Documentation for Robian19 Robot Main Board v1.2

Introduction

For Robian19 the organizers have designed a PCB which will be given to all the participants. Use of this PCB is optional. Here we list key features of this PCB along with details about using each feature. This board was designed so that participants can prototype their robots rapidly and focus on programming their robots. **Figure 1** shows the component placement on the top side of the PCB.

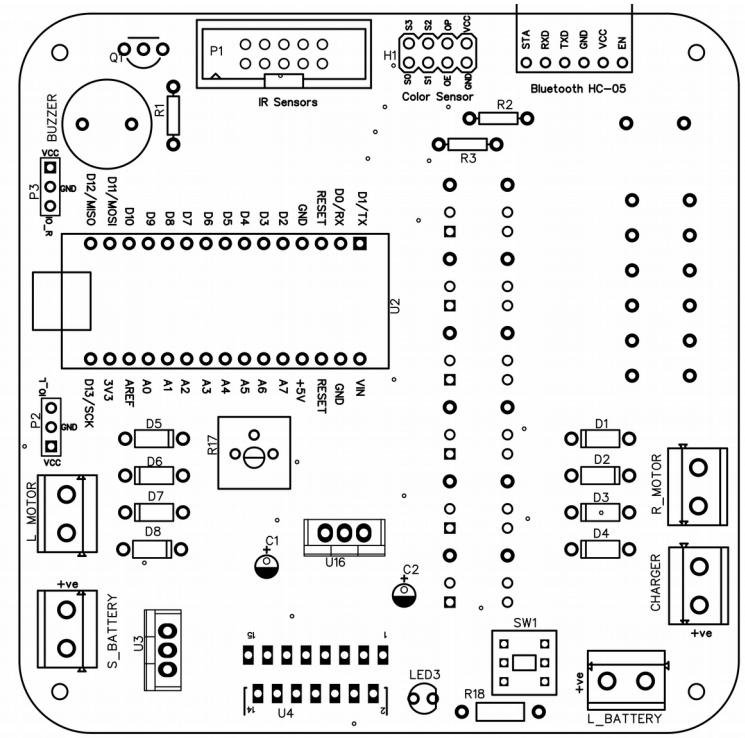


***Figure 1**: Top side of the Robot Main Board v1.2*

Key Features

- Supports Arduino Nano
- Line Sensor Module header for 8 IR sensors module
- Two headers for interfacing to digital IOs on Arduino
- Interface header for TCS3200 Color Sensor
- Header for HC-05 Bluetooth Module
- On-board 5V buzzer
- Selectable Analog Reference for AVR ADC
- Connectors for two DC motors
- L298 Mounting Header
- On/Off button for Large Battery
- Electrical Isolation (optical) between Digital and Power circuitry
- Two separate power sources for Digital and Power circuits
- Charger connector for charging Large Battery
- Voltage regulation (5v) for both power sources

Details:

Arduino Nano Support

Arduino Nano can be mounted at the location **U2** in the PCB. It is recommended that you solder female **SIP headers** on the board so that you will have the option to place/remove the Arduino at will.

Moreover note that you can also use Arduino Uno (or others) with this board. For this you will have to go through the schematics of the PCB (**page 5**) and connect appropriate pins to Arduino IOs.

Line Sensor Module Header

The main board can be interfaced to the Line Sensor Module (see *'LineSensorModule v1.1.pdf'* for details) via the 2x5 shrouded box header(**Figure 2 (c)**) marked '**IR Sensors**' on the board. An IDC ribbon cable (**Figure 2 (a)**) may be used to connect the two boards together.

