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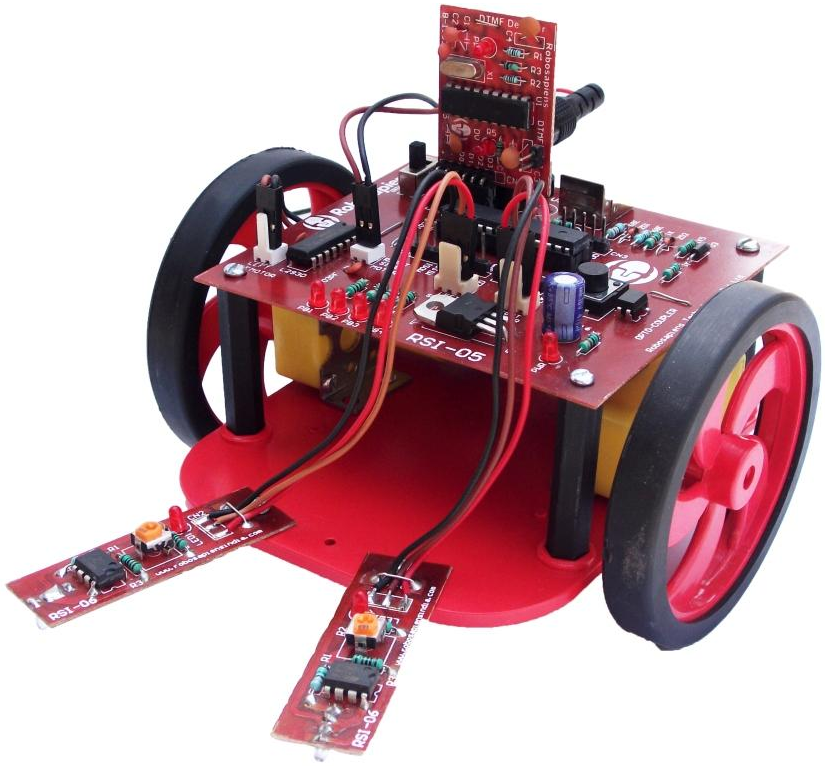
USER MANUAL FOR IBOT mini V3 ROBOTICS KIT

USING AVR STUDIO



Note: This tutorial is for the novice user. It shows how to set up AVR Studio 4.x and WinAVR so that C/C++ Source files will be compiled using GCC. For further information on AVR Studio, AVR Libc, GCC, AVR ISP, AVR JTAG ICE, and other tools please refer to the documentation which is also installed on the installation. Procedure described here is followed.

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1. Introduction

Robots and robotic technologies have an intellectual and emotional appeal that transcends any other type of engineered product, and this appeal is felt no more so than with children and young adults. Robots and robotic technologies represent a practical application of physics, computer science, engineering, and mathematics, and provide a very powerful and flexible approach to demonstrate a variety of engineering concepts. In addition, robotics appeals to a broad range of interests and allows multiple points of access to science, mathematics, and engineering for many types of learners. As a result, robotic technology and robots are being used by an increasing number of educators at the college level to reinforce computer science and engineering theory, and to teach basic software and mechanical engineering at the grammar school, middle school and high school levels. The giant strides that we have made in the areas of Communications and Computers are possible only because of the great successes that we have achieved in the field of Electronics.

It is sometimes unbelievable, how many electronics gadgets that we carry these days in our person – Digital Wrist-watch, Calculator, Cell-phone, Digital Diary or a PDA, Digital Camera or a Video camera, etc. The different type of Electronic equipments that has invaded our offices and homes these days is also mind boggling. Many things we use at home and office are “remote controlled”, for example, Television (TV), Air-Conditioners, Audio equipment, Telephone, etc. It is almost close to “magic” how even a child, now-a-days, can switch channels, or increase decrease the volume of sound in a TV at home by just clicking on a few buttons sitting at the comfort of a sofa away from the Television apparently without any physical wiring or connection!

Again, we are astonished, how we are able to talk to our near and dear living several thousands of Kilometers away, from wherever we are, at home, office, on the road in a car, or in a classroom – by just clicking a few n umbers on our palm sized cellular phones! Electronics has made deep impact in several vital areas such as health care, medical diagnosis and Treatment, Air and space travels, Automobiles, etc. In short, the technological developments of several countries of the globe are directly related to their strengths in electronics design, manufacture, products and services. Just as we teach physics, chemistry, biology and mathematics in our schools, it is high time we start teaching our children at school, Electronics as a separate subject by itself. This brings us face to face to an important question: How to teach the basic concepts of such an important subject like Electronics most effectively? If one wants to gain a good understanding of electronics, he or she should build circuits and test them independently. For this one should acquire a practical knowledge of the characteristics of different devices and in constructing the various circuits. Let us try to learn such skills by the proven scheme of **“LEARNING BY DOING”.** There is only one way to learn to do anything: and I found Robotics is the best way to learn all this.

So let’s start doing Robotics!!!

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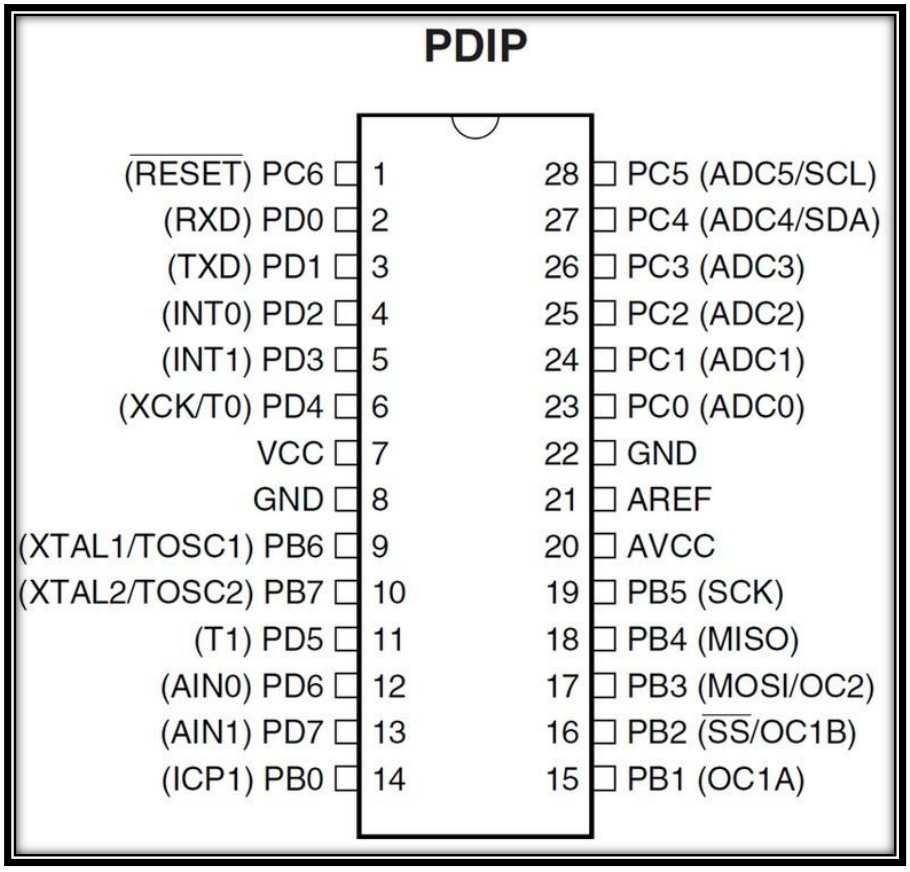
2. Introductions to AVR Series (ATmega8) microcontroller

2.1. Overview

The ATmega8 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced **RISC** architecture. By executing powerful instructions in a single clock cycle, the ATmega8 achieves throughputs approaching 1 MIPS per MHz allowing the designer to optimize power consumption versus processing speed.

2.2. Pin Out of Atmega 8



2.3. Pin Descriptions

VCC: Digital supply voltage.

GND: Ground.

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Port B (PB7-PB0): Port B is an 8-bit bi-directional I/O port with internal pull-up resistors. The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running. Port B also serves the functions of various special features of the ATmega8.

Port C (PC7-PC0): Port C is an 8-bit bi-directional I/O port with internal pull-up resistors. The Port C output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running. If the JTAG interface is enabled, the pull-up resistors on pins PC5 (TDI), PC3 (TMS) and PC2 (TCK) will be activated even if a reset occurs.

Port D (PD7-PD0): Port D is an 8-bit bi-directional I/O port with internal pull-up resistors. The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running. Port D also serves the functions of various special features of the ATmega8.

RESET: Reset Input. A low level on this pin for longer than the minimum pulse
Length will generate a reset, even if the clock is not running. Shorter pulses are not guaranteed to generate a reset.

XTAL1: Input to the inverting Oscillator amplifier and input to the internal clock operating circuit.

XTAL2: Output from the inverting Oscillator amplifier.

AVCC: AVCC is the supply voltage pin for Port A and the A/D Converter. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter.

AREF: AREF is the analog reference pin for the A/D Converter.

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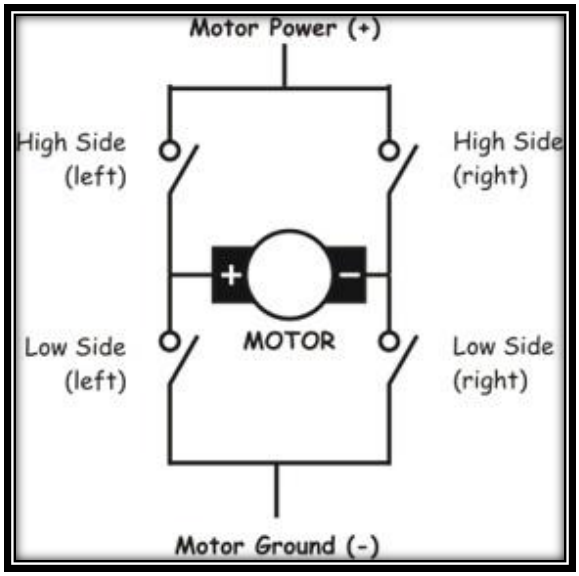
3. Introductions to Motor Driver

Whenever a robotics hobbyist talk about making a robot, the first thing comes to his mind is making the robot move on the ground. And there are always two options in front of the designer whether to use a DC Motor or a stepper motor. When it comes to speed, weight, size, cost... DC motors are always preferred over stepper motors. There are many things which you can do with your DC motor when interfaced with a microcontroller. For example you can control the speed of motor, you can control the direction of rotation, you can also do encoding of the rotation made by DC motor i.e. keeping track of how many turns are made by your motors etc. So you can see DC motors are no less than a stepper motor. In this part of tutorial we will learn to interface a DC motor with a microcontroller. Usually H-bridge is preferred way of interfacing a DC motor. These days many IC manufacturers have H-bridge motor drivers available in the market like L293D is most used H-Bridge driver IC. H-bridge can also be made with the help of transistors and MOSFETs etc. rather of being cheap, they only increase the size of the design board, which is sometimes not required so using a small 16 pin IC is preferred for this purpose.

3.1. H-Bridge



3.2. L293D Dual H-Bridge Motor Driver

L293 series of chips are power H-bridge motor drivers. The L293D chip is in 16-pins dip packages, and has two h-bridge drivers. An H bridge is typically capable of running one DC motor bidirectional (forward, backwards, off), or two separate motors unidirectional (forward, off). Thus a L293 chip can run two motors bidirectional, or 4 unidirectional.

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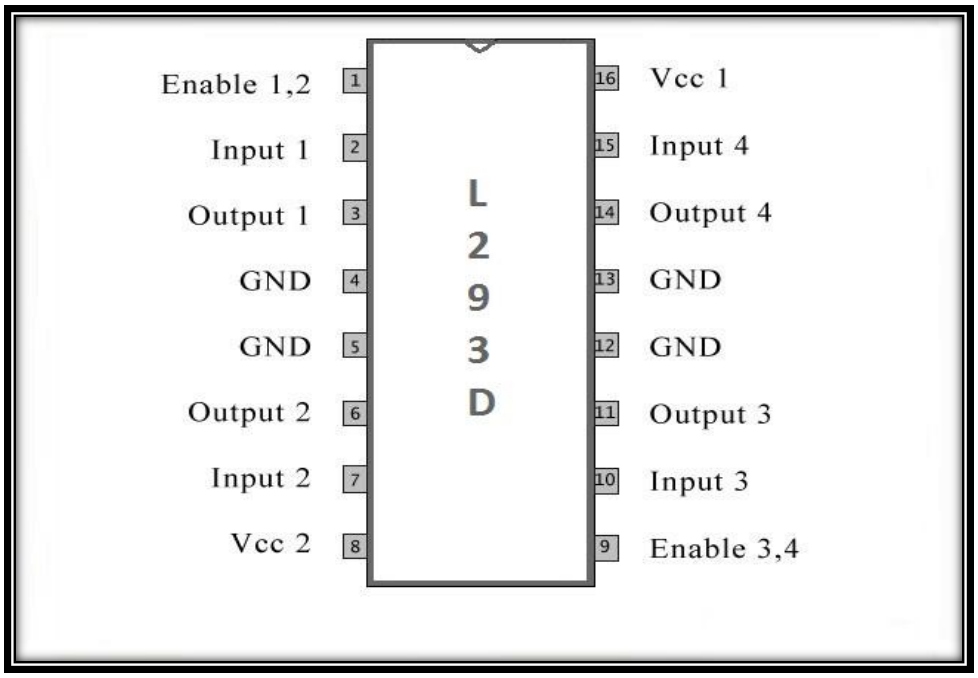
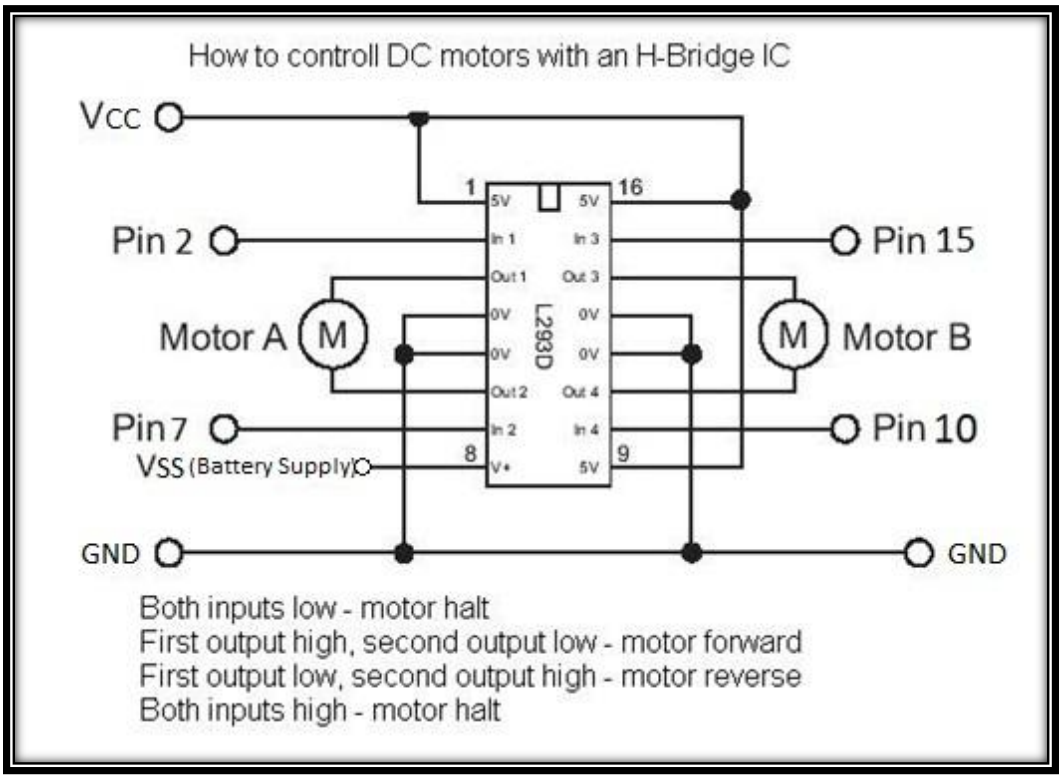
3.3. Pin Diagram of L293D



