DESCRIPTION DOCUMENT FOR WiFi <-> RS485 <-> LoRa DEVICE BOARD

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
CPU	Central Processing Unit
DC	Direct Current
GPIO	General Purpose Input Output
I2C	Inter Integrated Circuit
IDE	Integrated Development Environment
Li-Ion	Lithium Ion
MCU	Microcontroller Unit
mm	Mili Meter
PCB	Printed Circuit Board
SCL	Serial Clock
SDA	Serial Data
STM	ST Microelectronics
UART	Universal Asynchronous Receiver Transmitter
USART	Universal Synchronous Asynchronous Receiver Transmitter
USB	Universal Serial Bus
V	Voltage
WAN	Wide Area Network

2. REFERENCES

Company Website link	https://www.armtronix.in
Intractable's Weblink	
Github's Weblink	https://github.com/armtronix/arduino-LoRa-STM32

3. PURPOSE

The purpose of this document is to outline the design description for the Wifi <-> RS485 <-> LoRa device. It provides a high level summary of the product.

4. SCOPE

This document describes system architecture which includes Power supply, Wifi ESP32, Microcontroller and Lora Module.

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

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of an accident. Use a 1A 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.

If you are working with Li-ion battery, please take necessary precautions. Do not short the positive and negative terminals of the battery, as it may damage the battery and may create hazardous to your health. Please consider disconnecting battery or power supply from the board if you would like to make any changes in connections. Working without safety towards Li-ion batteries is not advisable.

6. INTRODUCTION

Wifi <-> RS485 <-> LoRa device has a combination of Wifi, LoRa technology bridge with RS485 for industrial application for remote monitoring and control in the Industrial 4.0 environment. Idealy suitable application remote monitoring and controlling ideally for industrial application, which can minimize wiring along the floor or roof. This board has Wifi module based on ESP32, STM microcontroller and DRF176G LoRa module interfaced through SPI communication and the board is designed to support for LoRa WAN protocol. The STM microcontroller and ESP32 used is this board is Arduino IDE compatible, so that users need not to worry about external programmer and board is designed such that, it can be directly connect to computer USB to program it just by using mobile data cable, and not required to use any external hardware to program both for STM controller or WiFi module. The device has an option to set Device ID for RS485 application by selecting Dipswitches on board, which also be taken care while developing application specific code for the device.

The new device will come with basic test code for Wifi, RS485 and LoRa for testing purpose only, not for any application. **The application specific code has to be developed by users**. ARMtronix can develop any application specific code on specific requirement basis only. Please mail if any such specific requirements at sales@armtronix.in.

7. PRODUCT FEATURES

- Works directly with AC input 100 V AC - 250 V AC.
- Product firmware can be updated/reloaded/changed as per user requirement.
- It has onboard USB to UART converter for programming purpose.
- Board is Arduino compatible.
- Has a LoRa module and is LoRaWAN compatible.
- Basic Firmware to enter SSID and password to connect to the router
- Has most of all the GPIOs of controller are accessible for user's application.
- Push Button on board Provided to Reset.
- ESP32 Wifi communication 802.11 b/g/n. 802.11 n (2.4GHz), upto 150Mbps
- LoRa communication frequency is 868Mhz with SX1272 Module DRF1276G.

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8. PRODUCT DESCRIPTION

a. PHYSICAL DESCRIPTION

- AC to DC Power supply module
- Wifi Module
- RS485 / Modbus
- USB-UART Converter
- LoRa Module.

b. FUNCTIONAL DESCRIPTION

Block Diagram

Wifi <-> RS485 <-> LoRa device has an on-board AC-DC power supply, which converts AC power to required DC power on board and it also has DC-DC regulator which takes DC input of 5V and provides regulated DC power as output for both Wifi and LoRa module. The device come with external antenna for LoRa.

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-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-PM01 is at maximum of 5W.
The 5V supply is used to power on relay 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 ESP32. It is powered on through 3.3 V DC. It works on both MQTT / HTTP protocol. Module has additional internal feature of Bluetooth, but the program has to be made to use this feature.

3. RS485 / Modbus

The device is compatible with standard RS485/Modbus. As the device ID configurable for RS485 application, user can connect multiple these devices in same RS485 bus and data can be broadcasted to Wifi or LoRa.

4. 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 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 single relay board for programming purpose.

5. LoRa Module

LoRa module DRF1276G from Dorji used on board for LoRa communication.

6. Microcontroller (Optoinal)

The Microcontroller executes the application algorithm to transmit and receive the data to and from LoRa network. The STM32F103CBT6 used on the board, has sufficient memory to load LoRa stack.

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10. TECHNICAL SPECIFICATION

a. ELECTRICAL SPECIFICATION

Input Specifications				
Description	**Min**	**Typ**	**Max**	**Unit**
Voltage AC	100	230	250	Volts AC
Current AC	-	0.2	-	Amps

Description	**Min**	**Typ**	**Max**	**Unit**
Wifi Frequency	-	2.4	-	GHz
LoRa RF Frequency	862	868	878	MHz

b. MECHANICAL SPECIFICATION

- Mechanical Dimensions of PCB are 96 x 47 X 28mm (Length x Width x Height)

