Stair Climbing Robot

Penkey Suresh 08d26006
Makarand Diwe 08026007
Narendra Chouhan 08026010

Introduction:

The robot can climb up stairs and obstacle comparable to stair upto certain height and width depending on the dimensions of the BOT.

Material Used:

Al Rod.
L clamps 8.
Wheels 6.
Screws.
Nylon Strings.
Harddisk Adapter (power supply).

Electric Components:

Motors -7.
7805.
L293D.
PCB.
10 bitbus wire.
Atmega168.

Working Procedure:

Working of the BOT takes place stepwise. There are roughly four to five steps for the process. The BOT comes to rest momentarilly after each step. The four steps for climbing the stair are

1. Lifting the front part.
2. Lifting the middle part of the bot while moving forward.
3. Lifting the back part of the bot.
4. Coming to the initial position.

It is designed in two parts. Both parts are connected by a clamp by which it can rotate in 270^{o}. Two wheels are attached to two motos in the front and two in the back. In the middle part two wheels are attached with out any motors. In the middle position two motors (one to the front part and one to the back) are attached (on the body) to its right and one to its left (to the back part) which will help to lift the front and back parts. Basing on the state of the bot, motors are operated to lift the bot up the stair.

Lifting the front Part:

Initially the bot is in horizantal position. When a stair is present the motor which is attached in the middle position (to the back part) starts rotating. This motor is connected to the front part by means of a nylon wire. So when the motors starts rotating it lifts the front to a certain height. Another motor connected to the front part also helps the bot to climb the stair. (some inclination is made wrt the clamp). The motor stops after certain time.

Result : Initial position (Both parts Horizantal)
Final position (Front part inclined to the ground, Back part horizantal)

Lifting the middle part of the bot while moving forward:

After the completion of the first part the bot comes to a halt for 3 sec. After that second step takes place. The motor connected in the middle (to the left) starts rotating. The motors shaft is connected to an aluminium rod. So when ever the motor starts rotating the rod also rotates. After certain degree of rotation rod hits the ground. As the motors is still rotating the rod tries to rotate which eventually lifts the middle part. The motors to the back also starts rotating which will drive the bot to the front.

Result : Initial position (Front part inclined to the ground, Back part horizantal)
Front part (On the stair horizantal, Back part inclined to the ground)

Lifting the back part of the bot:

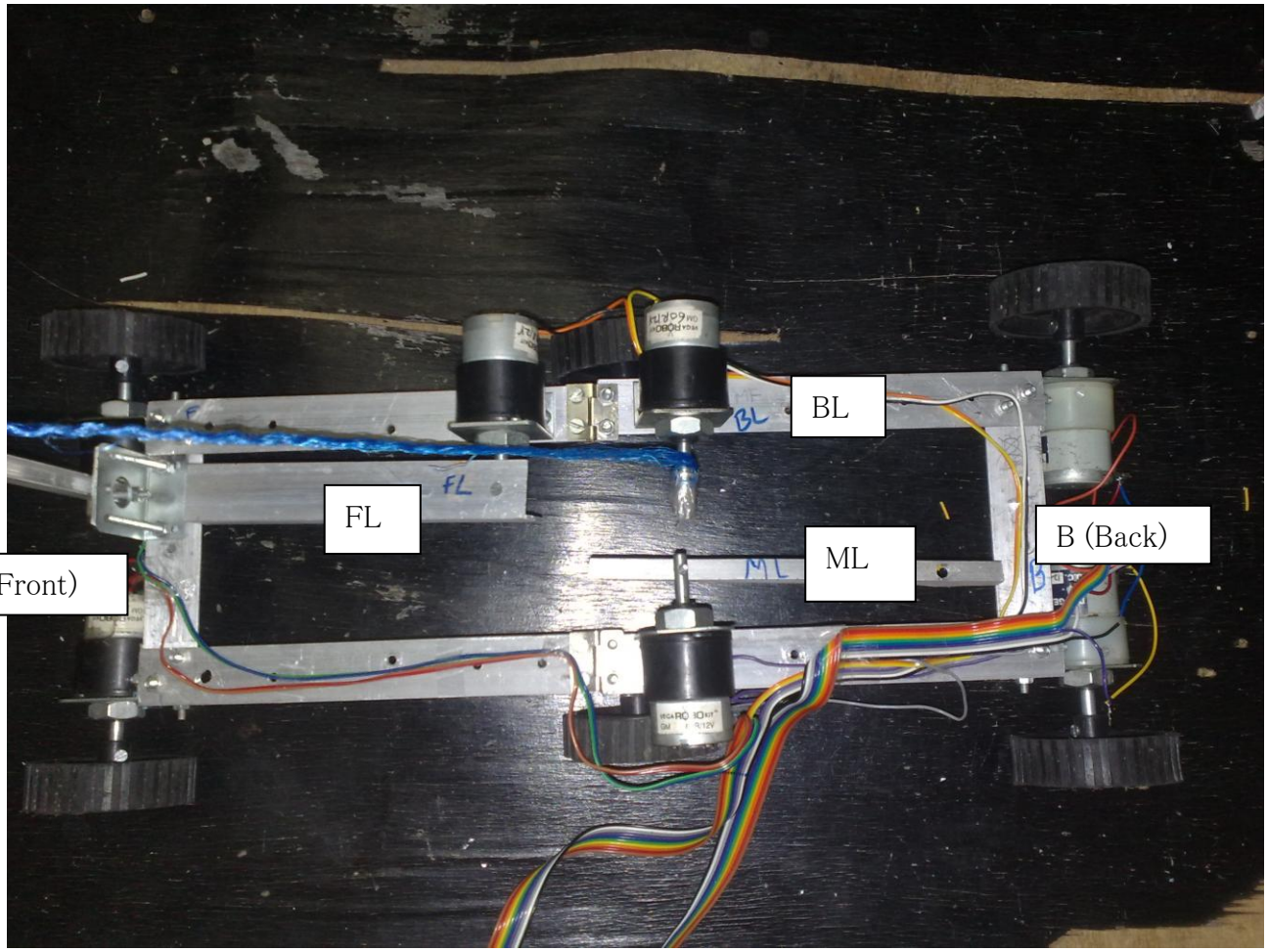
After the completion of the second part the bot comes to a halt for 3 sec. After that third step takes place. The motor connected in the middle, to the right (to the back right) starts rotating along with the front wheel motors. The motor (that is connected to first part via a nylon wire) lifts the back part while moving forward. Hence the back part is lifted up the stair.

Result : Initial position (Front part inclined to the ground, Back part horizantal)
Final position (Front part horizantal, back part above the front part)

Coming to the horizantal position:

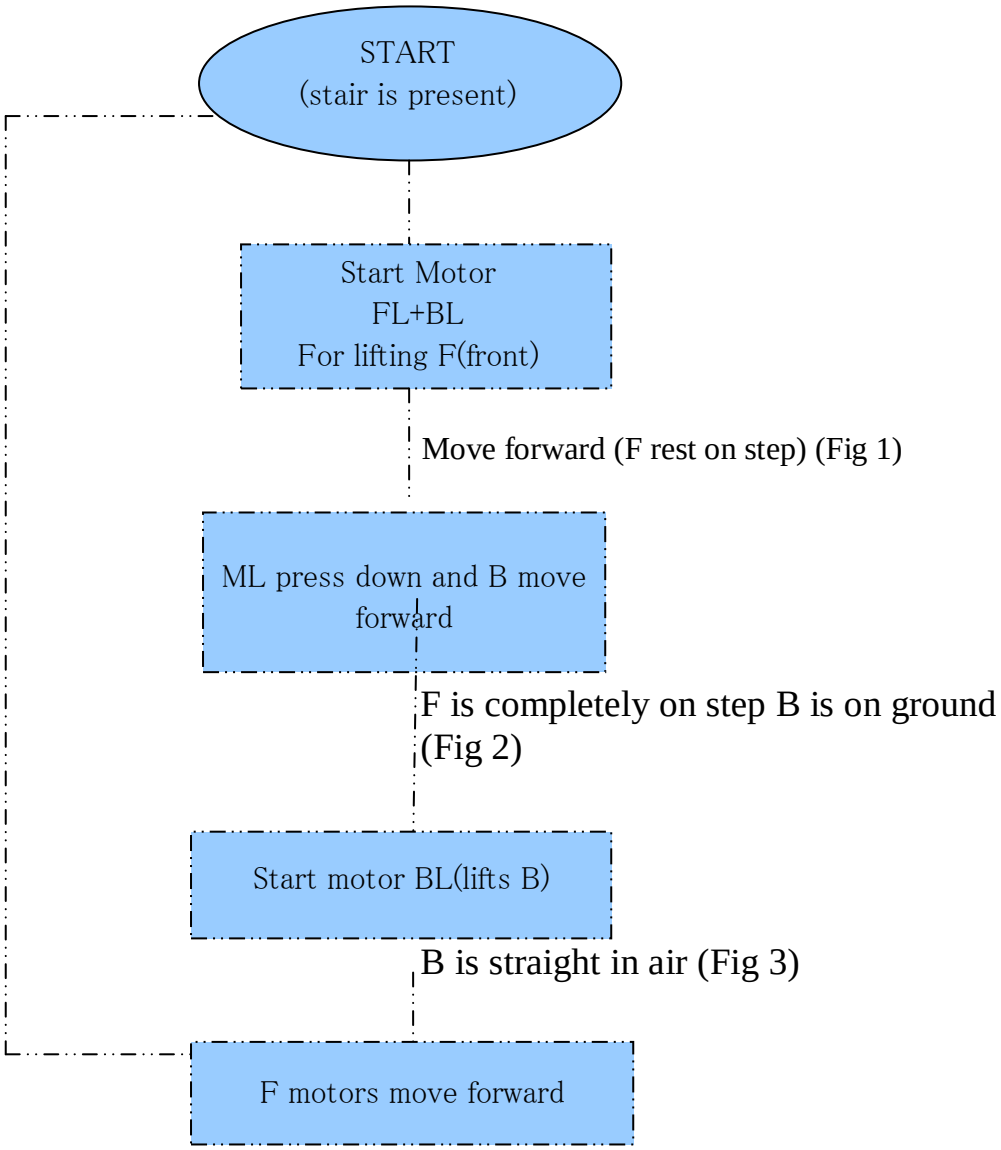
After the completion of the third part the bot comes to a halt for 3 sec. The motor with nylon wire starts rotating in the reverse direction unwinding the rope.

For the flow chart motors are denoted as below as per convinience.
Motor Mflift (Motor with nylon wire)
Motor Mblift (Motor in the middle attached to the