3.4. Interfacing



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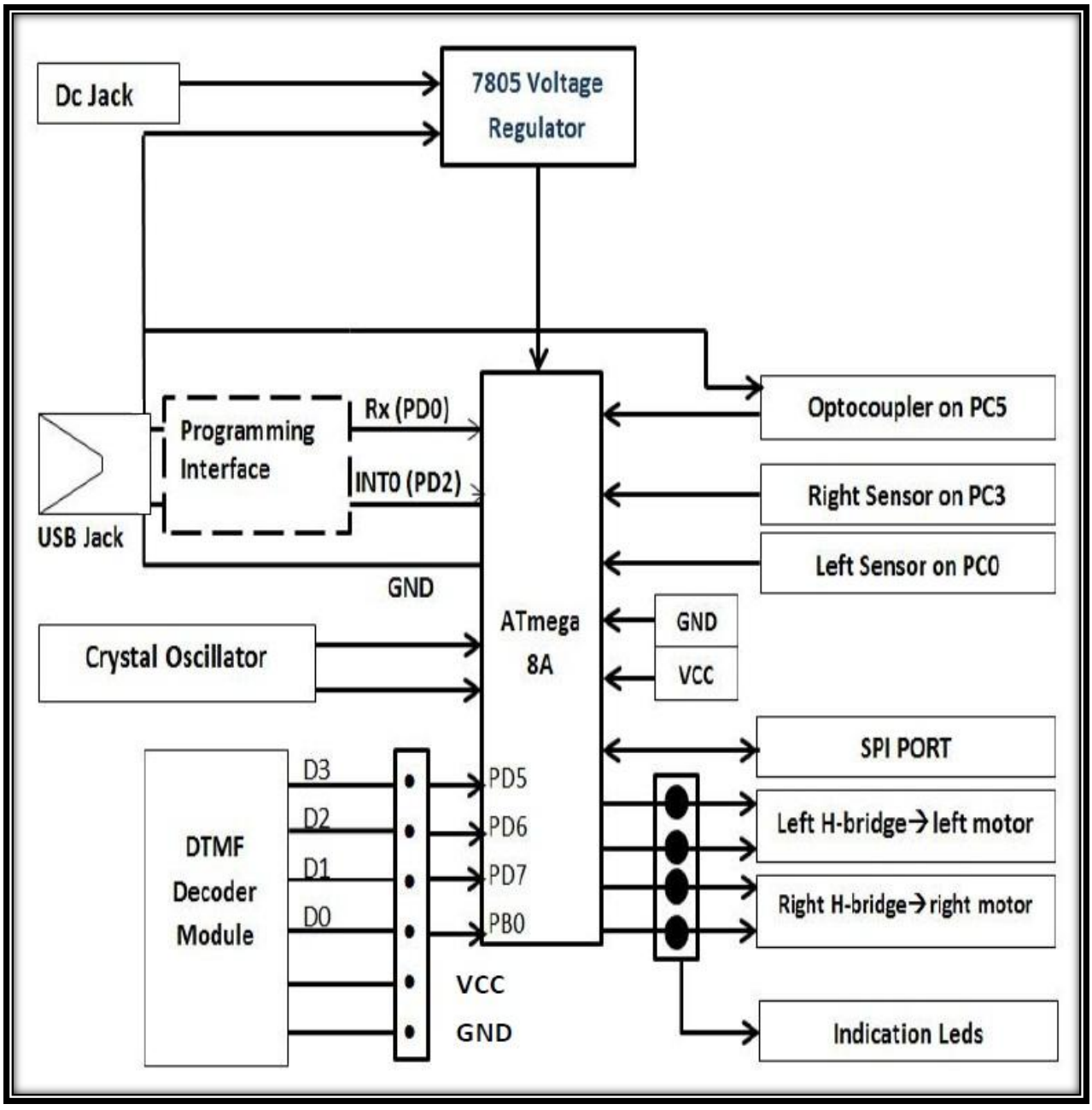
4. Block Diagram of Development Board Connected



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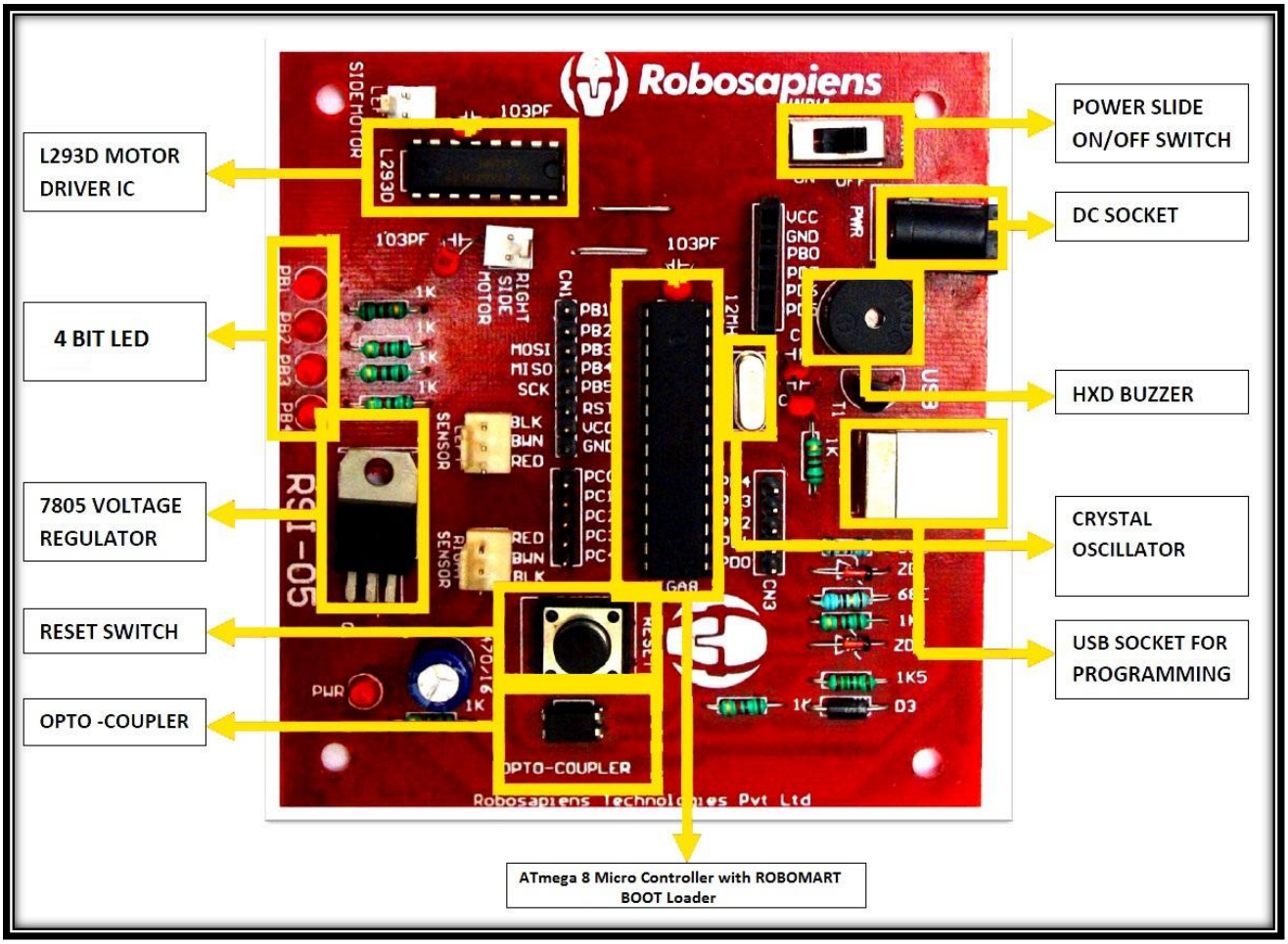
5. Block Description of Development Board Connected



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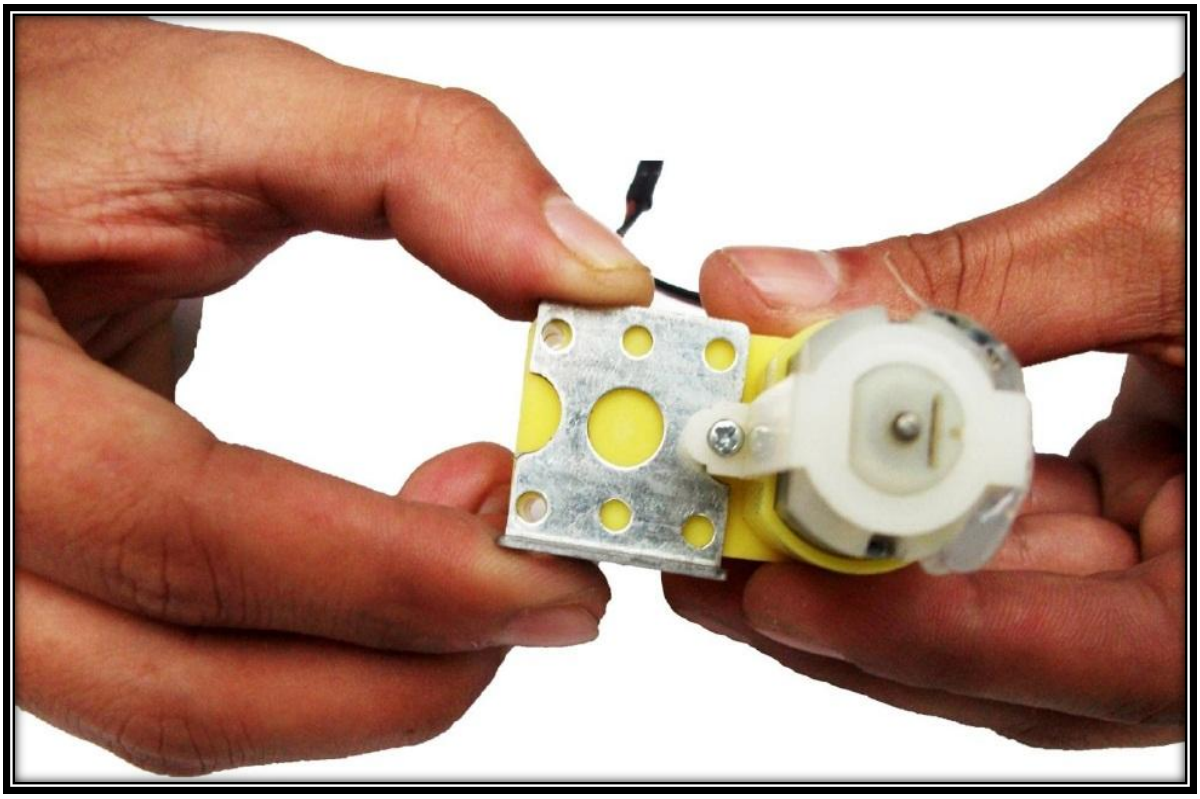
6. Assembling IBOT mini V3

Let's Start Assembling the IBOT mini V3 Robotics Kit -

a) Place the Clamp on the DC Gear Motor.

The DC gear Motors provided is fixed using clamps on the chasis board.



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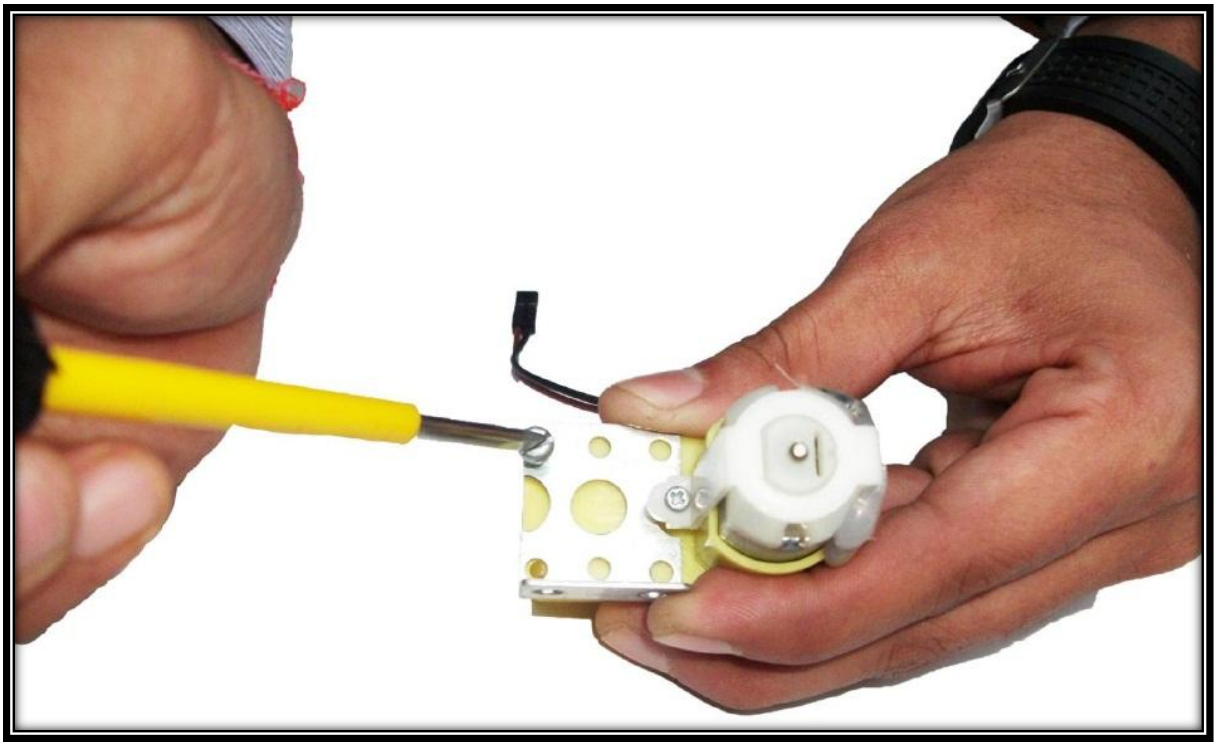
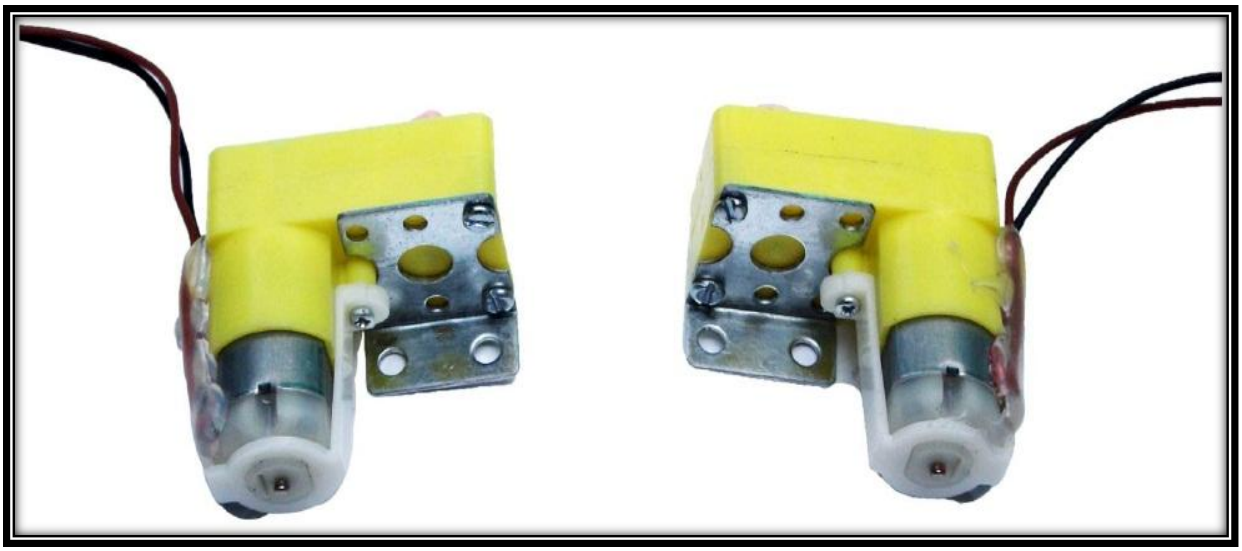
b) Fix the clamp on the motor using screws provided with the nut bolt packet.



c) Connect both the clamps with both the motors as shown in the below figure.



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d) Chassis board is provided with package.

The motive behind providing chassis board is –

- Give the Robot a base frame
- Chassis give the main body of Robot a support while locomotion.

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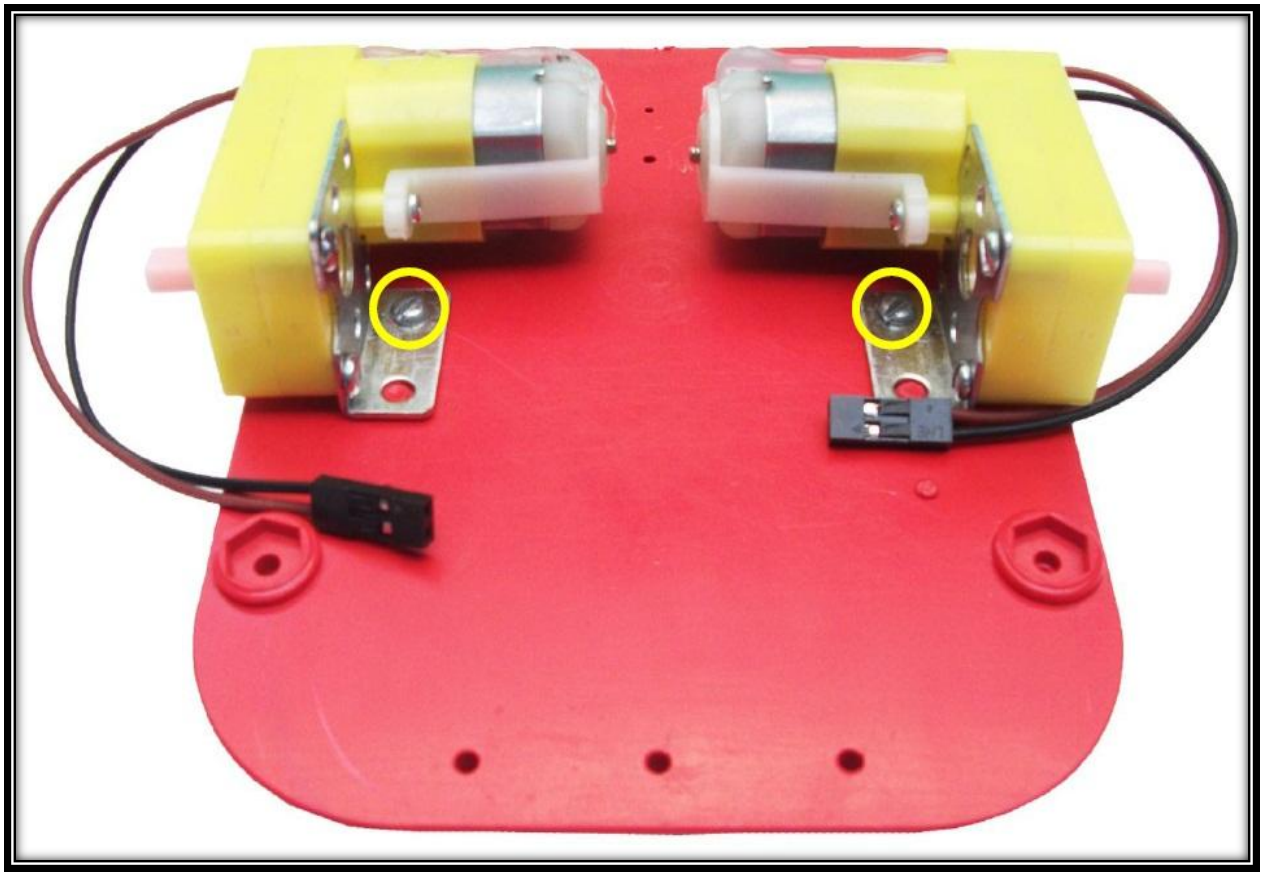
e) Place and fix the clamped motors on the chassis board using screws. The placement and fixes has been highlighted in the figure.



