4 legged Robot

Lab Project

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Abstract: *The main aim of this project is to make a robot which is inspired from a animal. The robot should mimic the movements of the selected animal. In this report, we will be discussing the each step on making one.*

I chose a dog.

Materials Used:

HARDWARE:

1) 3d printer

2) Arduino board

3) Servo motors - 8

4) Connecting wires and screws

5) Power Bank (5V /2A output)

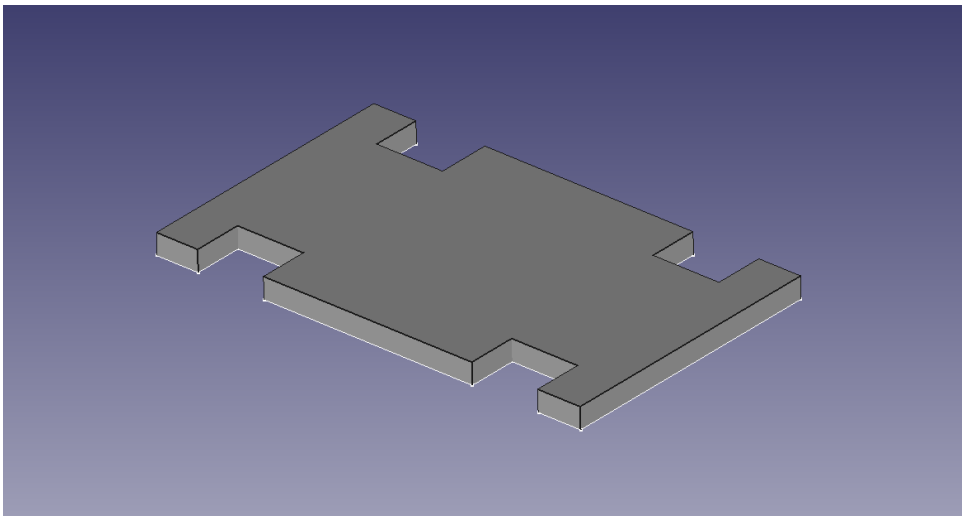
SOFTWARE:

1) Free cad

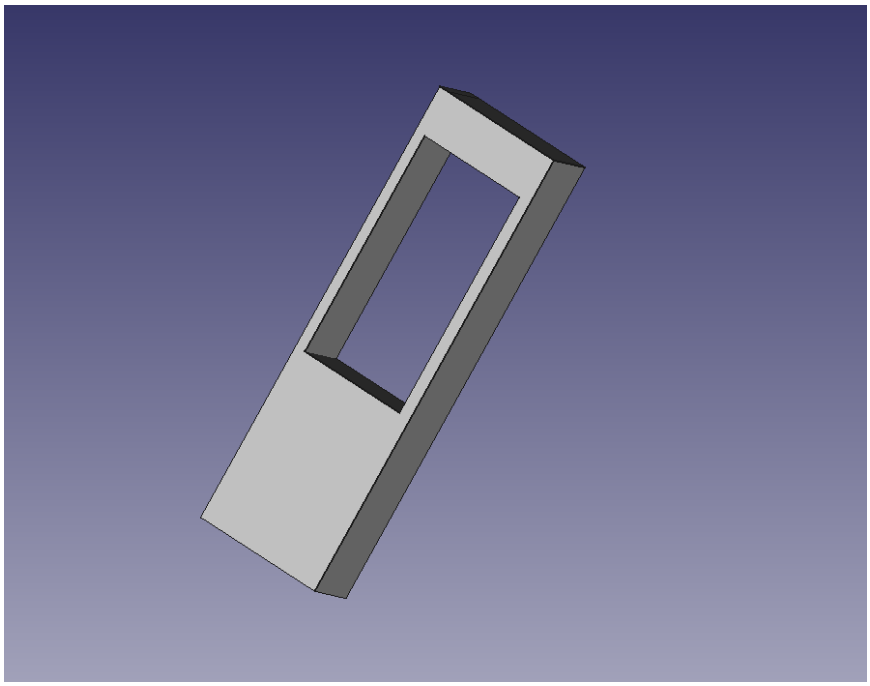
2) Arduino IDE

Free Cad drawings of robot:

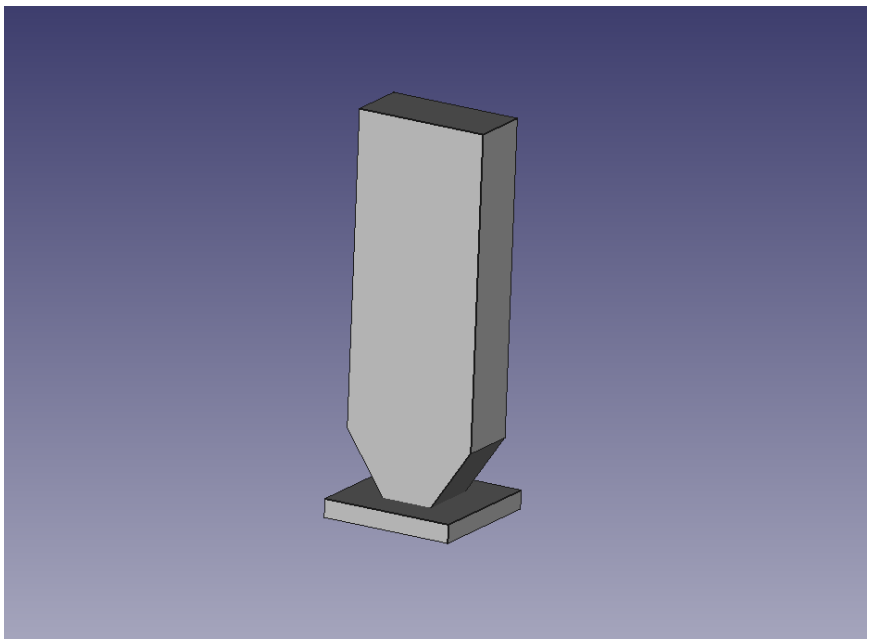
TOP



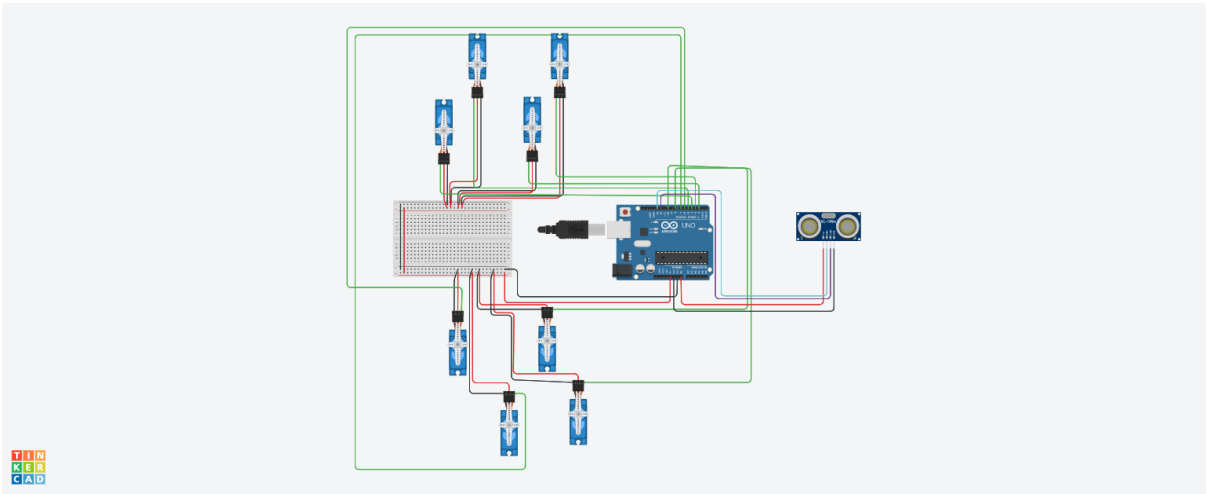
UPPER LEG

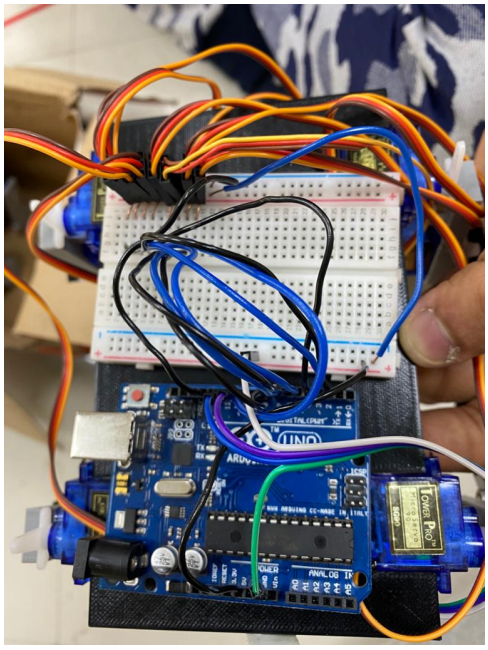


LOWER LEG



Circuit Diagram:



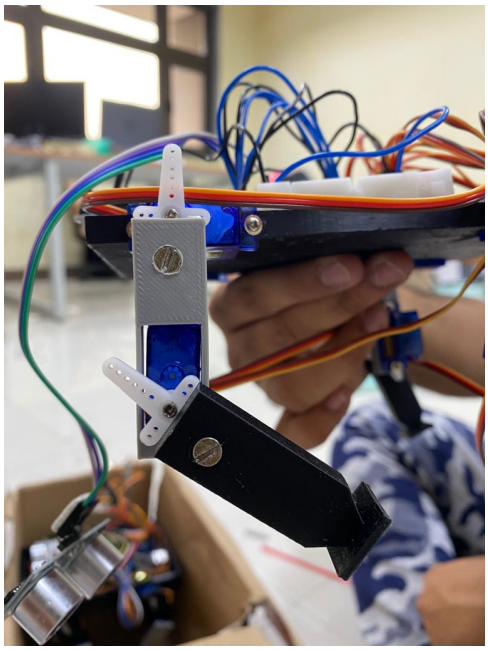


Discussion of method:

After the parts getting 3d printed, 4 servos are first screwed into the rectangular holes of TOP.

Similarly, the other 4 motors are screwed to the UPPER LEG.

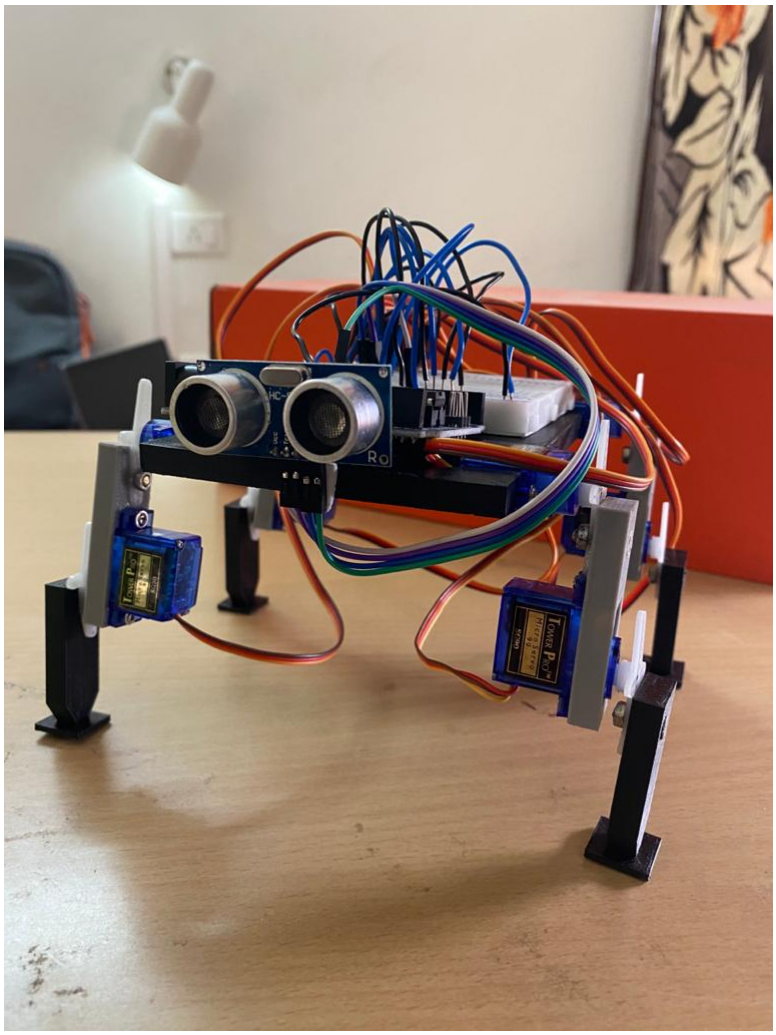
The UPPER LEG and LOWER LEG are attached by using the wing of servo motor. This completes a leg. A leg looks like a pic below.