11. ELECTRICAL CONNECTIONS

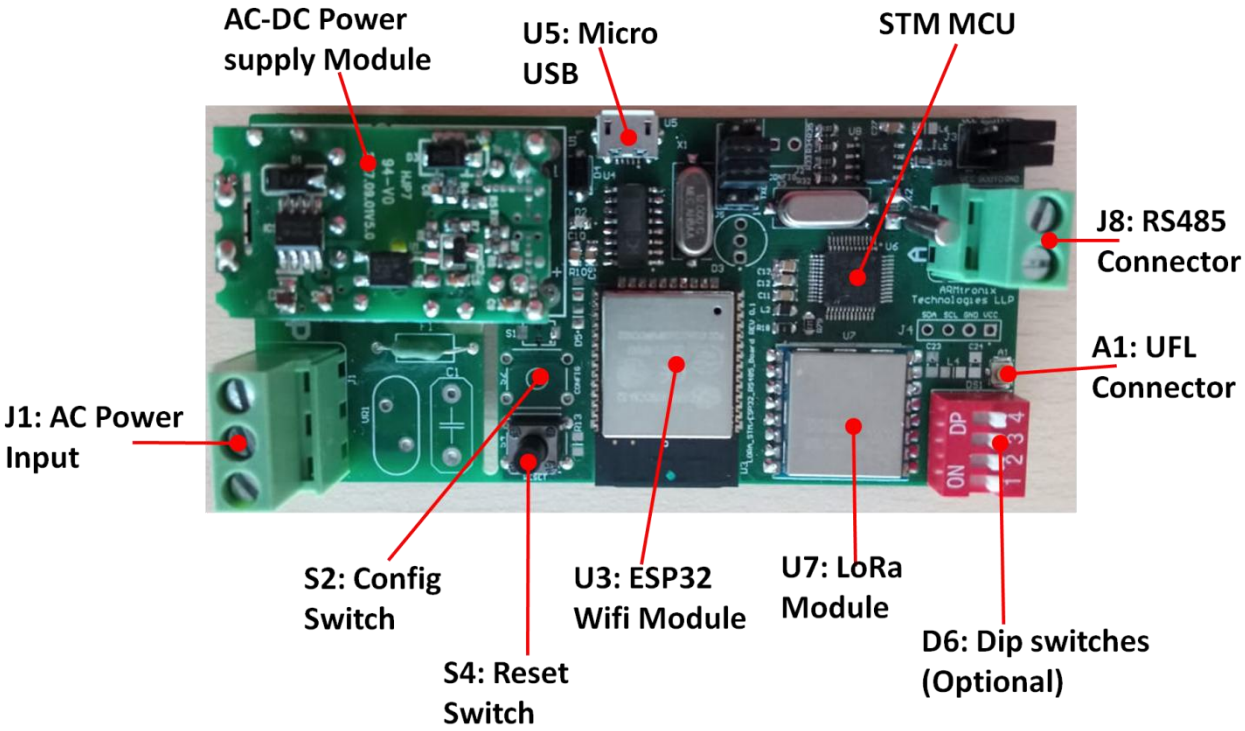

Figure 1: Header and Switch Details

Description of Header and Switches shown in Figure 1:

1. D6: Dip switches to set RS485 device address.
2. J2: MCU GPIO Header
3. J5: Programming MCU or ESP selection Header
4. J6: Micro USB connector for programming
5. J3: MCU Boot selection Header

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a. Header J1:

Header Pin No.	Label	Purpose
1	AC Phase In	Power Input
2	-	-
3	AC Neutral In	Power Input

Table 1: Header J1 Pin configuration

b. Header J8:

Header Pin No.	Label	Purpose
1	A	RS485_A
2	B	RS485_B

Table 2: Header J8 Pin configuration

c. Dip Switch D6*:

Dip Switch No.	MCU GPIO
1	MCU_PB8
2	MCU_PB9
3	MCU_PA11
4	MCU_PA12

Table 3: Dip Switch GPIO configuration

d. Header J5*:

Bi-Color LED	Rs485 Pin Name	MCU Pin No.	MCU Pin Name	ESP Pin No.	ESP Pin Name
1	Anode-1	27	PB14	28	GPIO17
2	Anode-2	28	PB15	10	GPIO25

Table 4: Bi-Color LED Pin configuration

e. Header J3*:

Header Pin No.	MCU Pin No.	Pin Name
1	-	VCC_3V3
2	-	VCC_3V3
3	44	BOOT0
4	20	BOOT1
5	-	DGND
6	-	DGND

Table 5: Header J3 Pin configuration

* Available in particular model only

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f. Hardware connections between LoRa and ESP or MCU.

LoRa Pin No.	LoRa Pin Name	*MCU Pin No.	*MCU Pin Name	ESP Pin No.	ESP Pin Name
1	Reset	2	PC13	37	GPIO23
2	DIO0	11	PA1	11	GPIO26
3	DIO1	26	PB13	9	GPIO33
4	DIO2	25	PB12	8	GPIO32
9	SCK	15	SCK	29	GPIO5
10	MISO	16	MISO	31	GPIO19
11	MOSI	17	MOSI	12	GPIO27
12	NSS	14	SS	30	GPIO18

Table 6: Connections between LoRa and ESP or MCU

* Available in particular model only

g. Hardware connections between RS485 and ESP or MCU.

RS485 Pin No.	Rs485 Pin Name	*MCU Pin No.	*MCU Pin Name	ESP Pin No.	ESP Pin Name
1	RO	13	PA3	33	GPIO21
2	RE	19	PB1	13	GPIO14
3	DE	18	PB0	16	GPIO13
4	DI	12	PA2	36	GPIO22

Table 7: Connections between RS485 and ESP or MCU

* Available in particular model only

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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 ESP32:

1. Use external mobile USB A type to micro USB data cable between computer and device.
2. Short Pin-1 to Pin-2 and Pin-7 to Pin-8 of Header J5 using bergsticks jumpers.
3. Connect Micro USB cable between your computer and U5 of “Wifi/BT Quad Relay Board”.
4. Open your code in Arduino IDE as shown.