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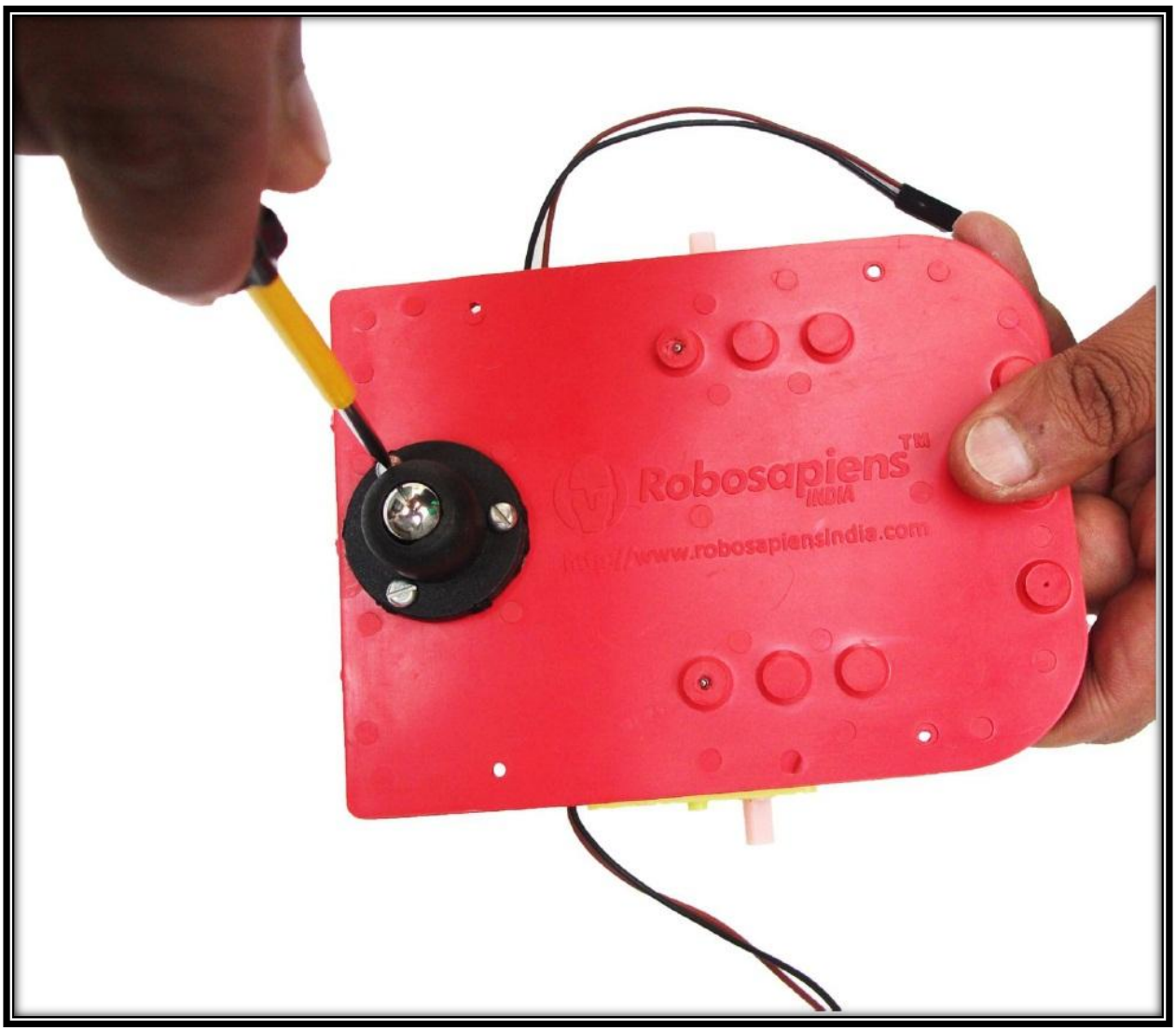
f) Caster or support wheel is included in the package.
Place the caster wheel and screw it using the screws.

- Caster wheel plays a vital role while Robot is in motion. The designed geometry needs to balance the weight of the motors.



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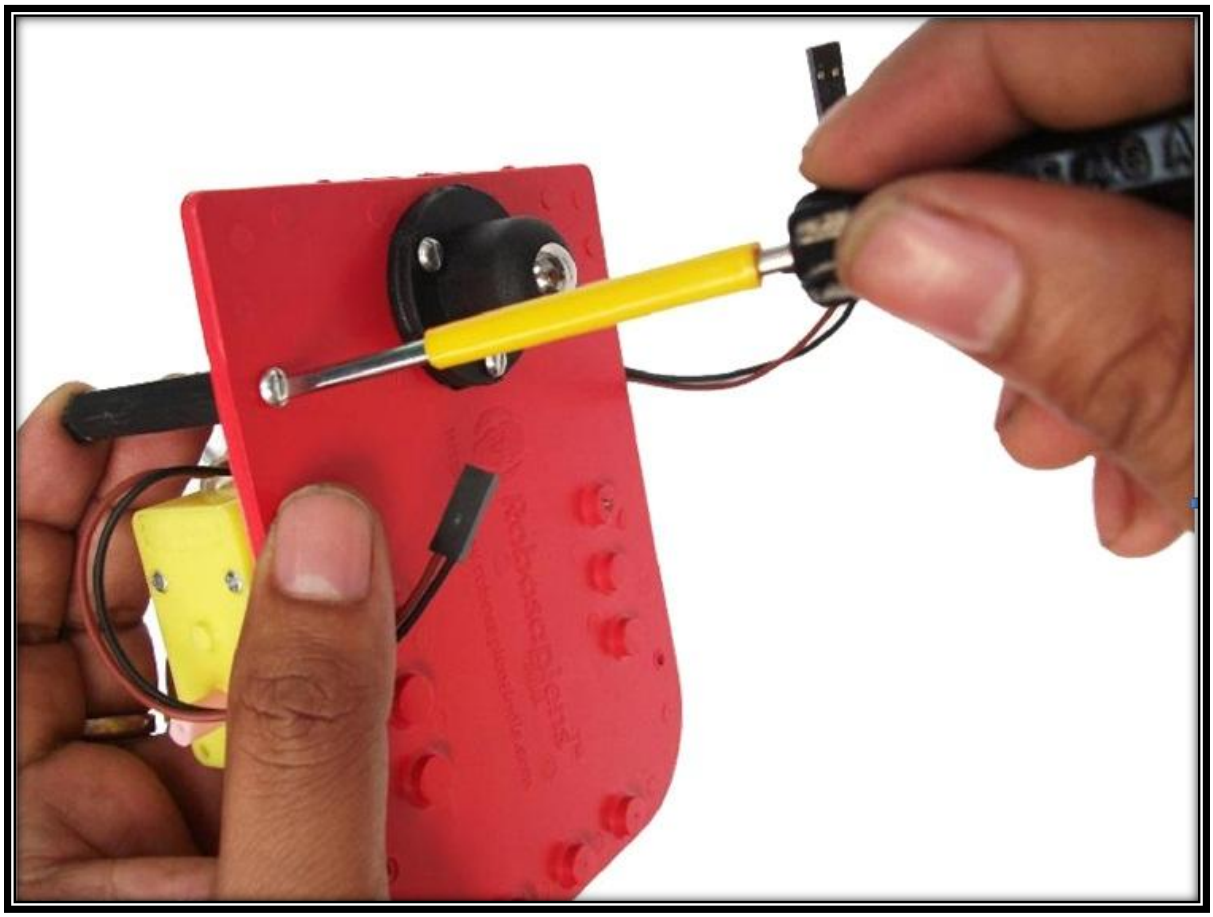
g) After fixing the caster wheel, spacers are connected as depicted in the figure.



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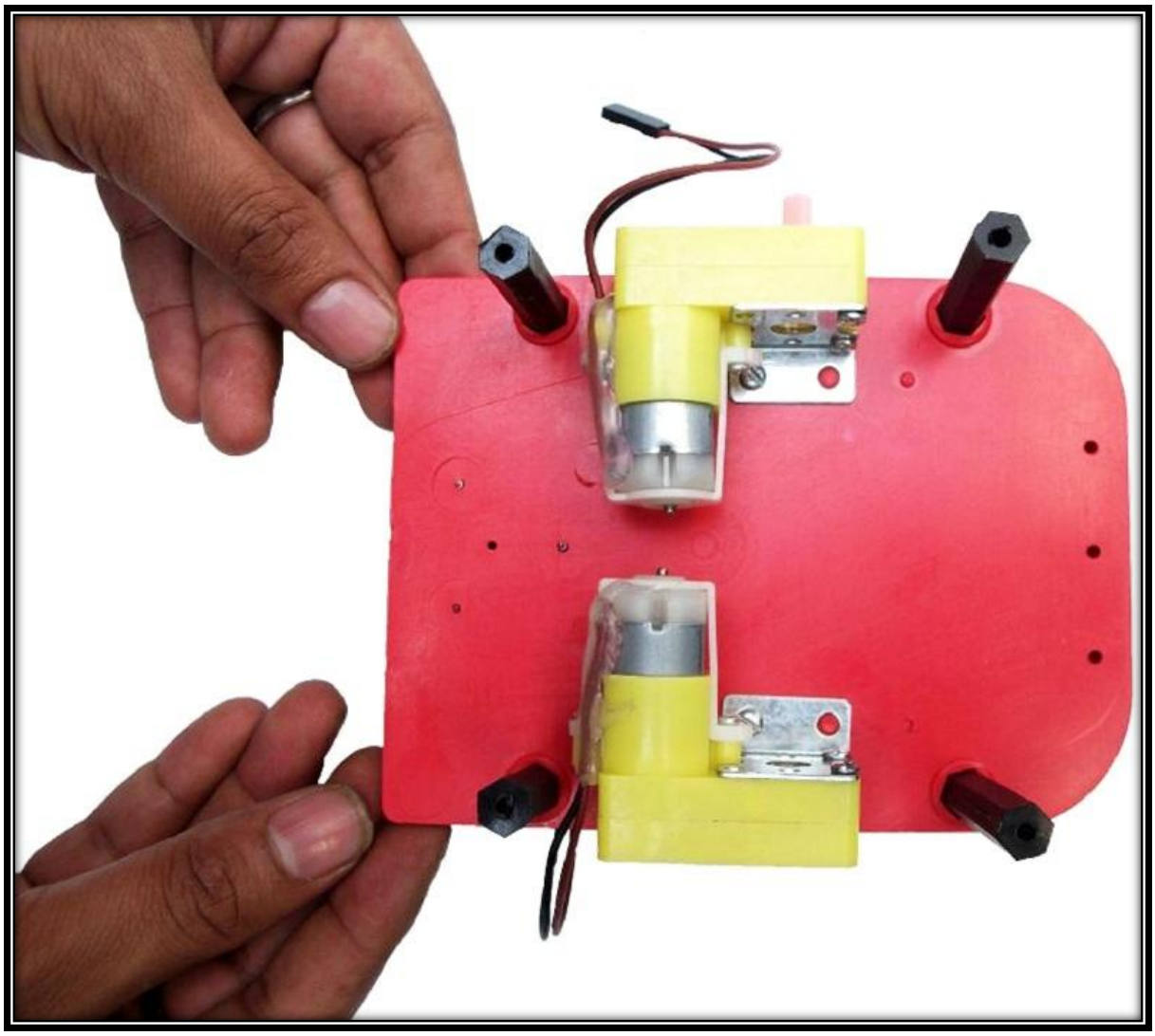
h) Connect all four spacers as shown in the figure.

The fundamental use of spacers is to provide a support for placing another layer or development board for robot control.



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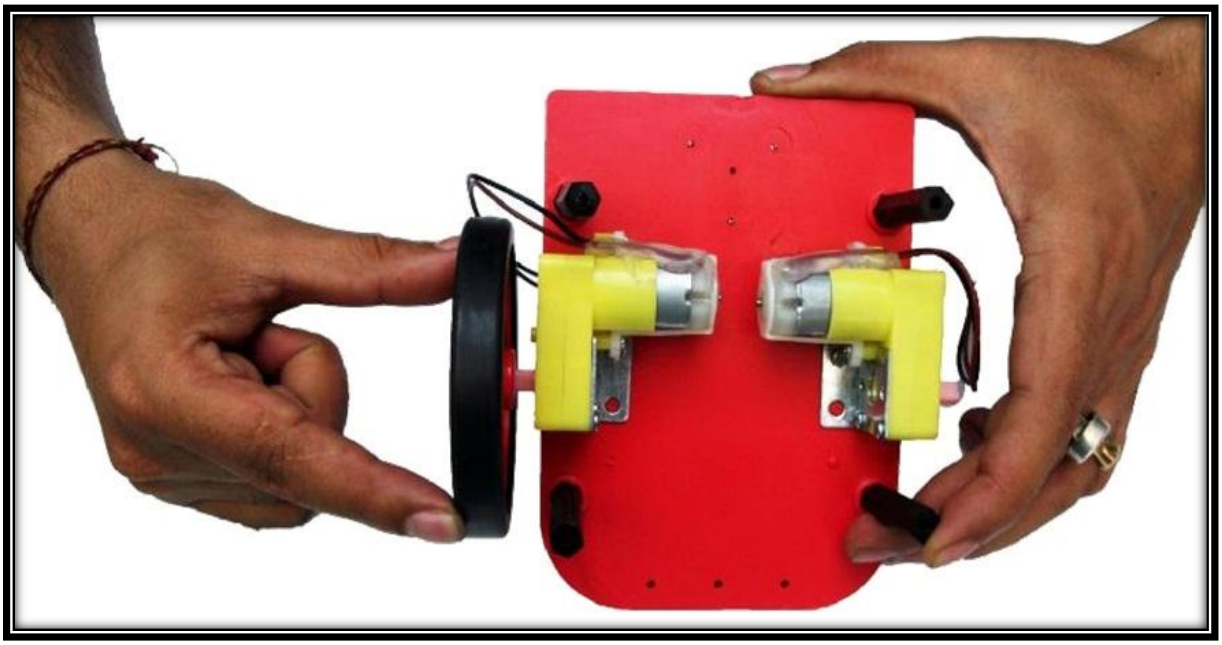
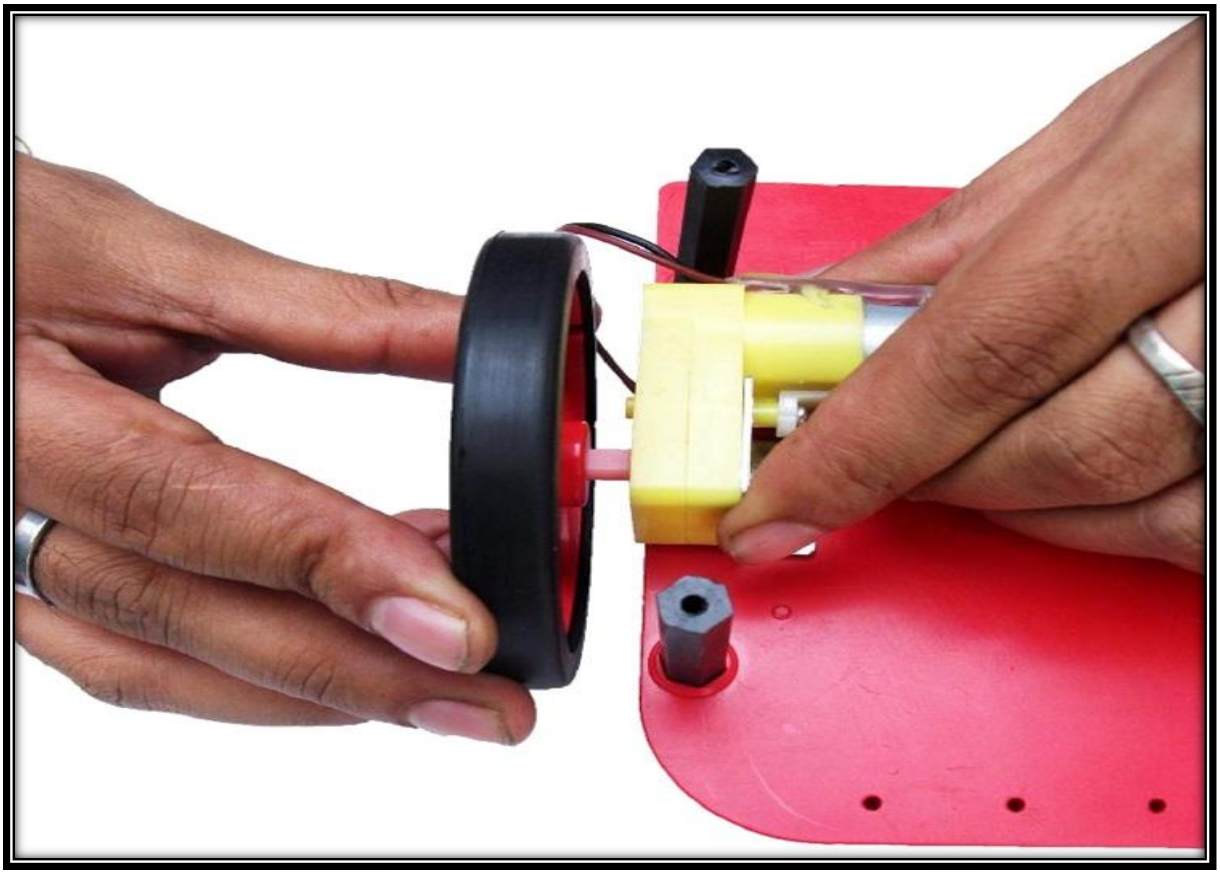
i) Wheels are connected to the motor's shaft.



j) Connection of the wheel and the shaft.



