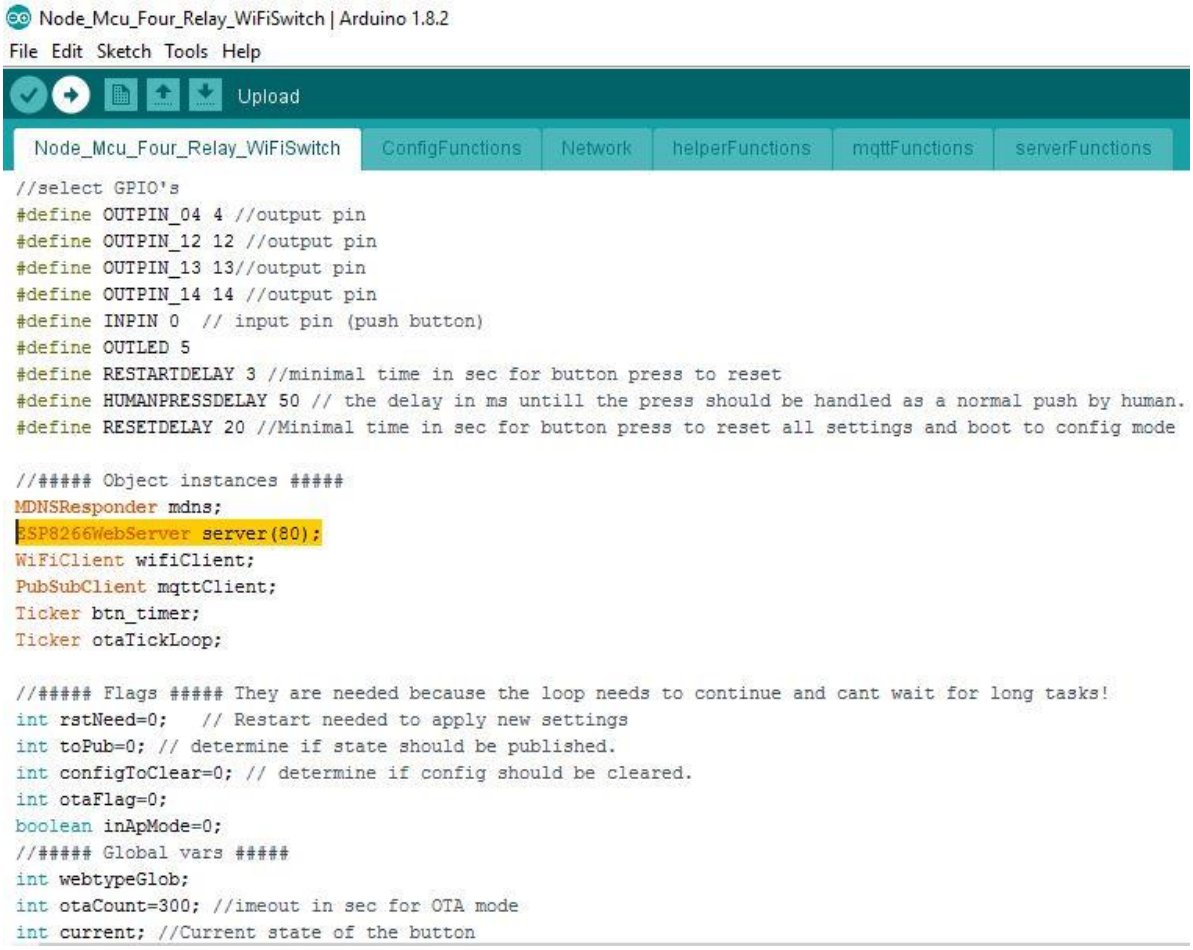

Figure 17: Executing code

b. STEPS TO LOAD PROGRAM TO ATMEGA328P:

1. Use external USB-UART converter between computer and this board.
2. Connect VCC of converter to “Pin-1.VCC_5V” of J1.
3. Connect TX pin of converter to “Pin-4.RXDA” of J1.
4. Connect RX pin of converter to “Pin-6.TXDA” of J1.
5. Connect DTR pin of converter to “Pin-8.DTRA” of J1.
6. Connect GND of converter to “Pin-10.DGND” of J1.
7. Follow same steps as shown in section from “13.a Steps to Load Program to ESP8266”, except Step 10. In step 2, you need to select “Arduino Uno” instead of “NodeMCU0.9 (ESP-12 Module)”. Follow the remaining steps as they are.

Once your loading of program is completed, disconnect converter from board and short Pin-3.TXDE to Pin-4.RXDA, short Pin-5.RXDE to Pin-6.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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