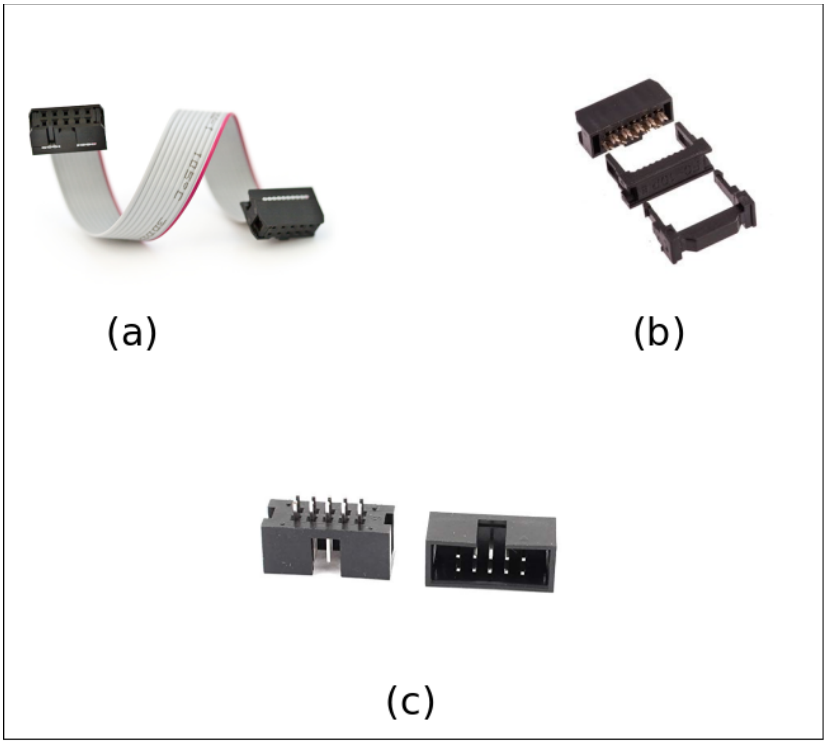


Figure 2: *(a) Ribbon Cable, (b) IDC Socket, and (c) Shrouded Socket*

Participants may buy 2x5 IDC Sockets (**Figure 2 (b)**) for the market and bring them to FYP Lab to get the cable made for them.

Headers for Digital IO

Headers **P2** and **P3** on the main board connect to **D11** and **D12** of Arduino Nano and provide VCC and GND as well. They can be used to to connect to buttons, sensors, and LEDs etc.

Header for Color Sensor

The main board provides a header for TCS3200 color sensor module shown in **Figure 3**. This header may also be used to connect other color sensors of your choice.

Figure 3: *TCS 3200 Color Sensor*

Header for HC-05 Bluetooth Module

A Bluetooth device HC-05 can be mounted on the respective header (see **Figure 1**, **top right** corner). LFR participants can use this for getting data wirelessly from their main board to the PC. This feature may be used to debug code, read sensor values, and to tune PID coefficients etc. Remember that LFR participants will not be allowed to use the HC-05 or other wireless modules in their robot as their robot has to be autonomous without any communications to the outside world.

Electrical Isolation (using Opto-Couplers)

In electronic circuits where both digital ICs (e.g. microcontrollers, TTL ICs etc) and high current devices such as motors and their drive circuitry are present it is desirable to electrically decouple the two circuits. This means the two sub-circuits need to be powered separately while allowing them to communicate optically (e.g.). This board provides optical isolation between the two sub-circuits using Opto-Couplers (PC817C).

It also provides two separate connectors for the two power sources. A large battery may be connected to the connector ***'L_BATTERY'*** and will provide power to the motors and their drive circuits. A smaller battery may be connected to ***'S_BATTERY'*** (**Figure 1, Bottom Left**), that will power the Arduino, Sensors and associated circuitry.

Be careful about the polarity of the batteries you are connecting as the board does **NOT** provide any protection against wrong connections.

Charging port for the Large Battery

You may connect a charger to the connector **'CHARGER'** for charging the larger battery. This port does not provide any current control for the charging device. It is recommended to use external current control (e.g. by limiting the current on the Power Supply) when charging the battery.