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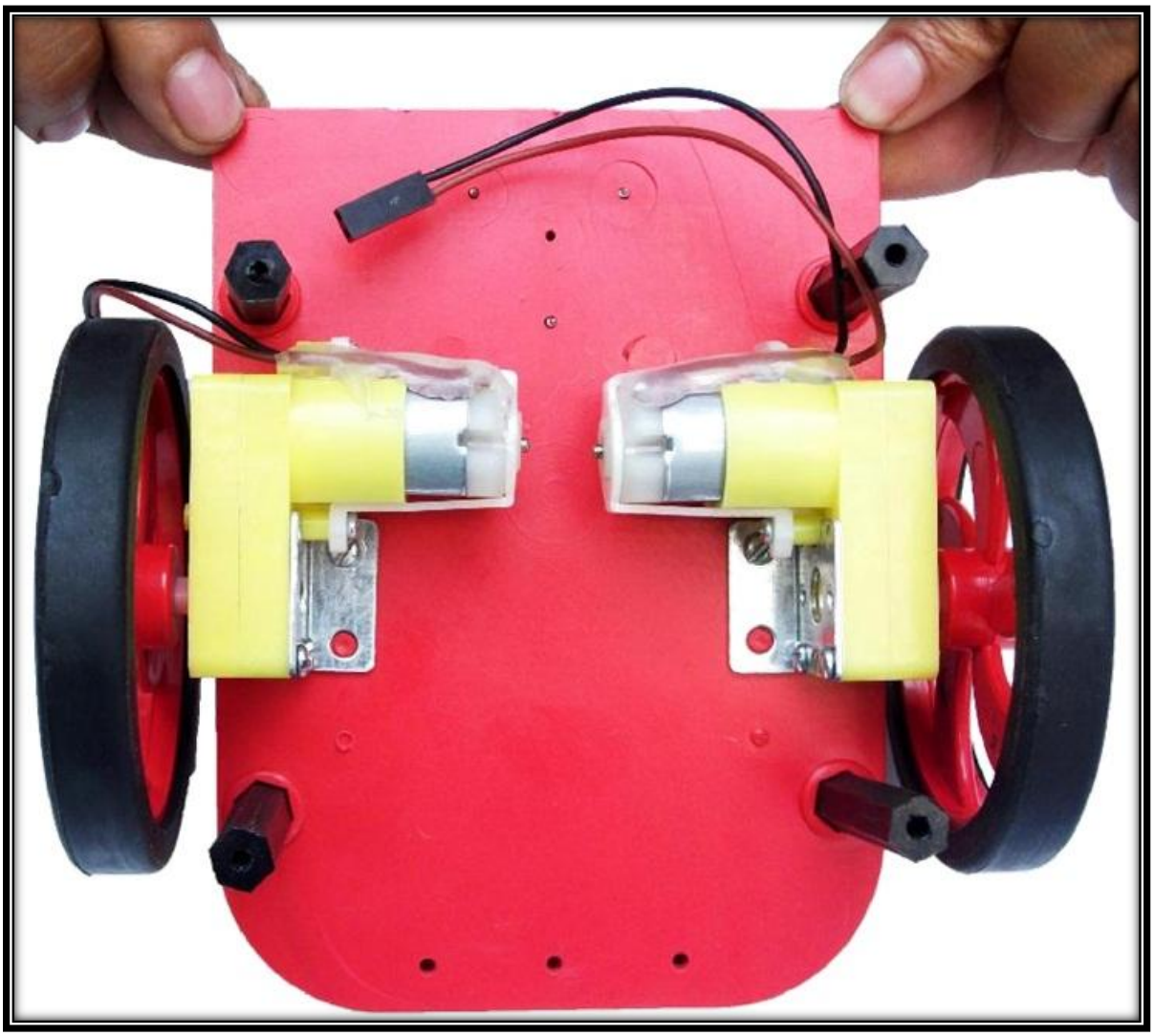
k) Connect both the wheels with both the motors.



(TOP VIEW)

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(ISOMETRIC VIEW)

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l) Fix the wheels connected with the shaft using a small screw as shown in the figure.

m) Place the screw as shown in the figure and tighten it using the screw driver.

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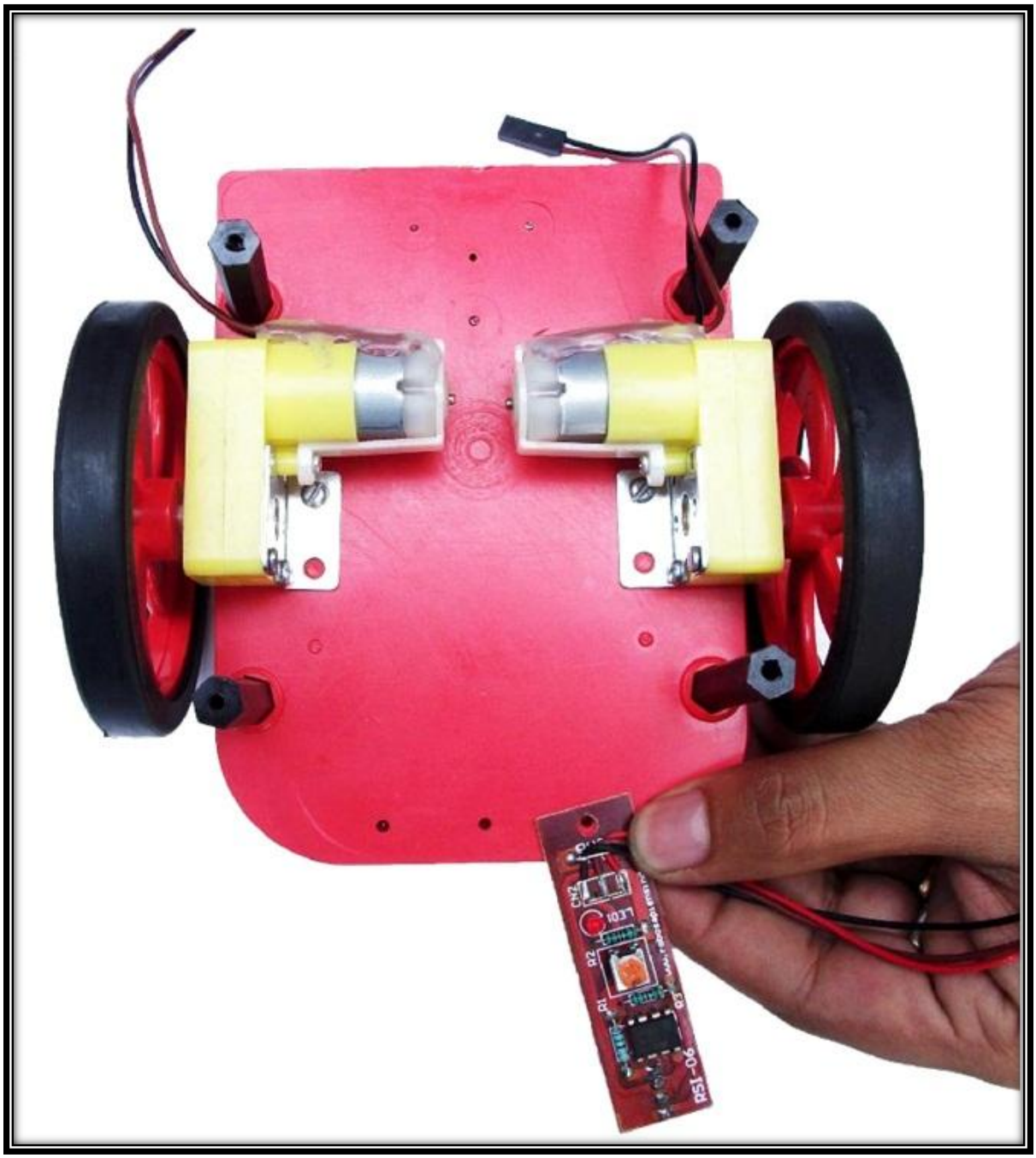
n) Place the IR proximity Sensor as in the figure.

IR Proximity sensors are input devices which gives digital input to the micro controller. The input depends on the environmental factor like light intensity, surface color etc.



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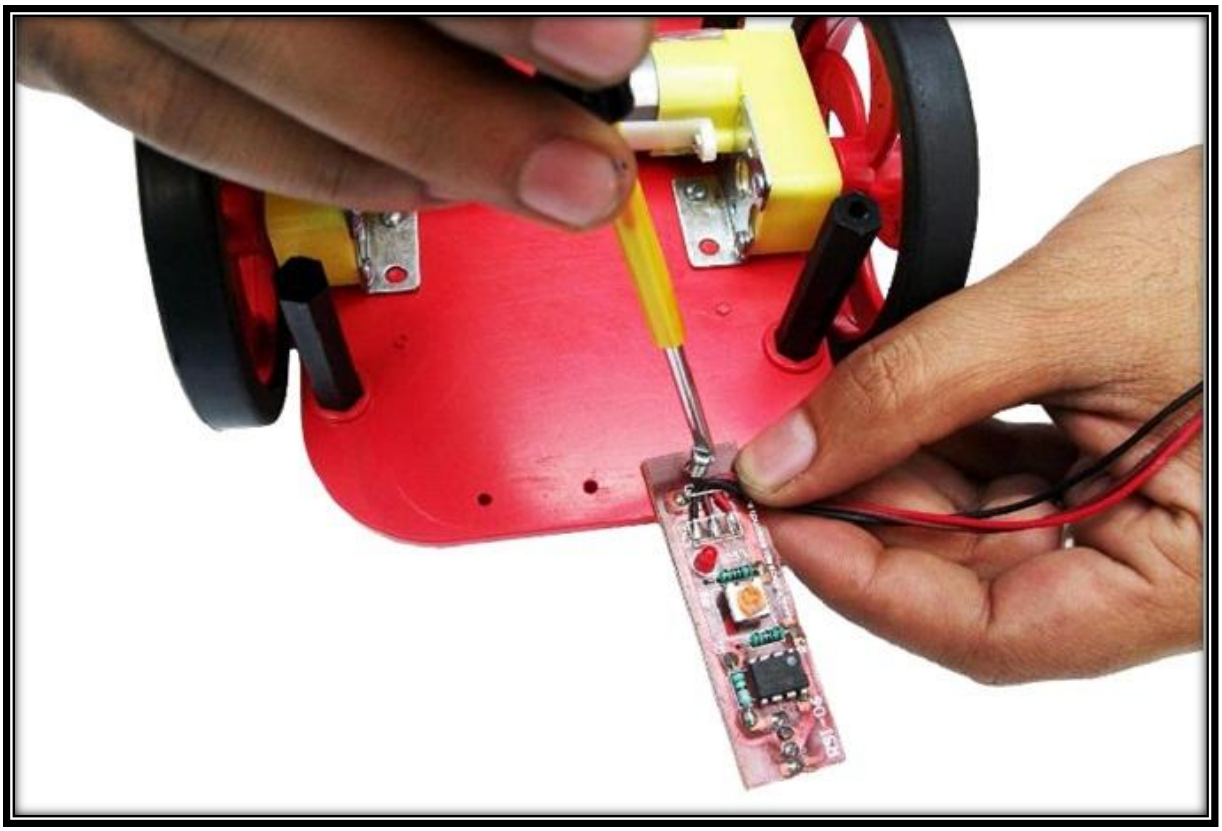
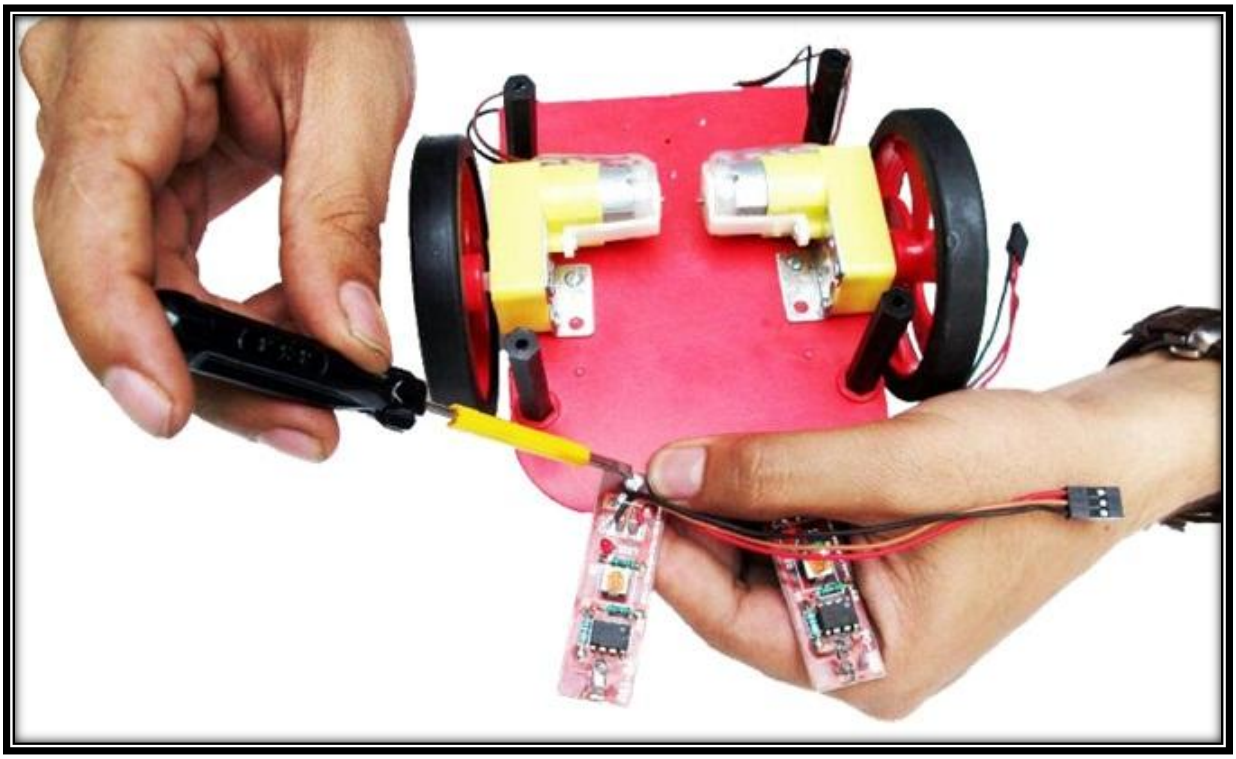
o) Fix the sensors using screws as shown in the figure.



p) Fix both the sensors provided using screws to determine the front of the robot.