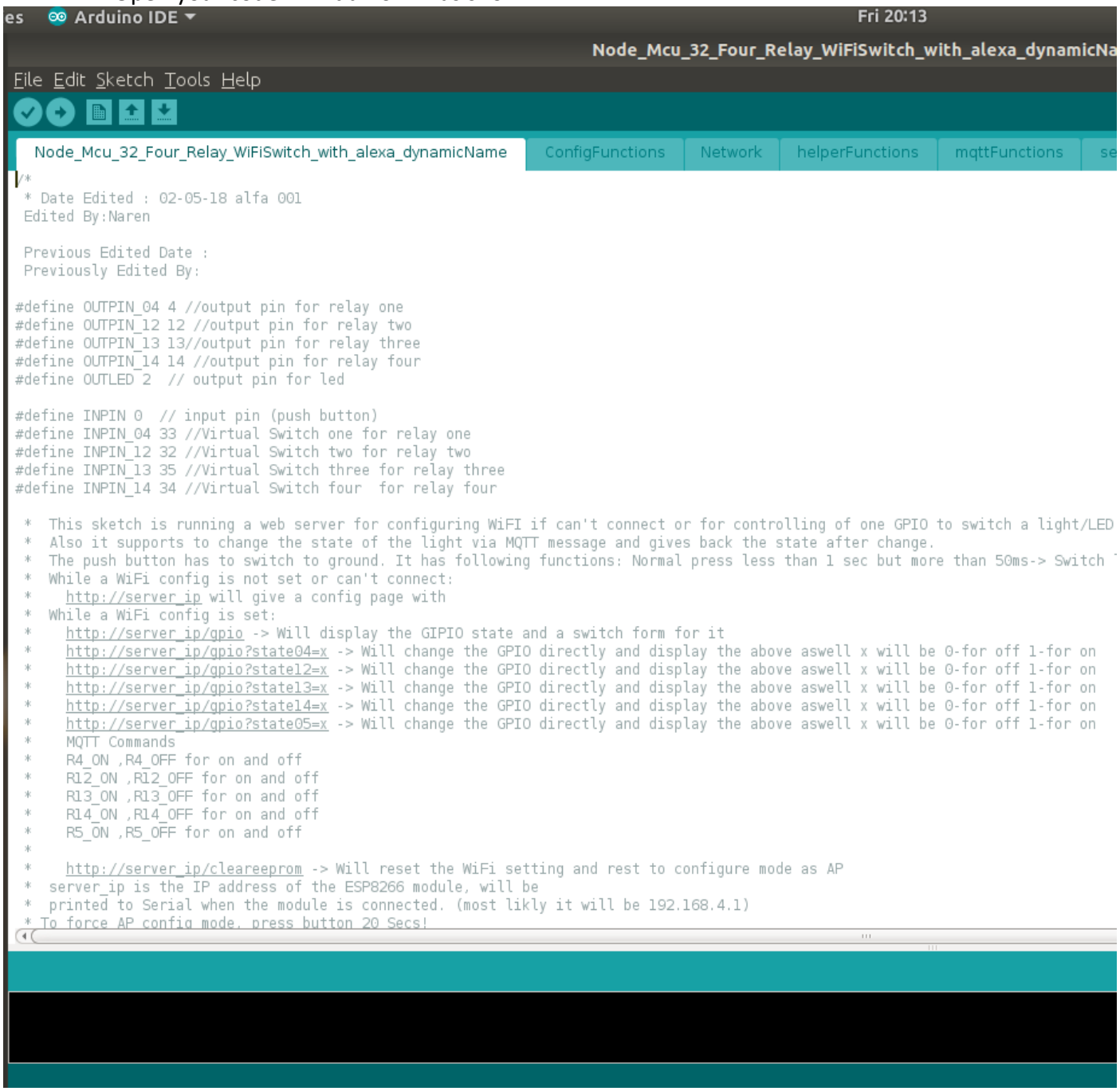

Figure 2: Program Opened in IDE

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5. Click on Tools Tab, move mouse pointer on “Board: xxxxxxxxxxx” and click on “NodeMCU-32S” as shown in figure 3.