L298 Motor Driver Connector

An L298 Dual H-Bridge IC may be soldered to the PCB at **U4** (**Figure 1, Bottom Center**) for driving the two motors. You will have to make a couple of changes (refer to the last section **'Errata'**, points **2**, and **3** for this) to the traces on the PCB before you can solder an L298 on the PCB. In this case it is also recommended to use two female SIP headers so that L298 IC maybe replaced if it burns out.

Alternatively U4 may be used to connect to an L298 Module (shown in **Figure 4**). For this purpose you will not connect the L298 IC on the board, rather will connect the six signaling pins to the module. In this case L298 Module will be powered by the '**L_BATTERY**' connected to the board and motors will be connected to the L298 Module instead of the main board.

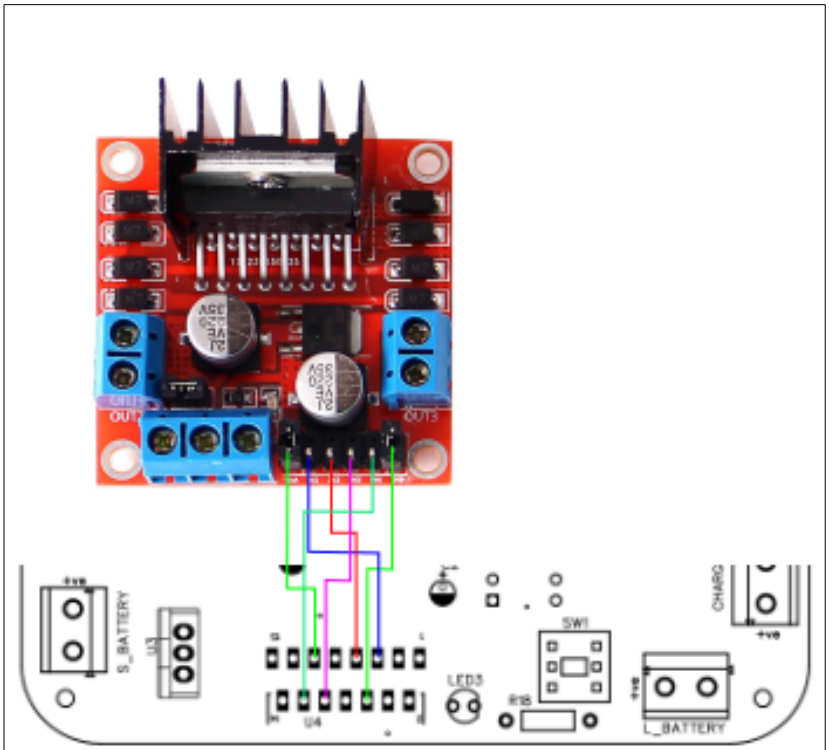
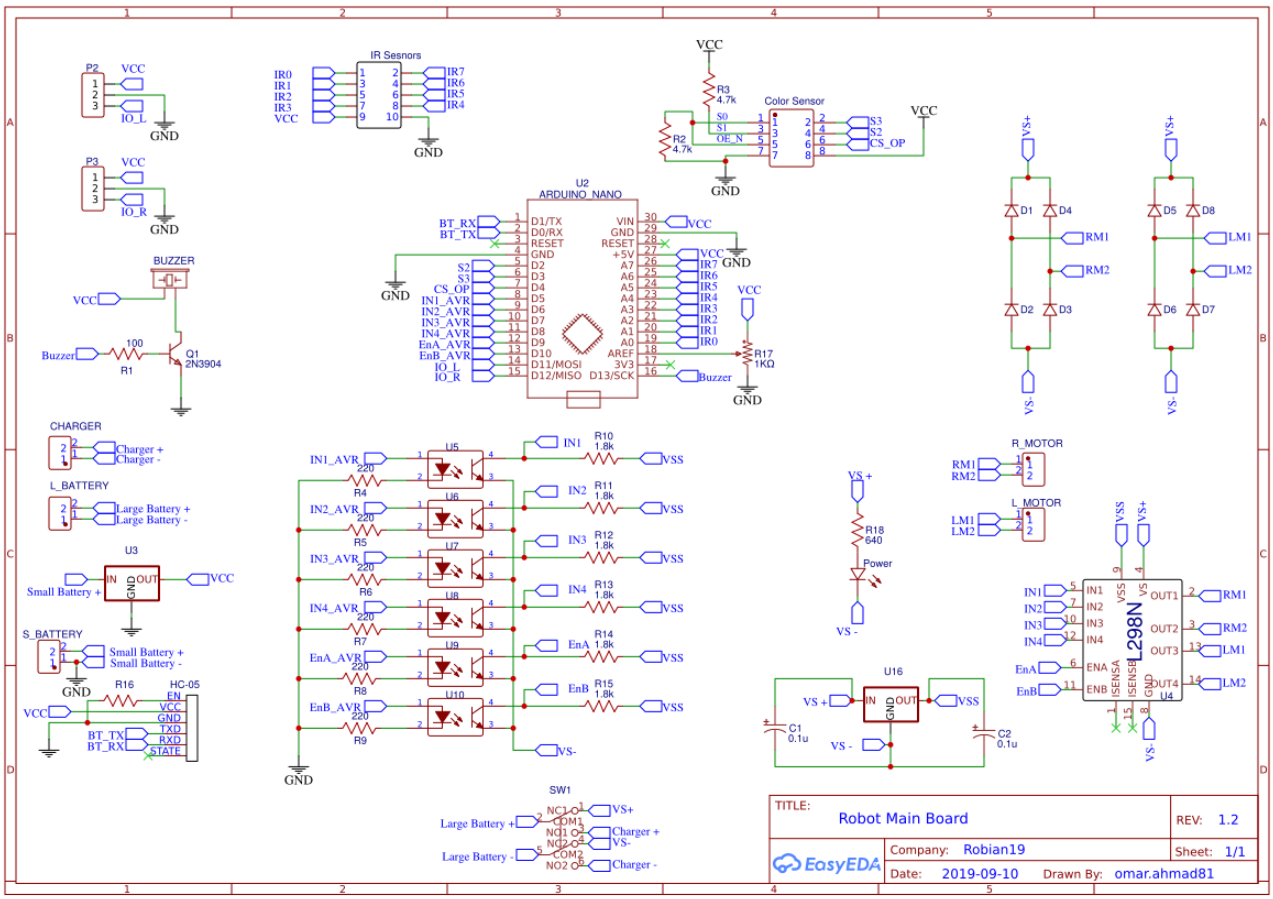