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(ISOMETRIC VIEW OF CONNECTED SENSORS, MOTORS AND WHEELS ON THE CHASSIS)

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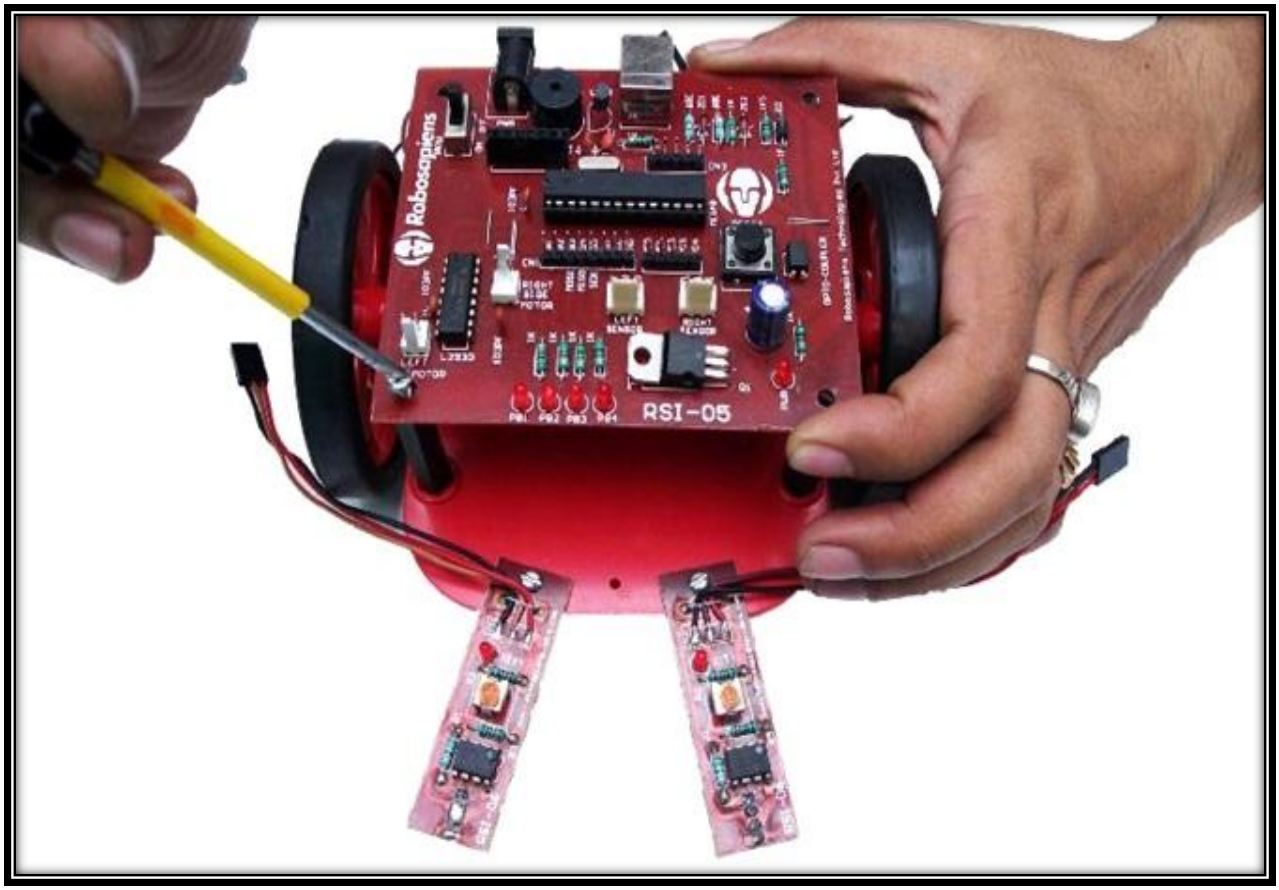
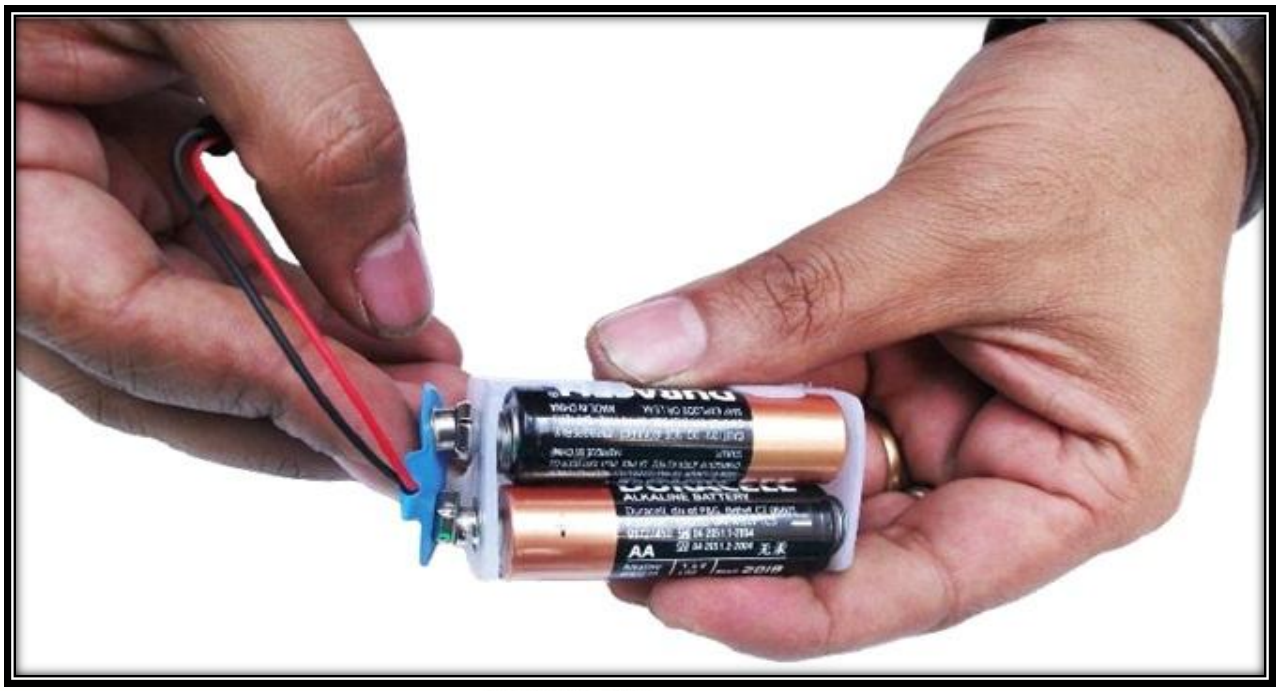
q) Now place the ATmega 8 mini board (RSI - 05) on the spacers and screw it at the four corners with spacers.



r) Load the battery jacket with 4 no. of 1.5V AA size pencil cells to create a power supply for the robot and connect the battery sniper provided with the nut bolt packet.



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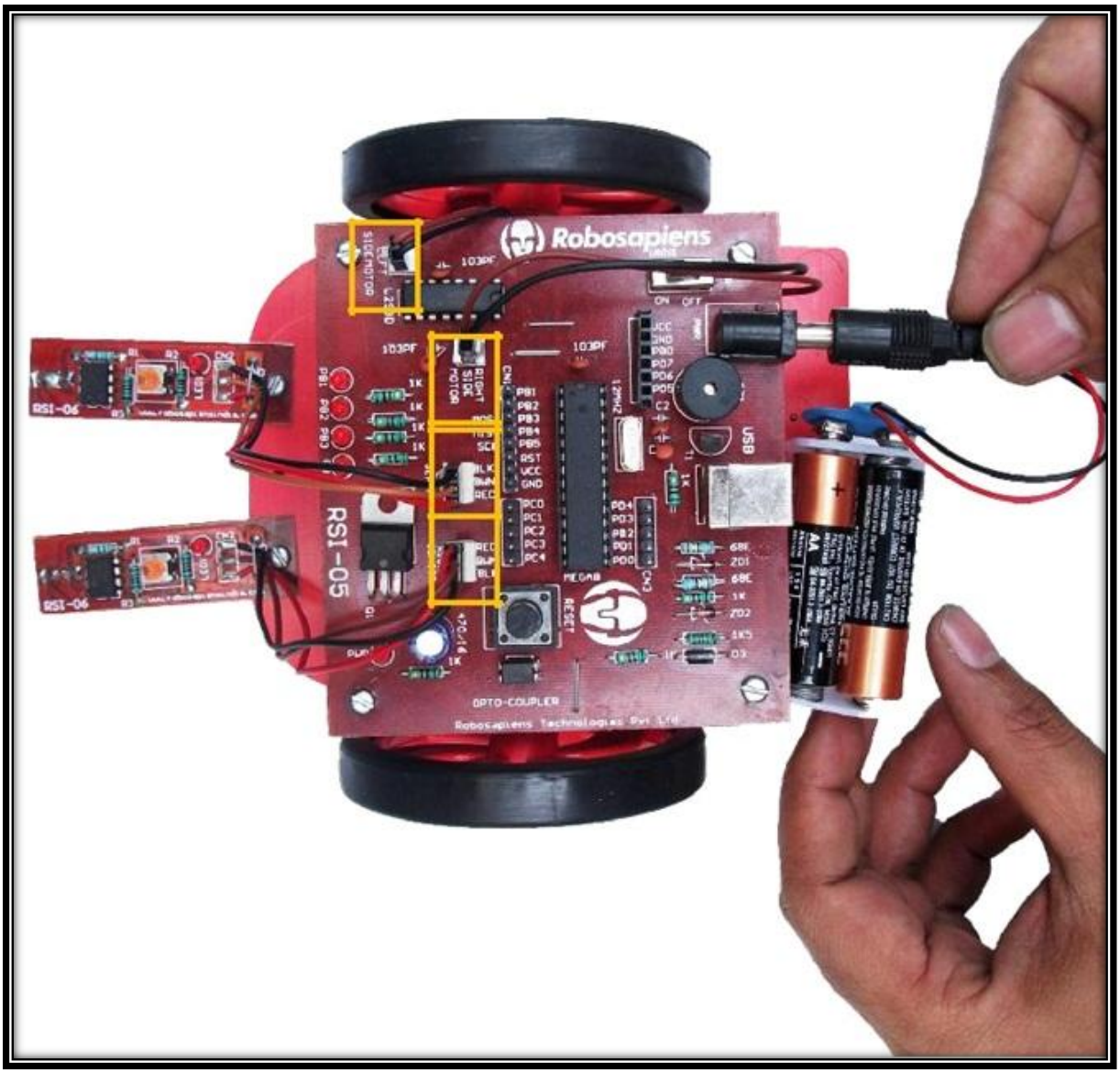
s) Now connect the DC jack of the battery sniper into the DC socket available for the power supply on the Board.

In the figure shown, connections' regarding the sensor and motors has been highlighted.



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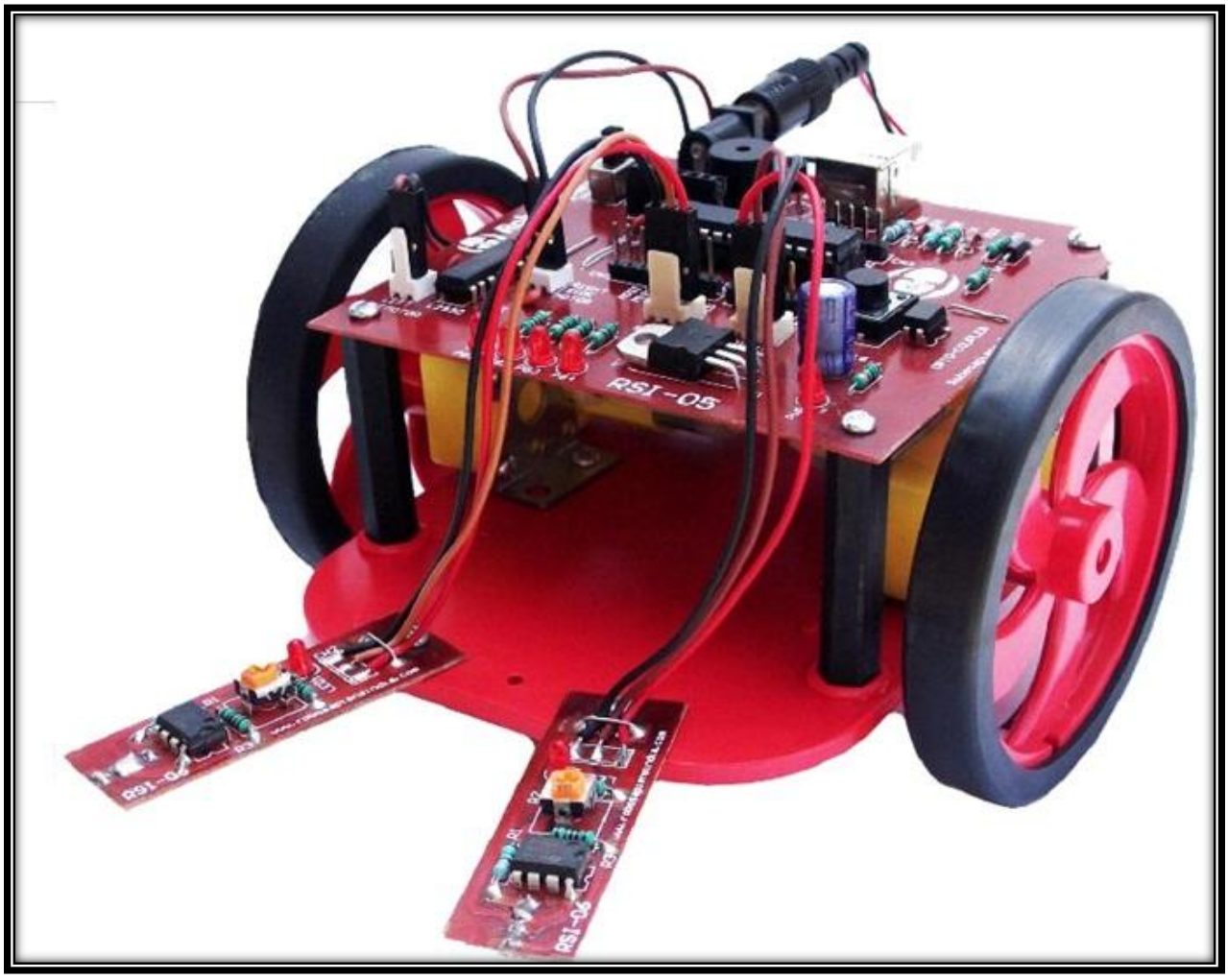

(ISOMETRIC VIEW AFTER FINAL CONNECTIONS)

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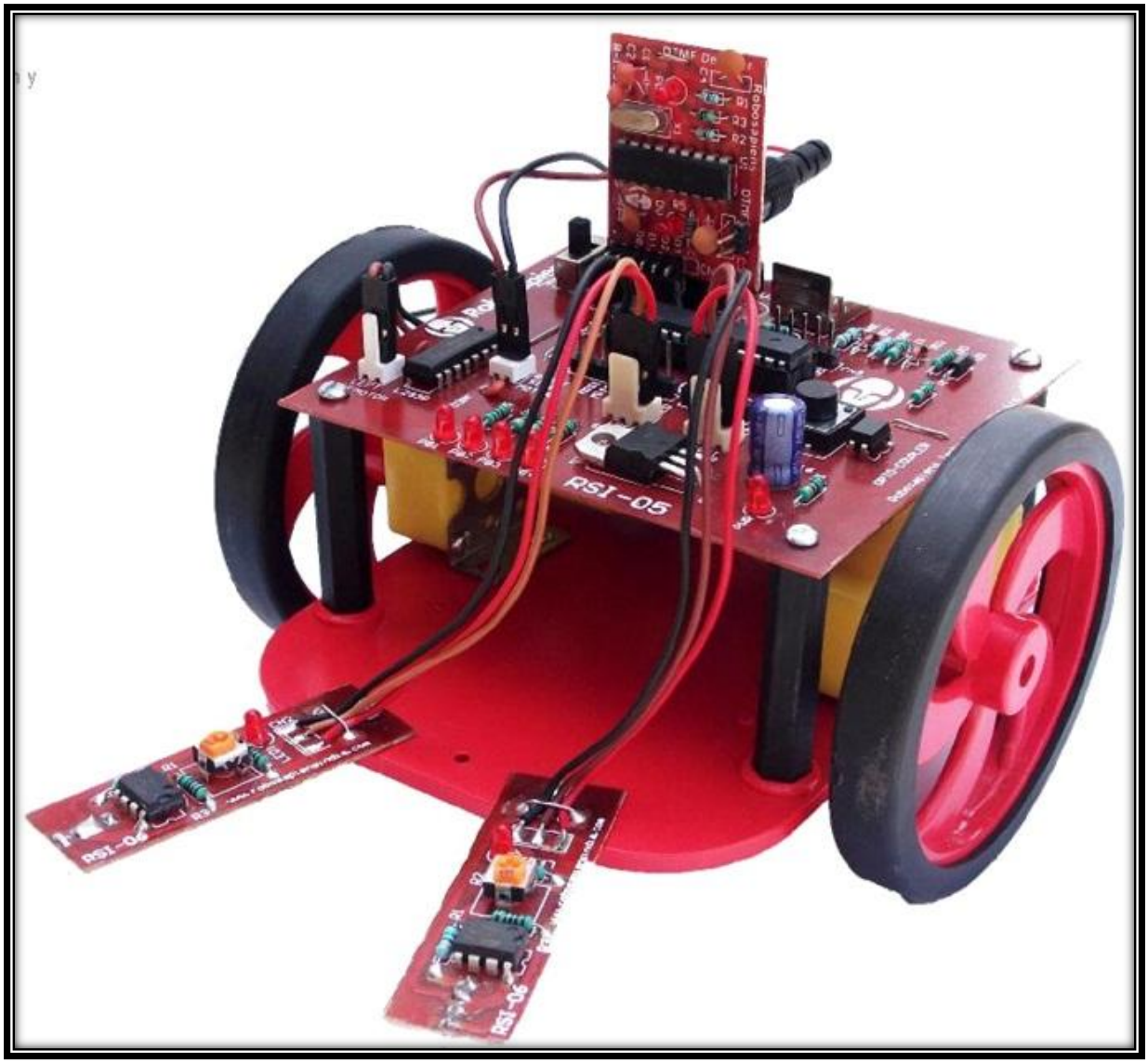
t) Connect the DTMF Module as shown in the figure.