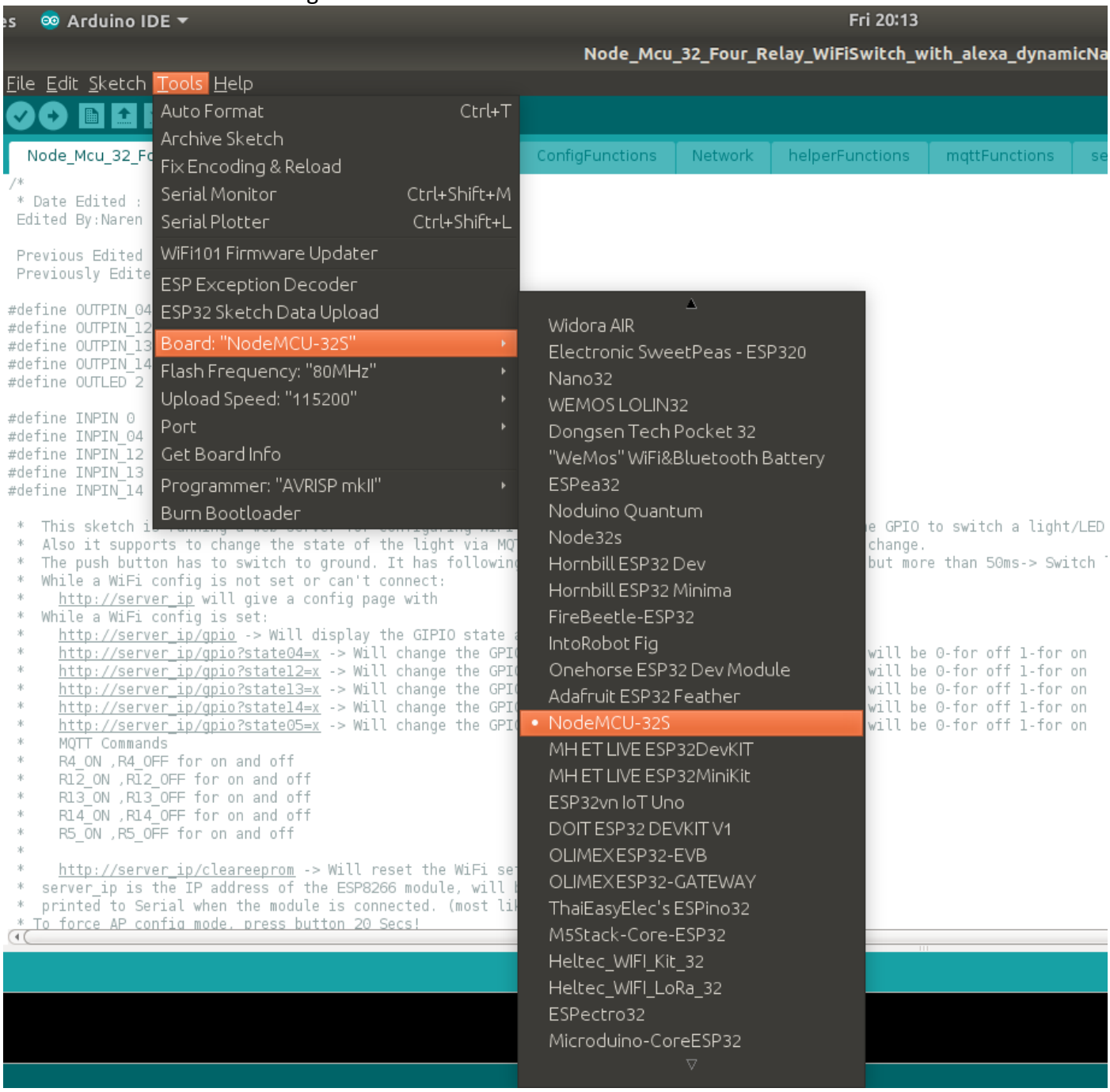

Figure 3: Board Selection

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6. Select Upload Speed as “115200”.