Figure 4: Connecting an external L298 Module to U4 on the PCB

Component List: (Approximate prices included)

ID	Name	Designator	Quantity	Unit Cost	Total Cost
1	Diodes 1N4448	D4,D3,D2,D1,D5,D6,D7,D8	8	0	0
2	640 Ohm	R18	1	0	0
3	Regulator LM7805	U3,U16	2	20	40
4	Bluetooth Module HC-05	U1	1	450	450
5	Header-Male-2.54_1x3	P2,P3	2	20	40
6	Color Sensor	H1	1	350	350
7	L298N Motor Driver IC	U4	1	150	150
8	0.1u Capacitor	C1,C2	2	0	0
9	Switch On/Off 6 Pin	SW1	1	10	10
10	Arduino Nano	U2	1	500	500
11	Opto Couplers CYPC817C	U5,U6,U7,U8,U9,U10	6	10	60
12	Headers	R_MOTOR,L_MOTOR,CHARGER,L_BATTERY,S_BATTERY	5	10	50
13	Transistor 2N3904/2N222	Q1	1	0	0
14	IR Sesnors	P1	1	40	40
15	100 Ohm	R1	1	0	0
16	4.7 kOhm	R2,R3,R16 (Do NOT solder R16)	3	0	0
17	220 Ohm	R4,R5,R6,R7,R8,R9	6	0	0
18	1.8 kOhm	R10,R11,R12,R13,R14,R15	6	0	0
19	BUZZER 5V	BUZZER	1	40	40
20	10 kOhm	R17 (May be omitted)	1	0	0
21	Power	LED3	1	5	5
				Total →	**1735**