A DTMF Decoder Module is the extra peripheral being given to realize an automation using mobile phones. It gives four bit of digital input to the micro controller. Detailed study will be done in near future.



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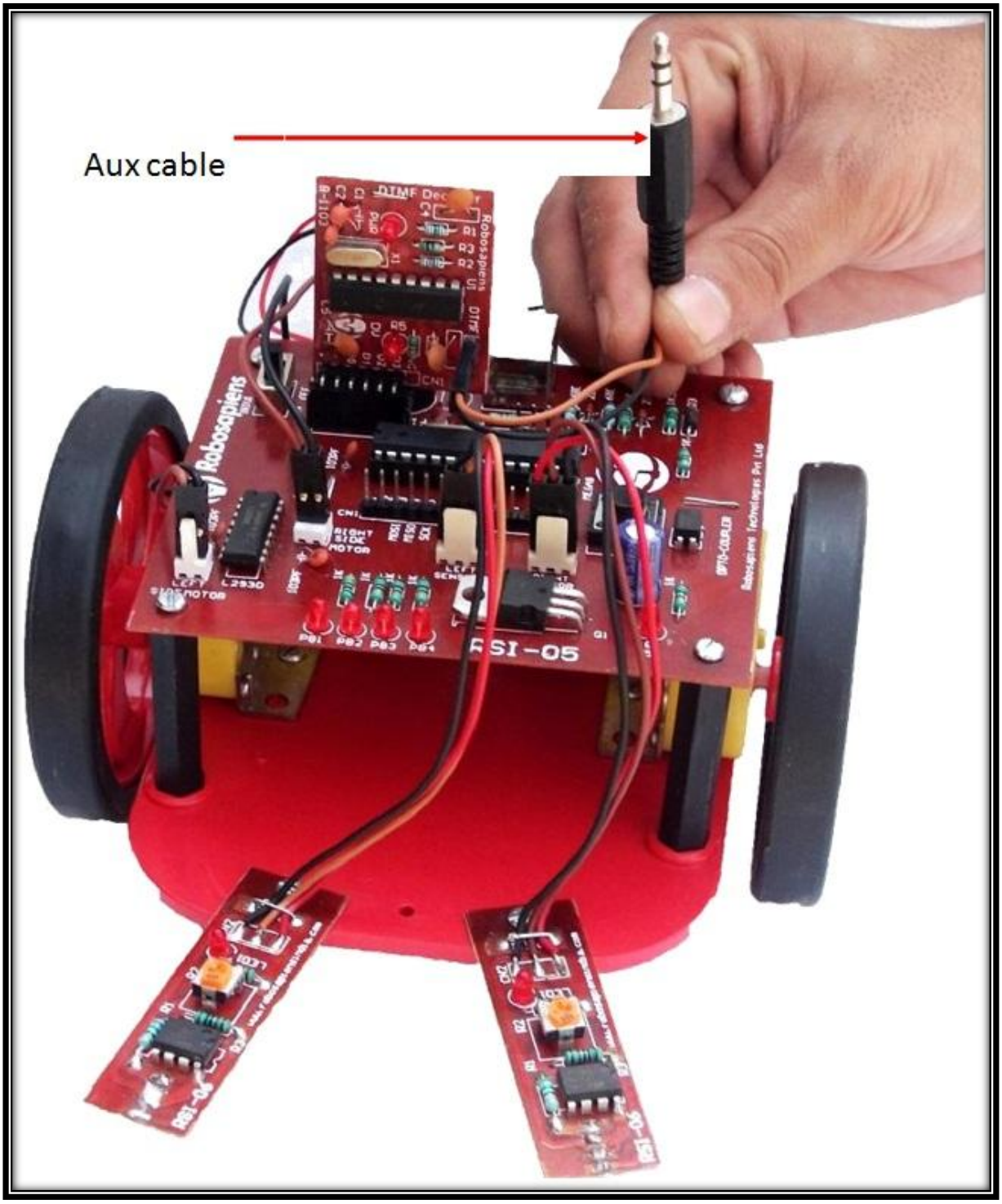
u) Now connect the AUX Cable given with DTMF Decoder Module as shown in the figure.



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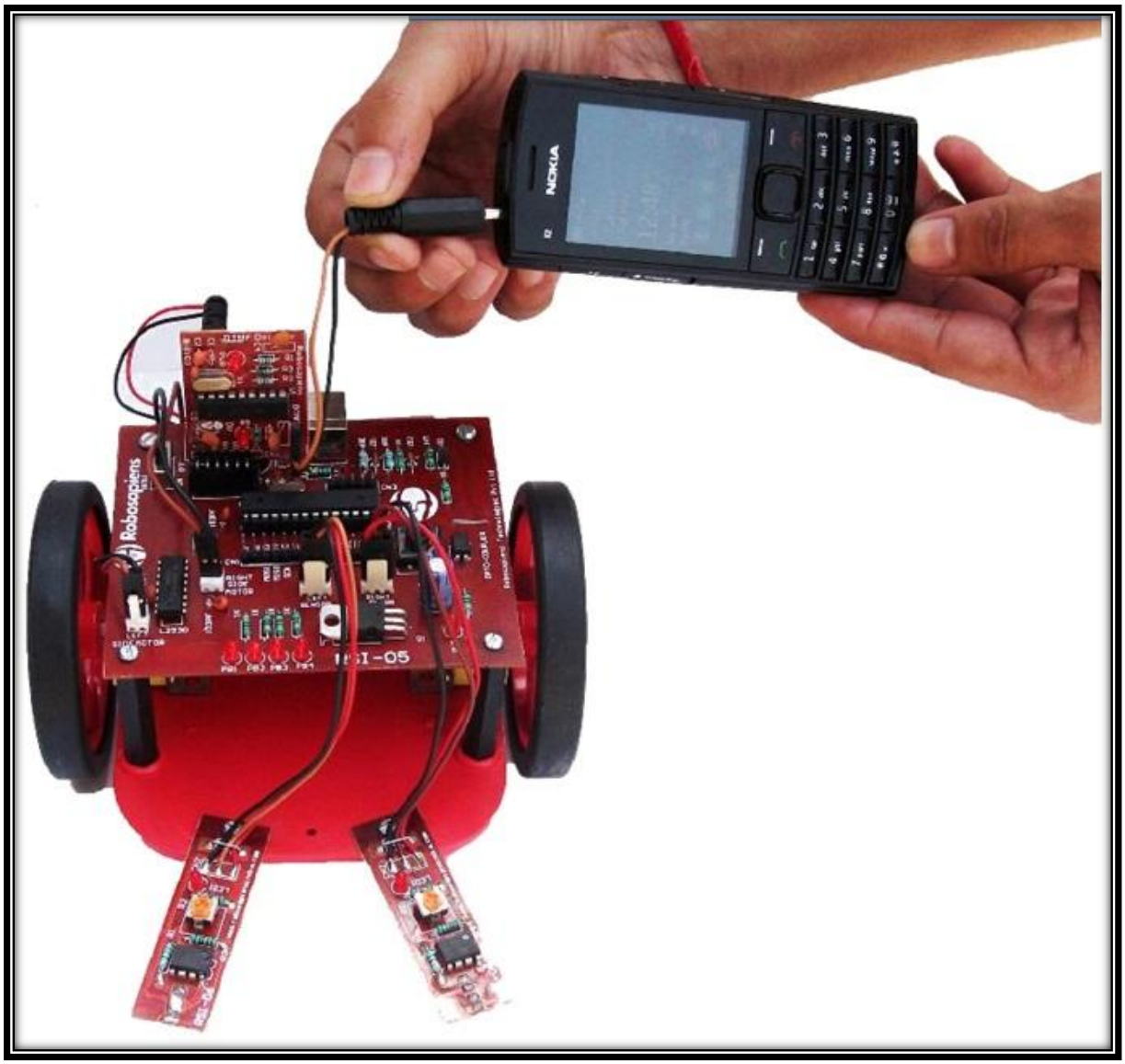
v) The other end of the AUX cable is connected to the mobile as shown in the figure.



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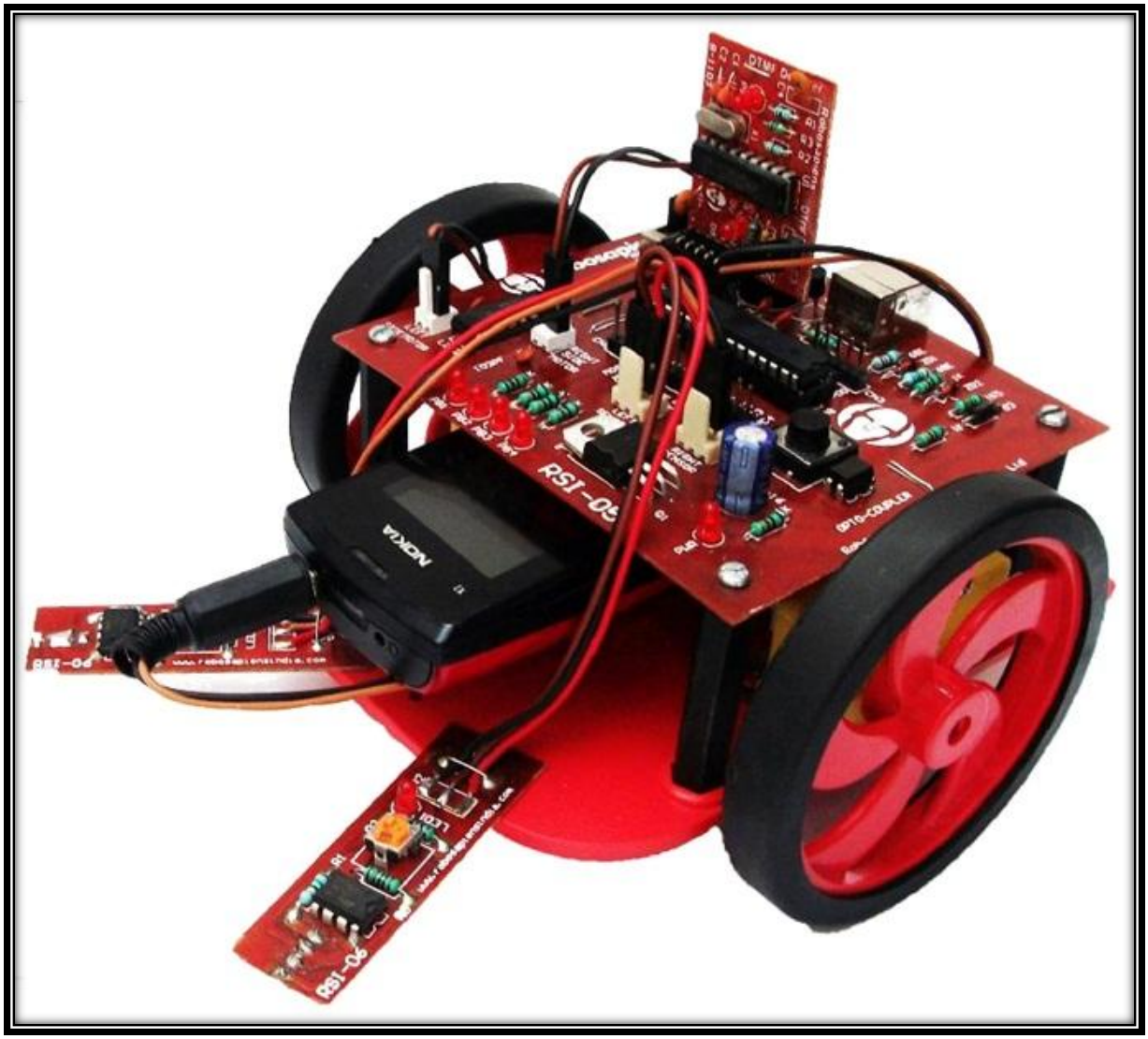
w) Place the mobile phone as shown to complete the assembly.



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7. Starting AVR Studio

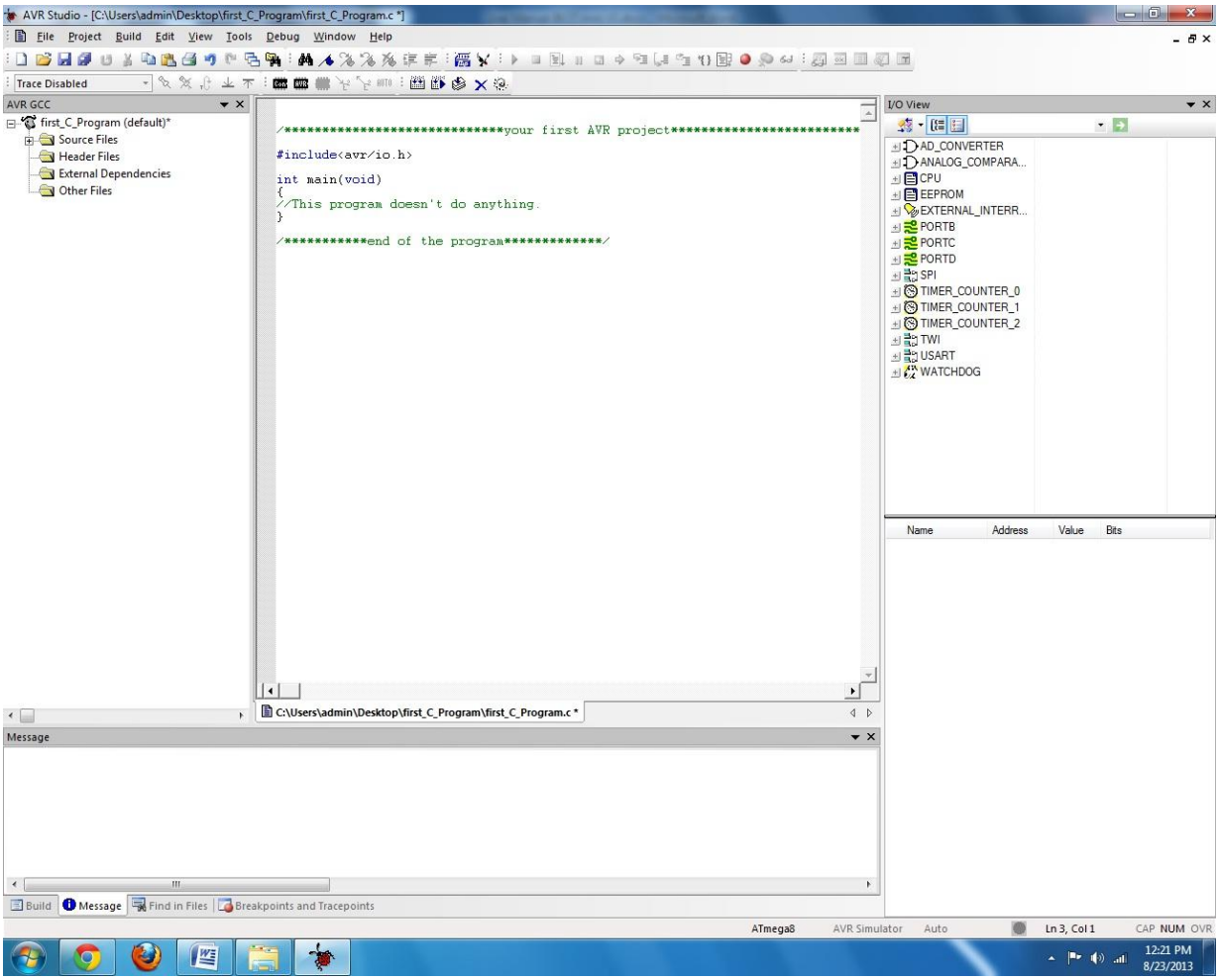
7.1. Writing your first C program

```
/*****************************your first AVR project*************************/
#include<avr/io.h>

int main(void)
{
//This program doesn't do anything.
}

/************end of the program*************/
```

Write down the above code to your AVR studio Text Editor. See Screen shot of the same below.