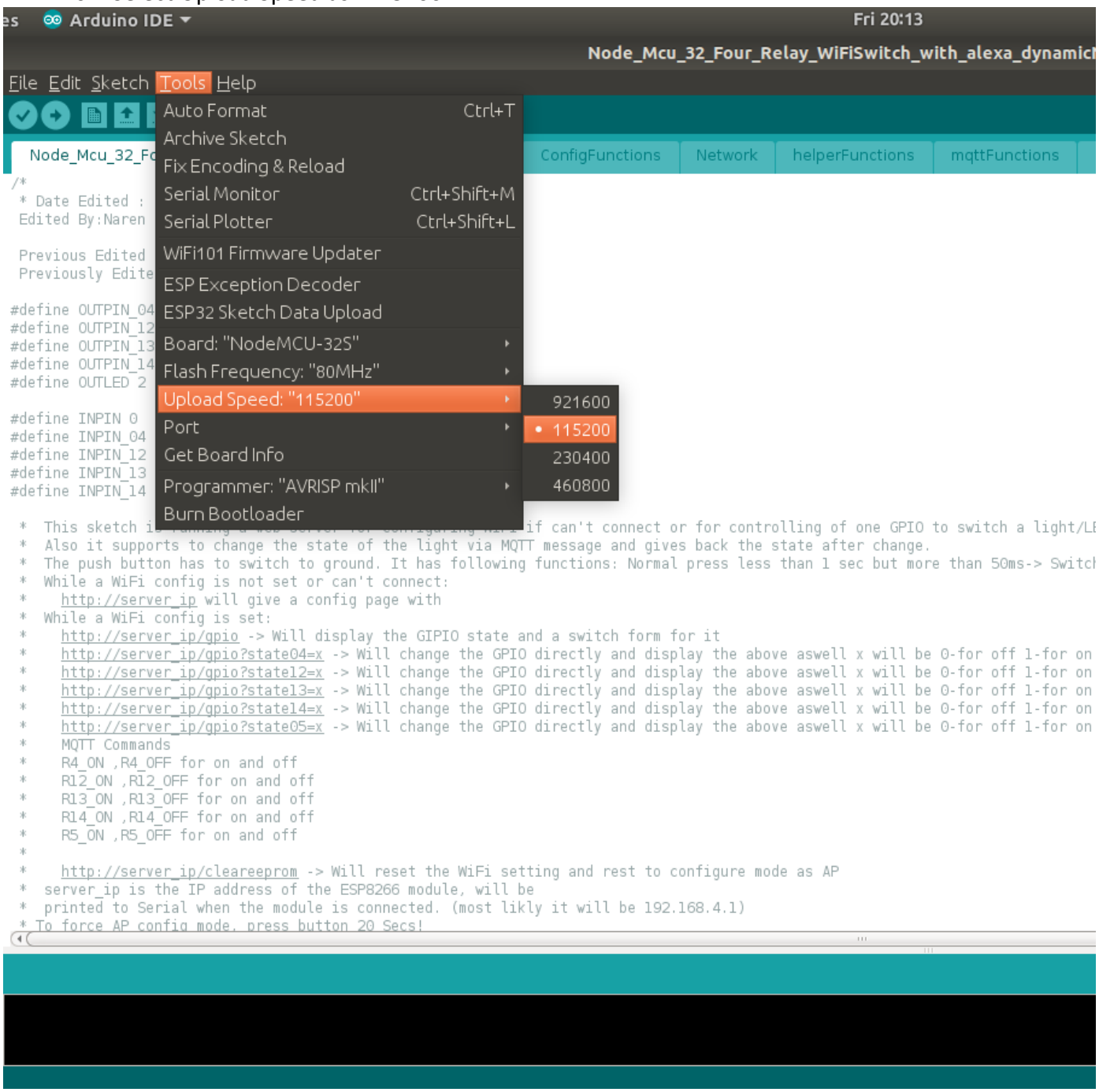

Figure 4: Baudrate selection

7. Click on tools tab, move mouse pointer to “Programmer: “Arduino as ISP’”, under this click on “Arduino as ISP”.
8. 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).
9. Run the program. Refer to Figure 13.
10. Once the program loading is completed, short Pin-1 to Pin-3 and Pin-5 to Pin-7 of header J5 using bergsticsk jumper to function normally.

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b. STEPS TO LOAD PROGRAM TO MCU:

1. Install Arduino board manager related for STM32F103CBT6.
2. Short Pin-3 to Pin-4 and Pin-5 to Pin-6 of Header J5 using bergsticks jumpers.
3. Open your code in Arduino IDE.
4. Click on Tools Tab, move mouse pointer on “Board: “xxxxxxxx” and click on “Generic STM32F103C Series” as shown in figure 5.

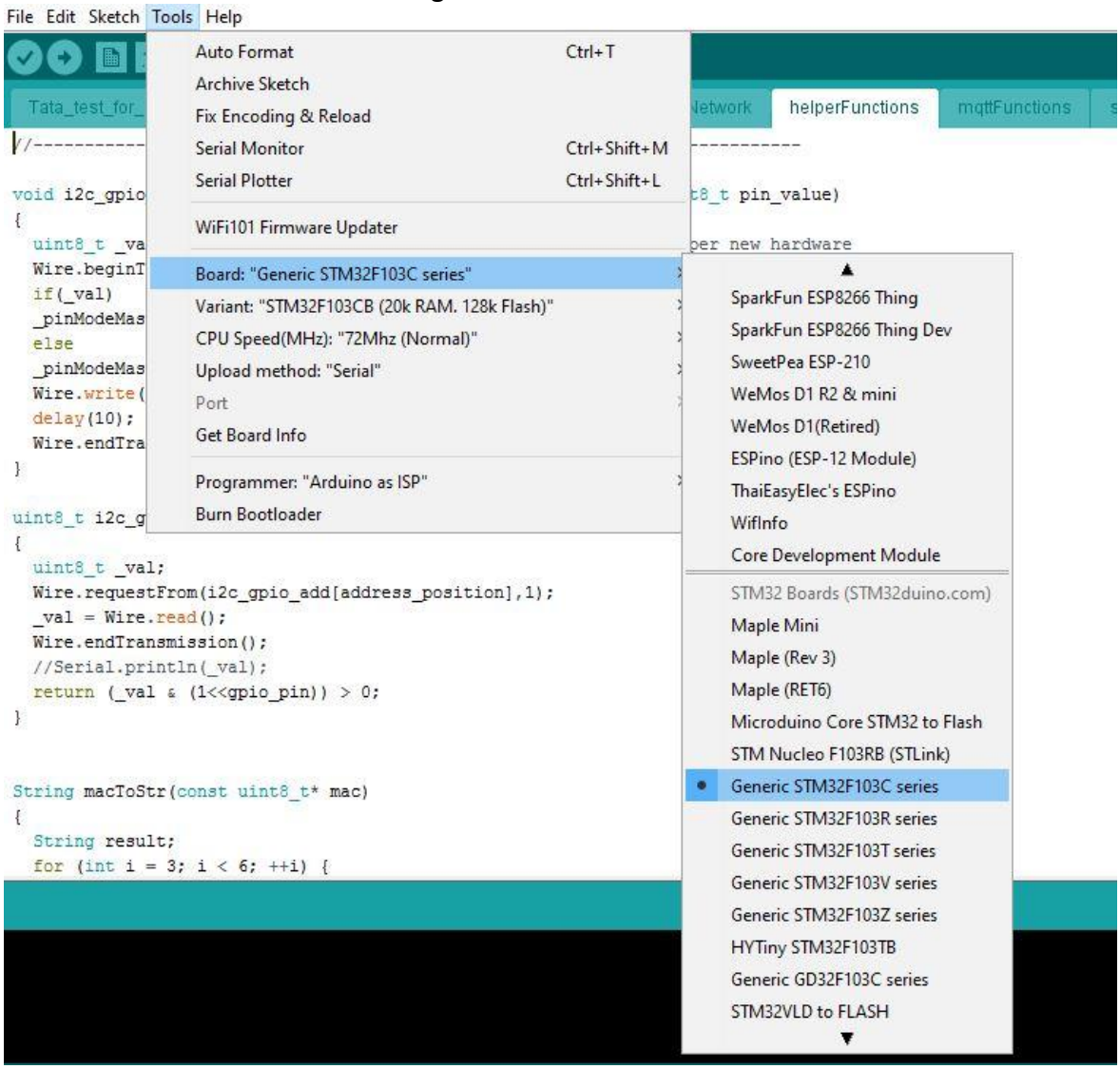

Figure 5: Board Selection

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5. Click on tools tab, move mouse pointer to “Variant: “xxxxx”, under this click on “STM32F103CB” to select. Refer to figure 6.