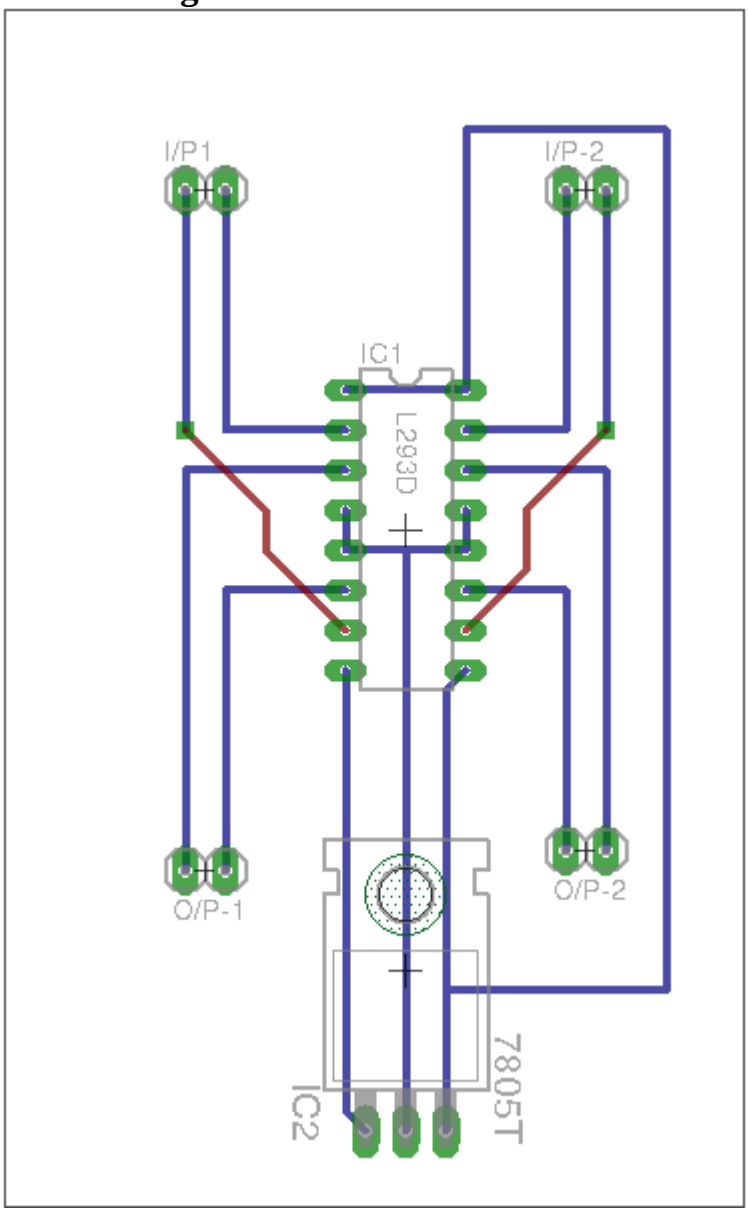


1. “F” is the front part.
2. “B” is the back part.
3. “FL” is arm aiding in lifting the front part.
4. “BL” is string lifting the back part.
5. “ML” is arm aiding in lifting the back part.

FLOW CHART


START
(stair is present)
Start Motor
FL+BL
For lifting F(front)
Move forward (F rest on step) (Fig 1)
ML press down and B move forward
F is completely on step B is on ground (Fig 2)
Start motor BL(lifts B)
B is straight in air (Fig 3)
F motors move forward
Complete machine is on first step

Circuit Diagram



This is a basic motor driving circuit. The inputs come from the microcontroller. The output connects to the motors. Input to 7805 is 12V.

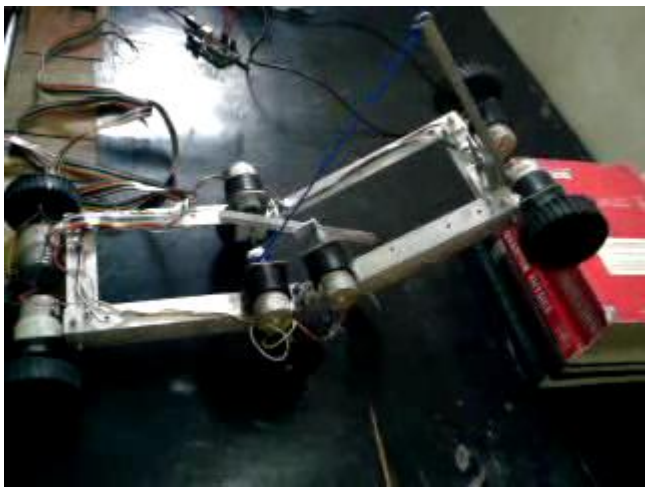


Fig1. Front rests on first step

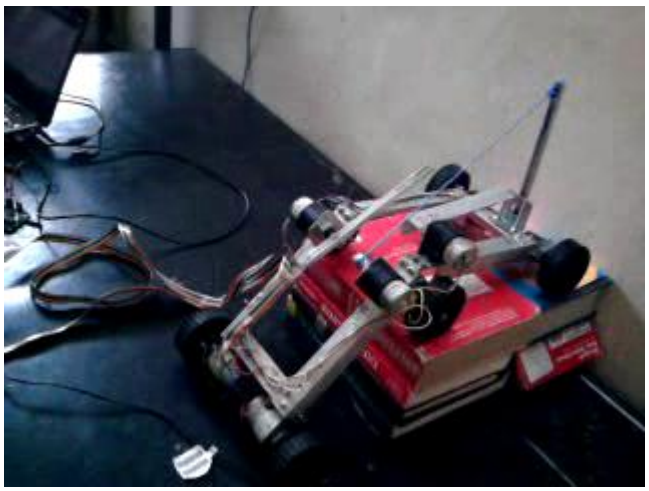


Fig2. Front is completely on the step

Fig3. Back lifted up

Programme:

Our basic function is “drive” having two arguments. First argument is for selecting motor. Second argument is for selecting the direction to move motor in. There are “5” possible values for first argument and “3” possible values for second argument.

```
//motor drive code
//pwm pins 3 4 5 6 9 10 11
int FR0=7,FR1=8;              //front motor
int BA0=12,BA1=13;            //back motor
int MLift0=3,MLift1=11;   //motor for arm lifting(middle lift)   (for each motor two input pins assigned)
int Mblif0=5,Mblif1=6;      //motor for back lift
int Mflif0=9,Mflif1=10;     //motor for front lift
boolean a;
void setup()
{
  pinMode(FR0, OUTPUT); pinMode(FR1, OUTPUT);
  pinMode(BA0, OUTPUT); pinMode(BA1, OUTPUT);
  pinMode(MLift0, OUTPUT); pinMode(MLift1, OUTPUT);
  pinMode(Mblif0, OUTPUT); pinMode(Mblif1, OUTPUT);
  pinMode(Mflif0, OUTPUT); pinMode(Mflif1, OUTPUT);

                                    ////////////////////////////////////
                                    //fl working
                                    //  drive(0,1);
                                    //  delay(250);
                                    //  drive(0,-1);
                                    //  delay(250);
                                    //  drive(0,0);
                                    ////////////////////////////////////
                                    ////////////////////////////////////
                                    //bl working
                                    //  drive(4,-1);
                                    //  delay(9000);
                                    //  drive(4,1);
                                    //  delay(9000);
                                    //  drive(4,0);
                                    ////////////////////////////////////
                                    ////////////////////////////////////
                                    //lifting F
                                    //  drive(4,-1);
                                    //  drive(0,-1);
                                    //  delay(8000);
                                    //  drive(0,0);

                                    //  drive(4,1);
                                    //  delay(7000);
                                    //  drive(4,0);
```

```
                                    //  drive(0,1);
                                    //  delay(500);
                                    //  drive(0,0);
                                    ////////////////////////////////////
                                    ////////////////////////////////////
                                    //ml working
                                    //drive(5,1);
                                    //delay(500);
                                    //drive(5,-1);
                                    //delay(500);
                                    //drive(5,0);
                                    ////////////////////////////////////
                                    /*moving forward on the step
                                      drive(5,-1);
                                      drive(-1,1);
                                      delay(5000);

                                      drive(5,1);
                                      delay(500);

                                      drive(5,0);
                                      drive(-1,0);
                                    */
}
void drive(int which_mot ,int dir ){              //third argument can be speed of the motor
  int a;
  int b;
  unsigned char c;
                                      //-1 for back         Directions back/front/midlift
                                      //0 for fl
                                      //1 for front
                                      //4 for bl
                                      //5 for front lift
  if(which_mot==-1){
    b=BA0;
    a=BA1;
  }
  if(which_mot==0){
    b=MLift0;
    a=MLift1;
  }
  if(which_mot==1){
    b=FR0;
    a=FR1;
  }
  if(which_mot==4){
    b=Mblif0;
    a=Mblif1;
  }
  if(which_mot==5){
    b=Mflif0;
    a=Mflif1;
```

```
  }
  if(dir==1){                    //to move forward
    digitalWrite(b,LOW);
    analogWrite(a,255);
  }
  if(dir==0){                    // to stay still
    digitalWrite(b,LOW);
    digitalWrite(a,LOW);
  }
  if(dir==-1){                   //to move in reverse direction
    analogWrite(b,255);
    digitalWrite(a,LOW);
  }
}
void  loop()
{
}
void back_lift(void){
  drive(4,-1);
  delay(3000);
  drive(4,1);
  delay(3000);
  drive(4,0);
}
void front_lift(void){
  drive(4,-1);
  drive(0,-1);
  delay(10000);
  drive(0,0);

  drive(4,1);
  delay(8000);
  drive(4,0);

  drive(0,1);
  delay(500);
  drive(0,0);
}
void mov_fr_lift(void){

  drive(5,-1);
  drive(-1,1);
  delay(5000);

  drive(5,-1);
  delay(500);

  drive(5,1);
  delay(500);
  drive(5,0);
  drive(-1,0);
}
```

Work handled individually:
Makarand Diwe (08026007):- Build the base chassis. Written the basic code.
Narendra Chouhan (08026010):– Designed the mechanical algorithm for the machine and build the machine major lifting mechanism.
Penkey Suresh (08d26006):– Integrated the basic functions to perform a higher level of function. These are the functions for lifting the “Front” and “Back” parts and the “ML”.

Code debugging by all members.

References:-

Arduino programming tutorials.