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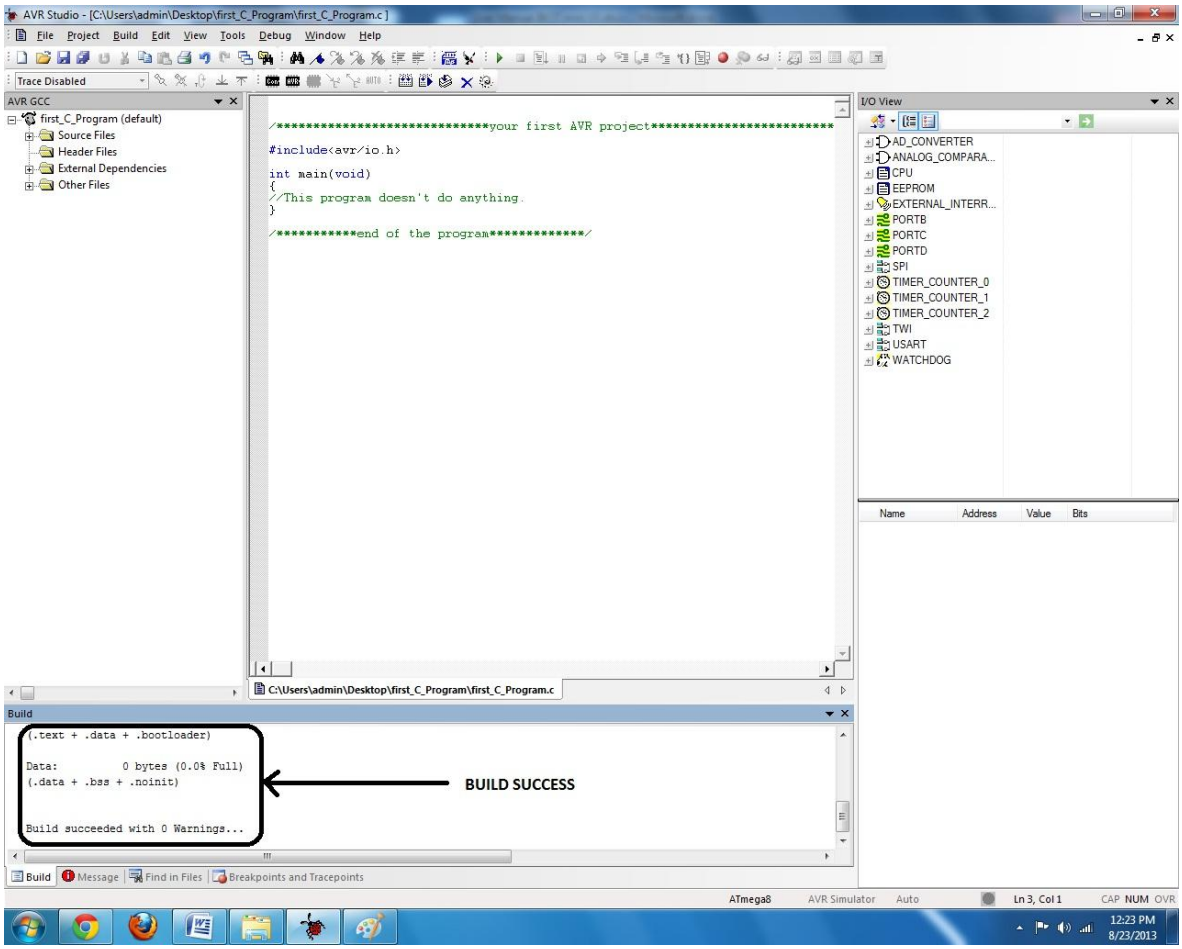
7.2. Compilation of your first C program

Press F7 key to compile your project or See screen shot to compile using GUI interface.



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8. Dumping Program in Development Board Connected

Step 1. Connect one end of your USB Cable with Computer's USB Port and connect other end with the development board.

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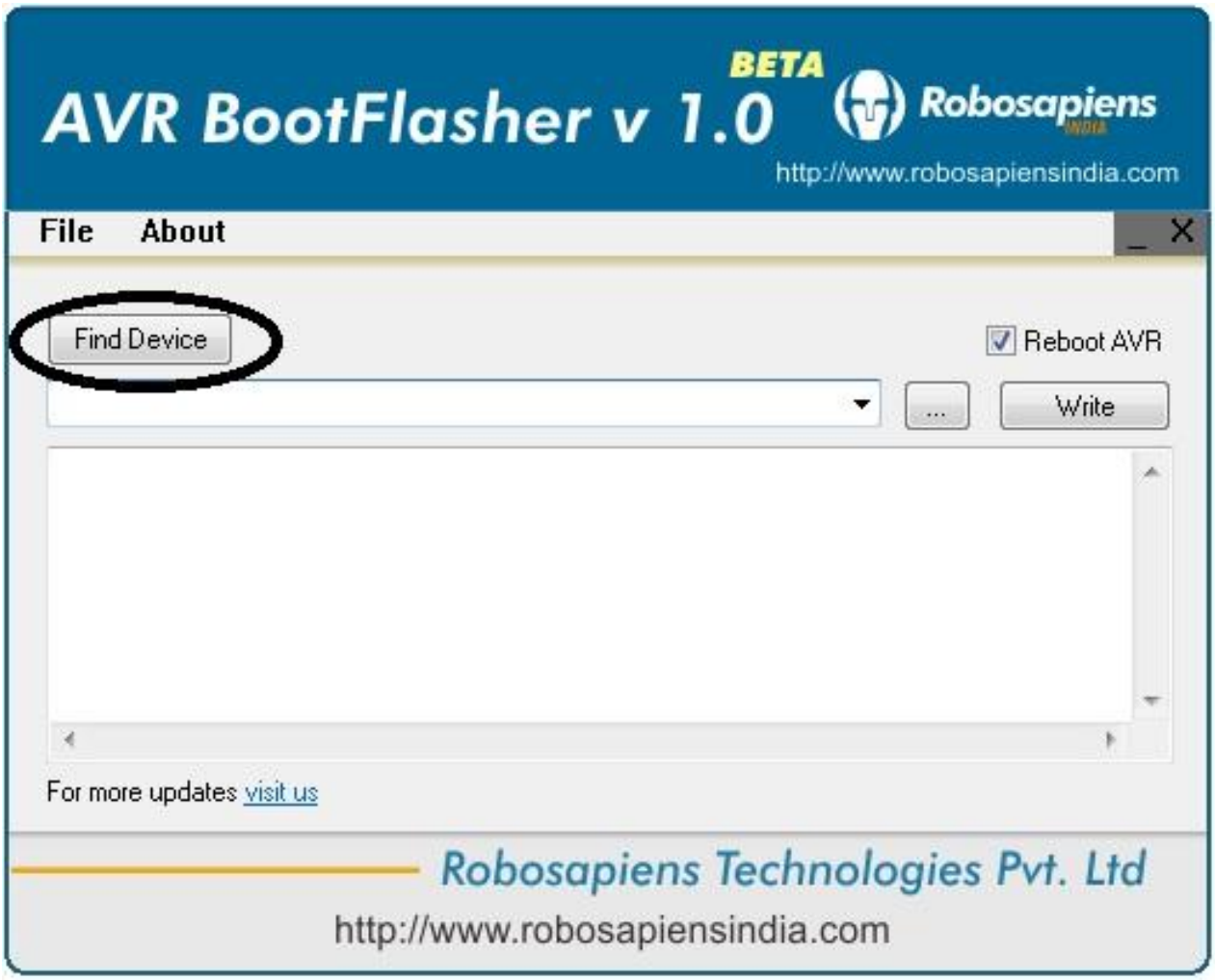
Step 2. Click on to the button 'Find Device'.



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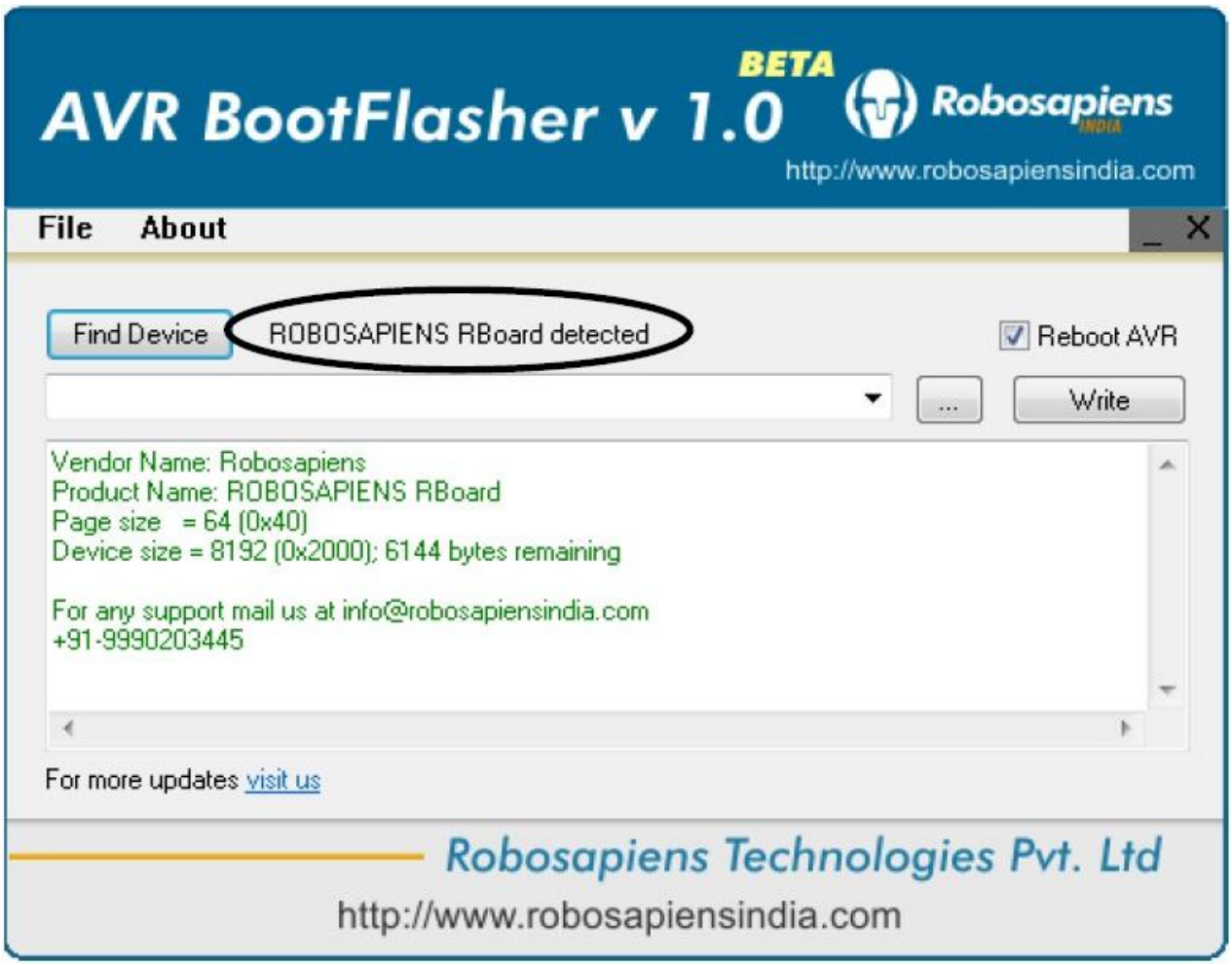

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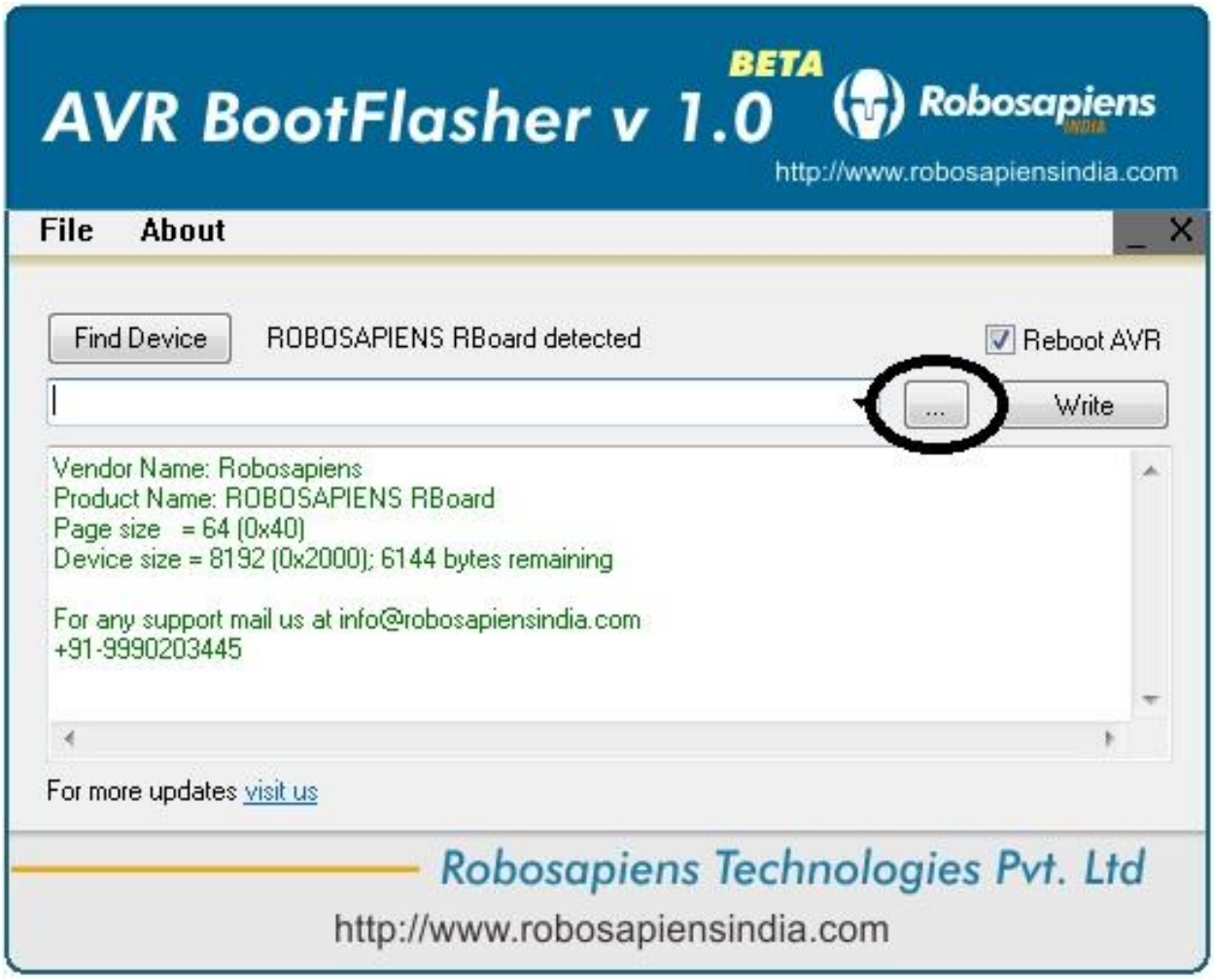
Step 3. Browse your '.hex' file to be flashed in the device.



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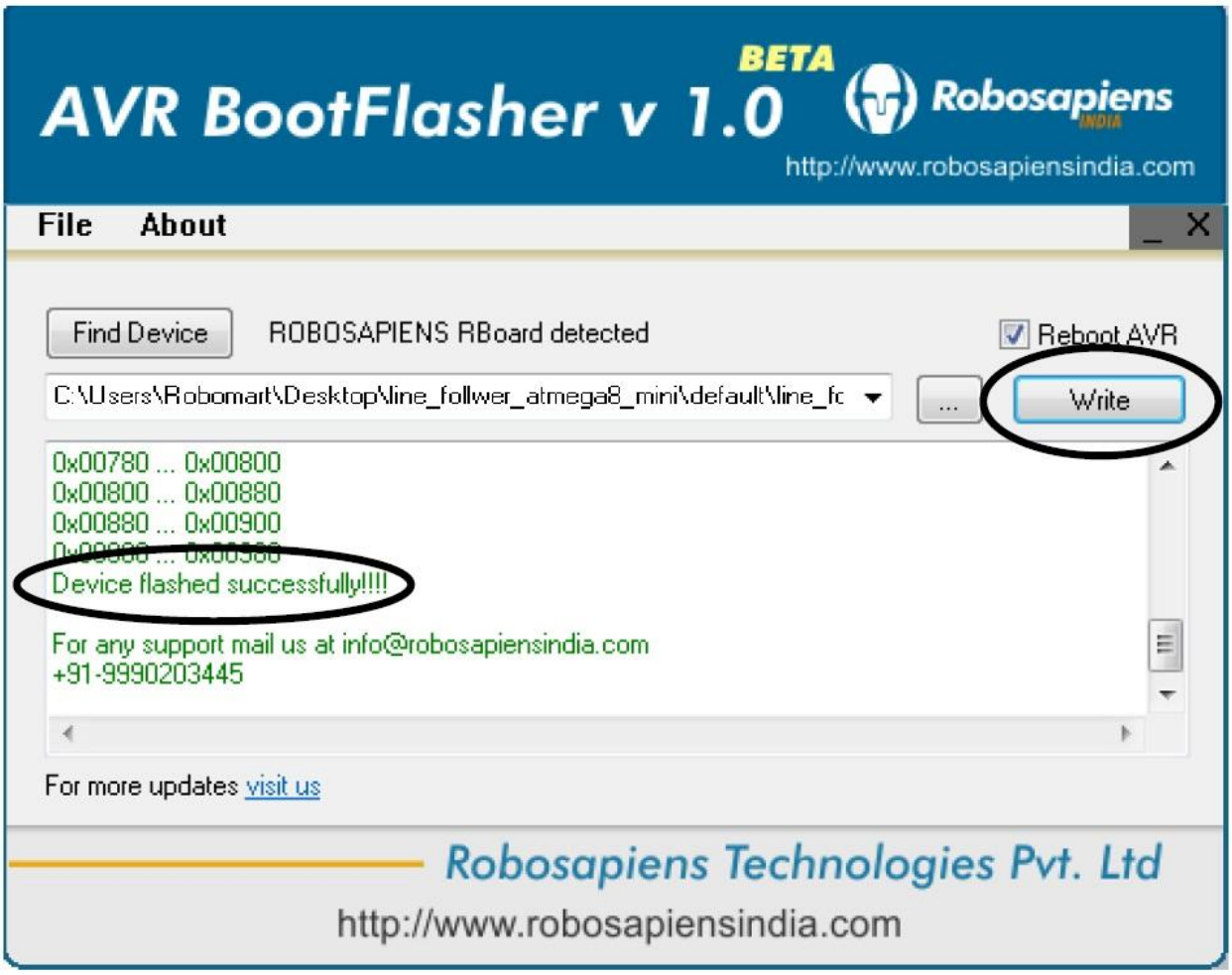
Step 4. Finally click on to the write button to burn the .hex file in the MCU.