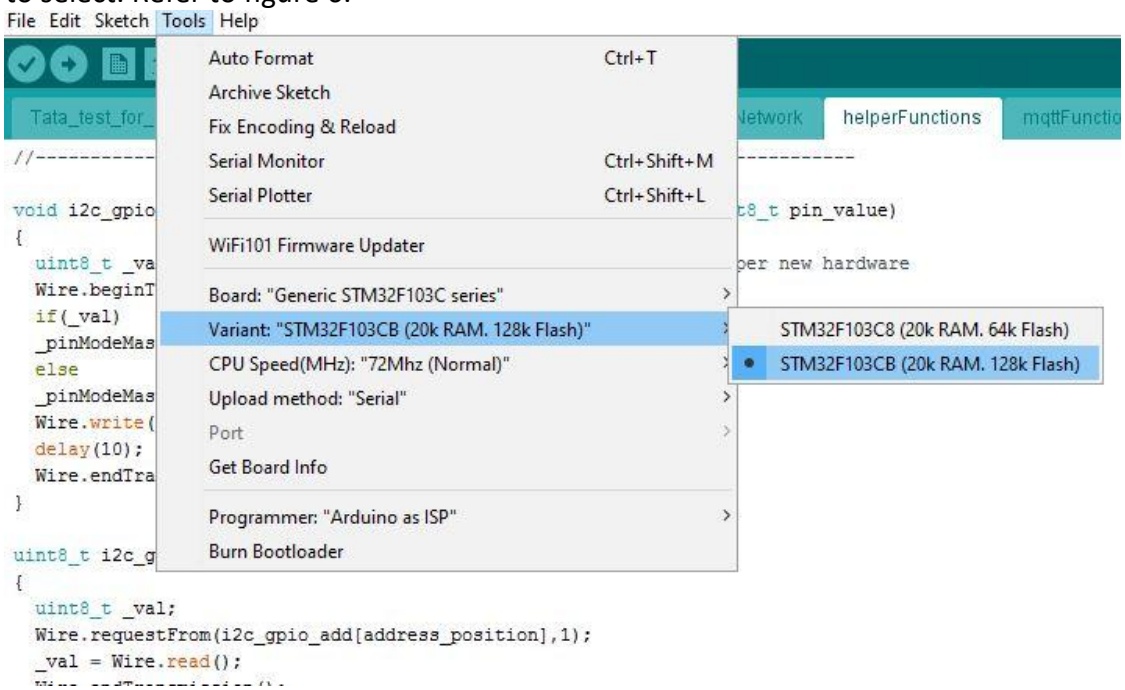

Figure 6: Variant Selection

6. Click on tools tab, move mouse pointer to “CPU Speed(Mhz): xxxx”, under this click on “72Mhz (Normal)” to select. Refer to figure 7

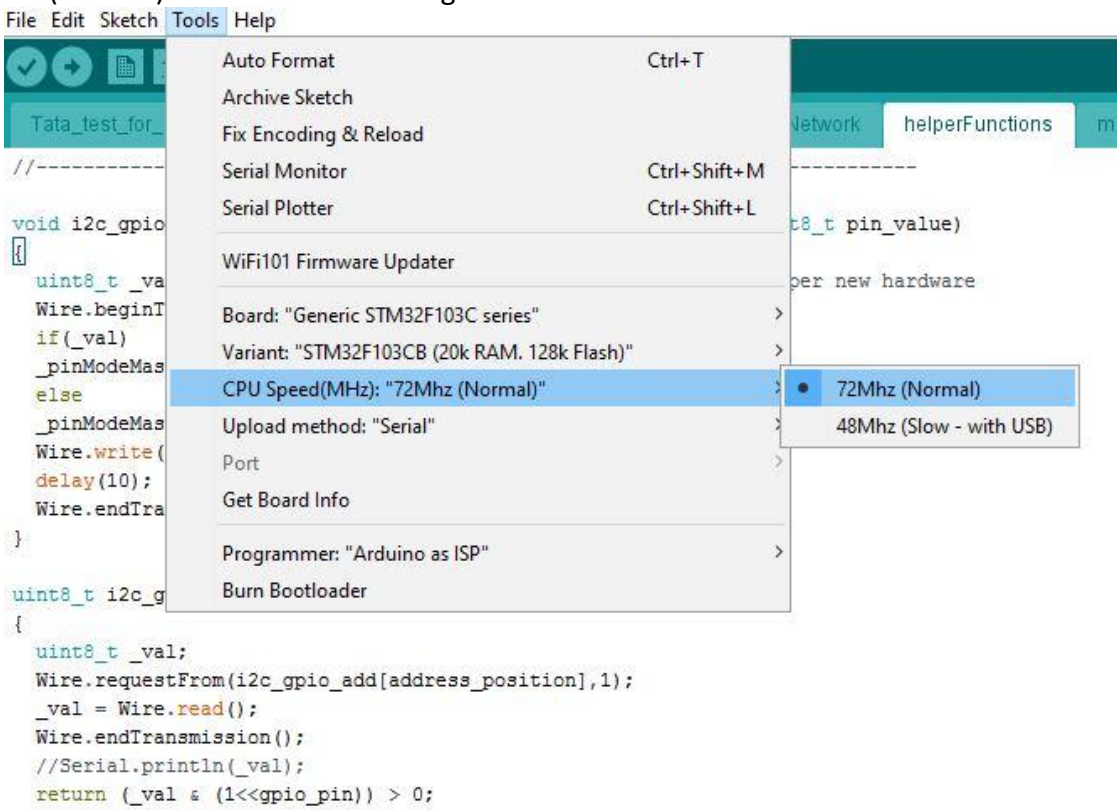

Figure 7: CPU Speed selection

A R M t r o n i x , C o p y r i g h t R e s e r v e d .

7. Click on tools tab, move mouse pointer to “Upload Method: “xxxxx”, under this click on “Serial” to select. Refer to figure 8.