Schematics of Main Board Version 1.2



Errata

1. Do not solder **R16** on the board as it will prevent communication with HC-05 Bluetooth device.
2. Some connections on the PCB have to be made using jumper wires. These have been highlighted in Red, and Orange in **Figure 5** below.
3. Red connections depict missing traces due to omission in design.
4. Some vias on the board are too narrow and will limit the current carrying capacity of the connecting traces. These have to be reinforced using jumper wires shown in Orange color.

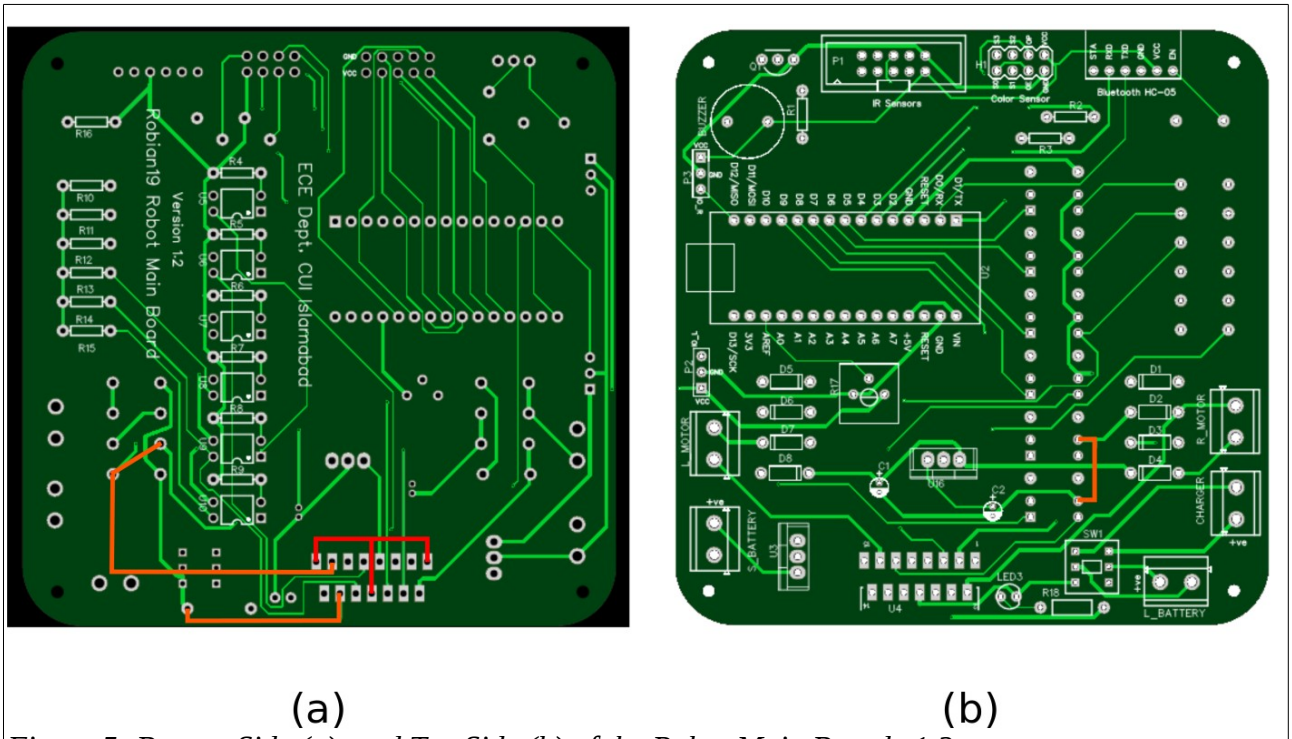


Figure 5: Bottom Side (a), and Top Side (b) of the Robot Main Board v1.2

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