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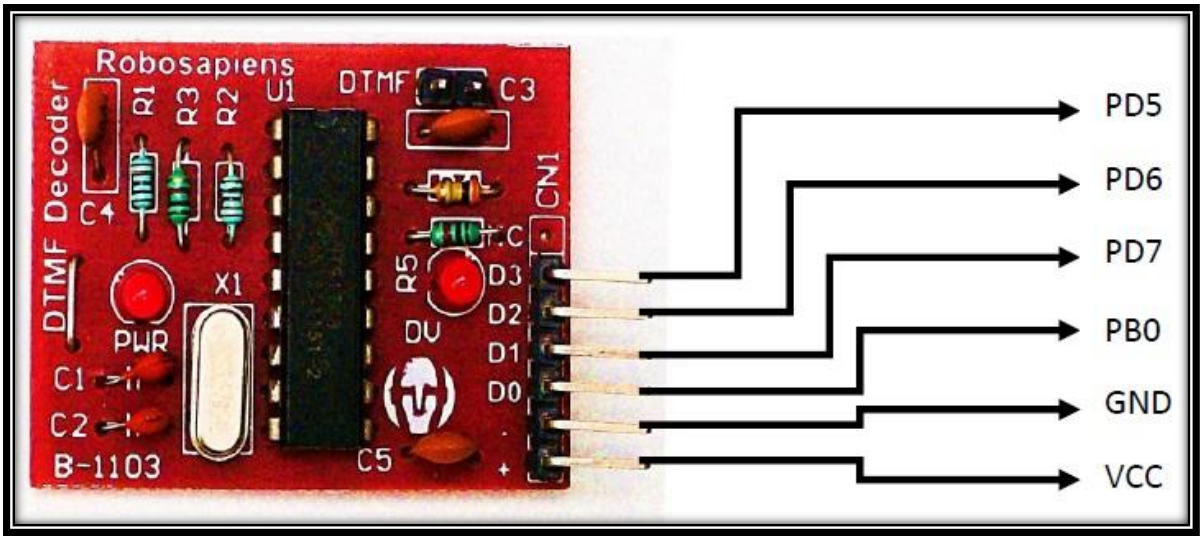
9. Connecting peripherals with IBOT mini V3

9.1. DTMF Decoder module



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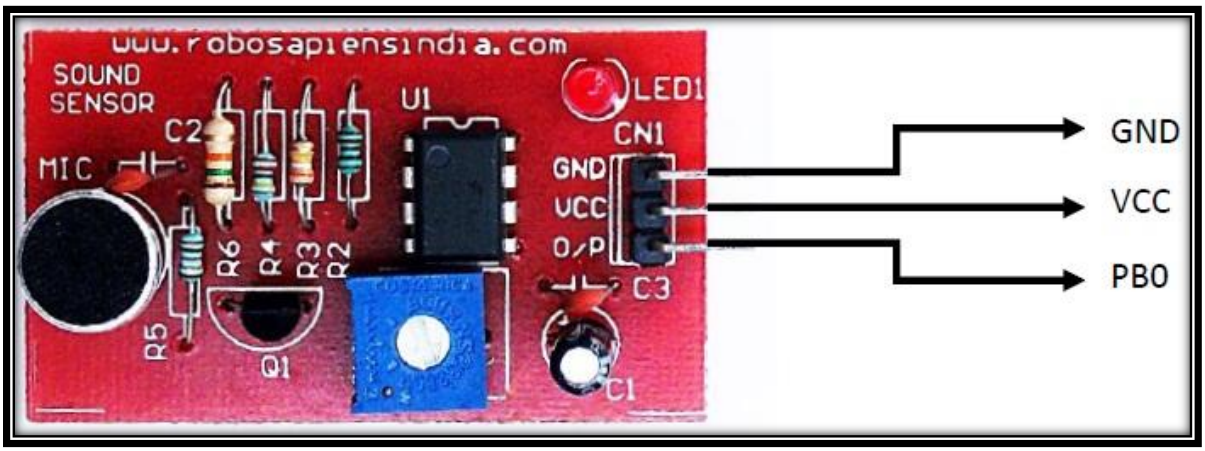
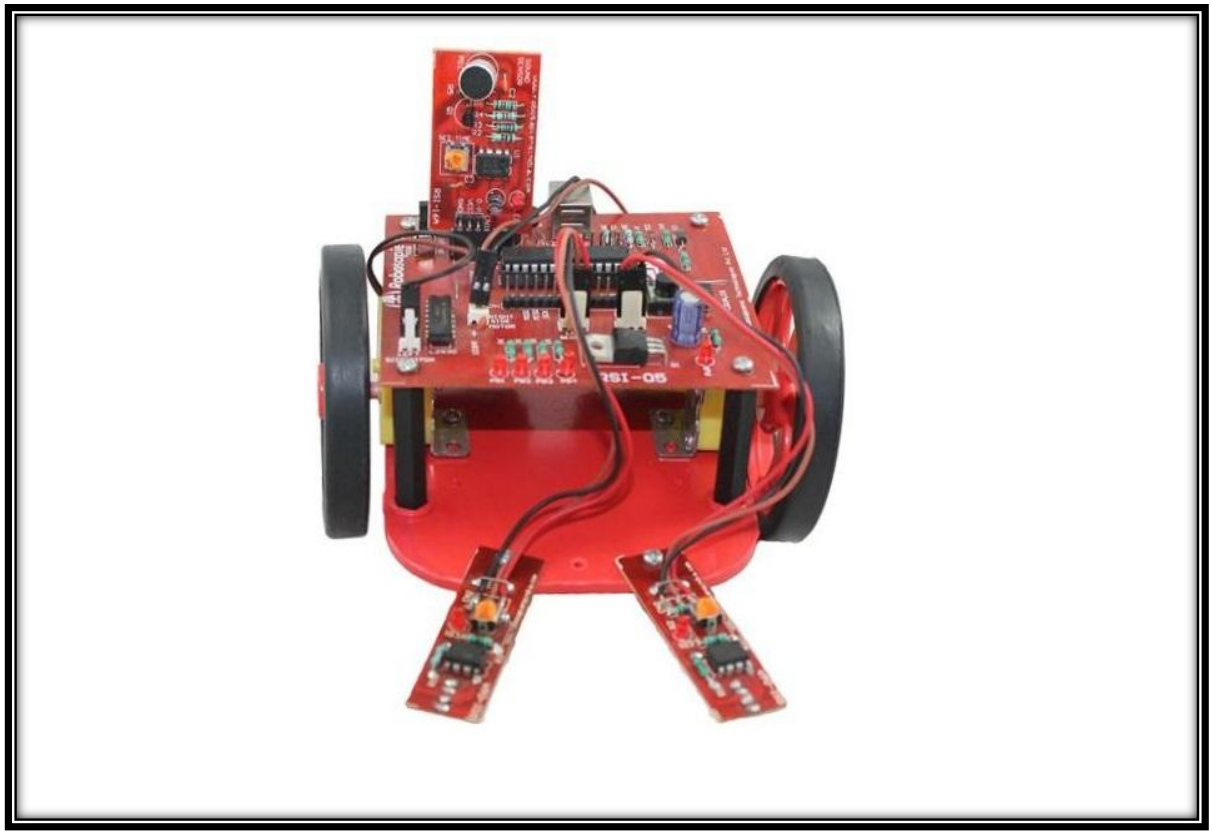
9.2. Sound Sensor





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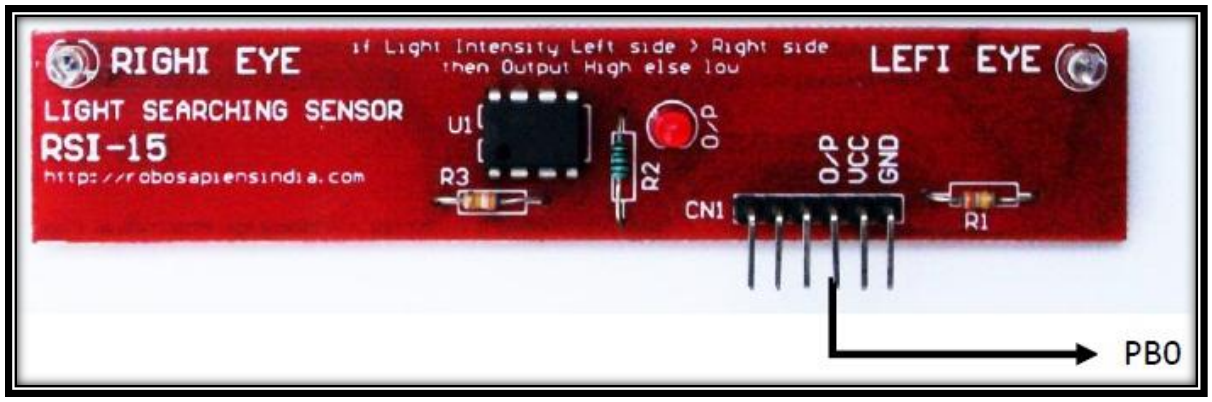
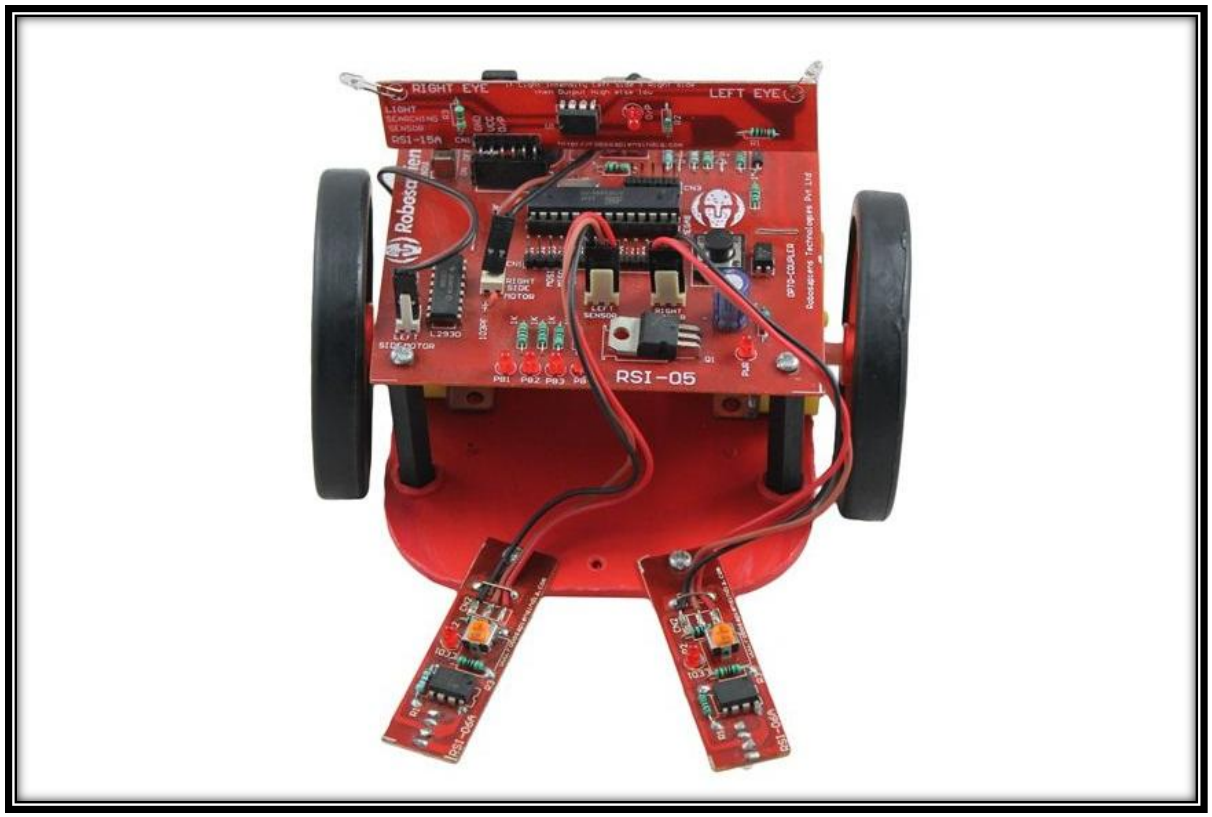
9.3. Light Sensor





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10. Study of some C program using Loops and variables

10.1. Running LEDs

```
//Project name        : Running LEDs
// Designed By        : ROBOMART
//                      http://www.robomart.com

/* Program for "Running LEDs"
_____________________________________________________
Connection settings of Kit
LEDs---@---------------------->PB1
LEDs---@---------------------->PB2
LEDs---@---------------------->PB3
LEDs---@---------------------->PB4
RIGHT MOTOR (+) ---------->PB1
RIGHT MOTOR (-) ----------->PB2
LEFT MOTOR (-)  ----------->PB3
LEFT MOTOR (+)  ---------->PB4
Buzzer------------------------->PD4
BOOT Loader Condition Check--->PC5 (If 0 boot loader section else program execution section of Flash memory)
RESET------------------------->PC6
Crystal Oscillator (12MHz) ----->PB6 and PB7 (hence PB6 & PB7 are not available for user)
VB=Battery Supply
VCC=regulated 5V+
Gnd= Ground (0V)
*/

#define F_CPU 120000000UL
#include<avr/io.h>
#include<util/delay.h>
#include "robosapiens.c"
int main(void)
{
DDRB=0b00011110;   // PB1, PB2, PB3 and PB4 of PORTB are set as output.
While (1)                // infinite while loop
{
 for (int i =1; i<=4; i++)
 {
   PORTB=1<<i;
   Wait (0.5);          //wait function defined in robosapiens.c file function argument:
                         // time in second
 }

}

}
```

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10.2. Line follower Robot program

```
//Project name        : Line Follower Robot
// Designed By        : ROBOMART
//                      http://www.robomart.com

/* Program for "Robot Following Line"
_____________________________________________________

Connection settings of Kit

LEDs---@----------------->PB1
LEDs---@----------------->PB2
LEDs---@----------------->PB3
LEDs---@----------------->PB4
Left Sensor--------------->PC3
Right Sensor-------------->PC0
Buzzer-------------------->PD4
SOUND SENSOR------------>PB0
RIGHT MOTOR (+)-------->PB1
RIGHT MOTOR (-)--------->PB2
LEFT MOTOR (-)----------->PB3
LEFT MOTOR (+)---------->PB4
BOOT Loader Condition Check----->PC5 (f 0 boot loader section else program execution
section of Flash memory)
RESET------------------------->PC6
Crystal Oscillator-------------->PB6 and PB7
VB=Battery Supply
VCC=regulated 5V+
Gnd = Ground (0V)
*/

#include<avr/io.h>

void main()
{
DDRD=0b11111111;  //set PD4 as output bit
DDRC=0b0000000;    //set PORTC as input port
DDRB=0b00011110;  //PB1, PB2, PB3, PB4 as output port
int ls=0, rs=0, a=1;   // define & initialize ls, rs integer as 0 to
                        // acquire the left sensor status in ls and right sensor
                        // status in rs

While (1)               // create infinite loop
{
rs=(PINC&0b0000001);   //acquire only left sensor status connected at PC0
ls=(PINC&0b0001000);   // acquire only right sensor status connected at PC3
PORTD = ~PORTD;
```

.....continued

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```
if((rs==0b0000001)||(ls==0b0001000))
{
PORTD=(1<<4);
}

if((rs==0b0000000)&(ls==0b0000000))   //check sensor status for both sensor OFF
{
PORTB=0b00011110;  //stop
ls=0;                    //set sensor status off
rs=0;                    //set sensor status off
}

if((rs==0b0000001)&(ls==0b0000000))  //check sensor status for left sensor=ON and right
                                     //sensor=OFF
{
PORTB=0b00010000; //turn right
PORTD = (1<<4);
ls=0;                   //set sensor status off
rs=0;                    //set sensor status off
}

if((rs==0b0000000)&(ls==0b0001000)) //check sensor status for left sensor=OFF and right
                                    // sensor=ON
{
PORTB=0b00000010;  //turn left
PORTD = (1<<4);
ls=0;                    //set sensor status off
rs=0;                     //set sensor status off
}

if((rs==0b0000001)&(ls==0b0001000)) //check sensor status for both sensor ON
{
PORTB=0b00010010;  //move forward
PORTD=~PORTD;
ls=0;                   //set sensor status off
rs=0;                   //set sensor status off
}

}

}
```

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