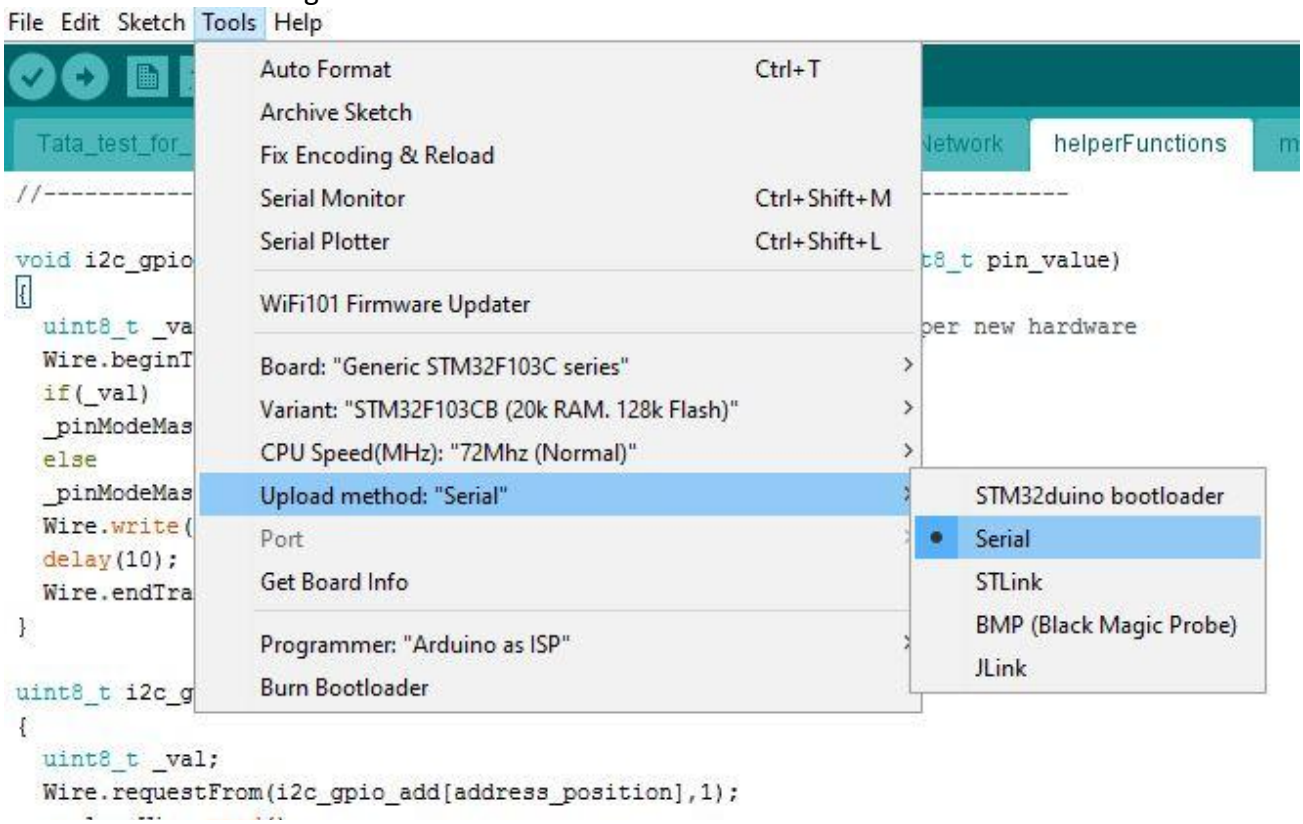

Figure 8: Upload method selection

8. 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 9.

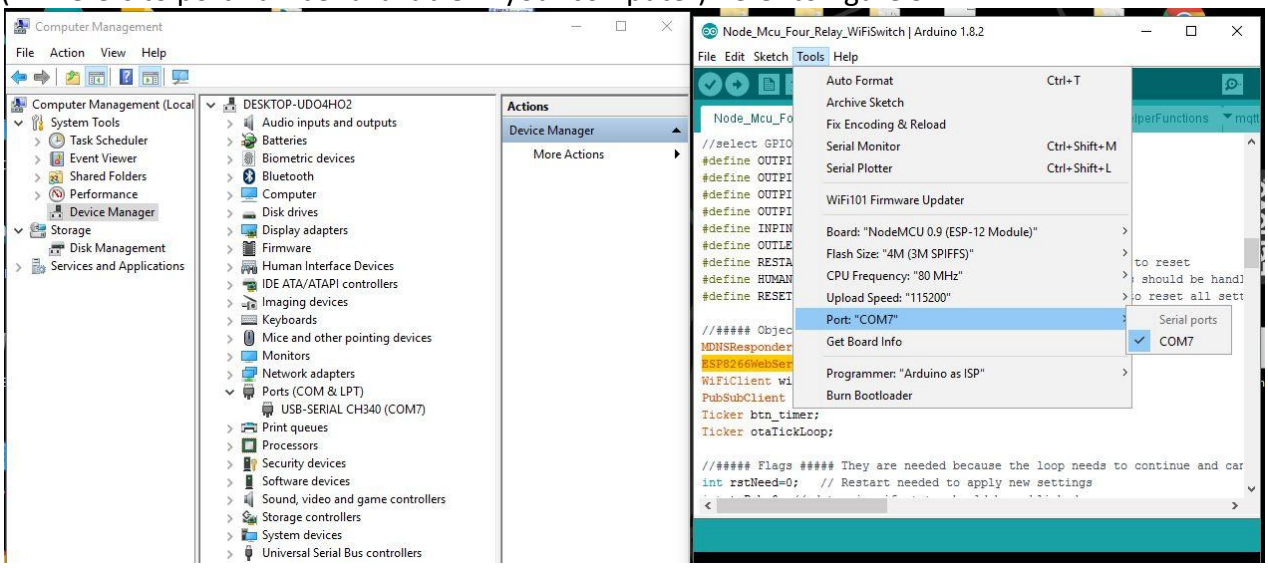

Figure 9: COM port selection.

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9. Click on tools tab, move mouse pointer to “Programmer: “Arduino as ISP’”, under this click on “Arduino as ISP” to select. Refer to figure10.

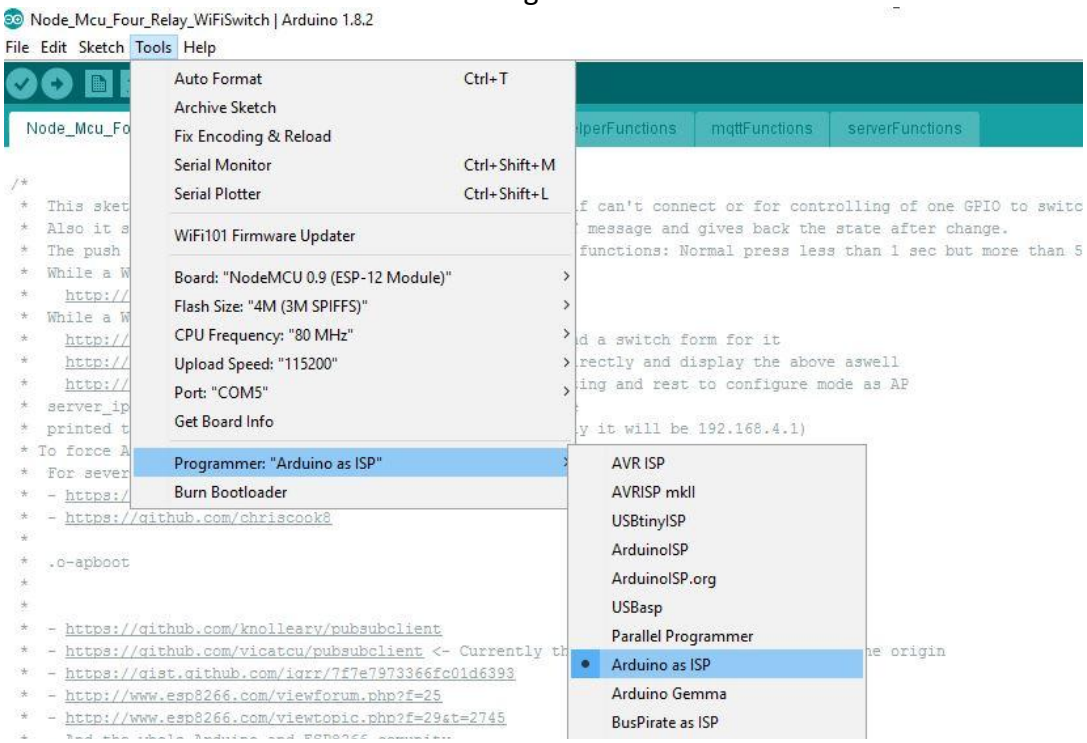

Figure 10: IDE Selection

10. Run the program. Refer to Figure 11.

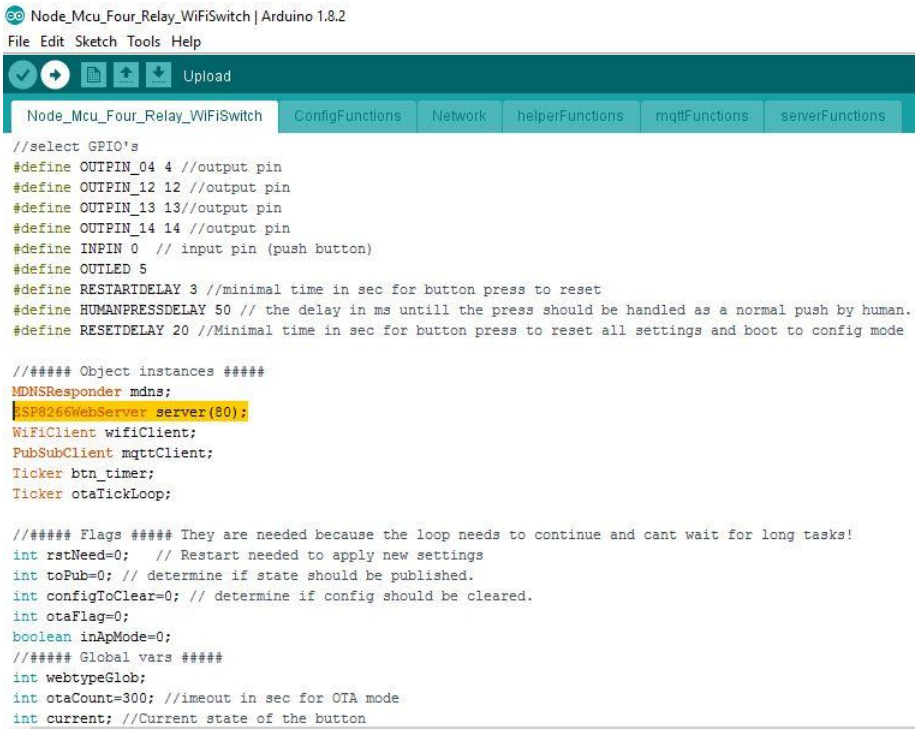

Figure 11: Running code

11. Once the program loading is completed, short Pin-1 to Pin-3 and Pin-5 to Pin-7 of header J5 using bergstick jumper to function normally.

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