Now, The leg is attached to the wing of servo motor of TOP. refer the above pic to get an idea.

After assembling all the parts, the model looks like:

Robot Dog:



Working:

About the Model (Significant points to note):

The model has 3 main parts — top, upper and lower leg.

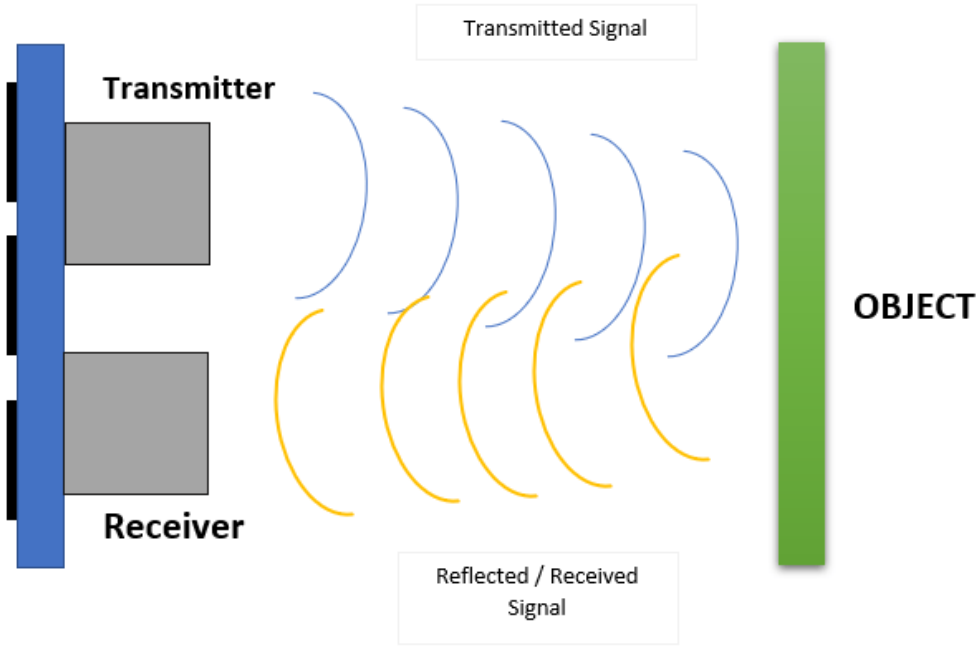
The top carries the Arduino, bread board and ultrasonic sensor. there are 4 holes on 4 corners to accommodate the 4 servo motors.

The upper leg has a rectangle hole to accommodate the servo motor.

The lower leg has a square base to increase the contact with the ground and not slip over the surface.

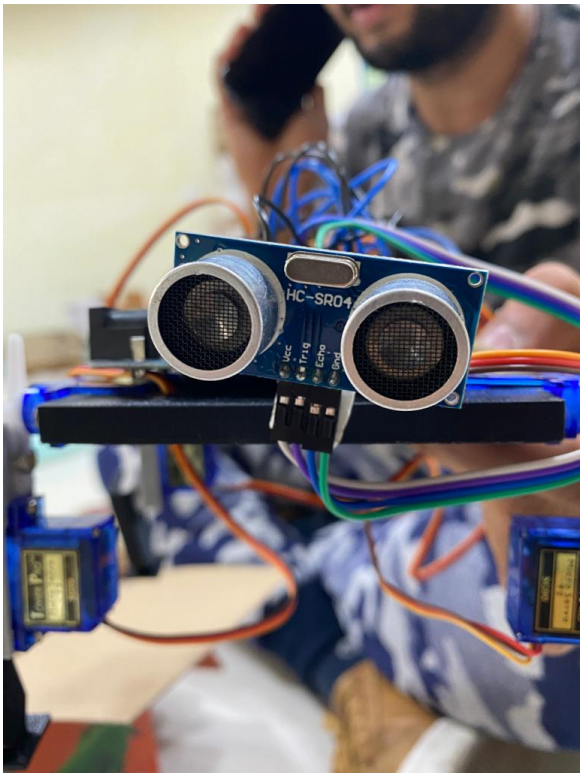
Ultrasonic Sensor (HC-SR04) working:

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal.



In the robot, the ultrasonic sensor is used to avoid collision into the obstacle.

when the distance is less than 10cms, the robot stops.



Walking:

Since the robot should mimic the movements of a dog, on close observation of Dog, we observe, ***Dog's diagonal legs move synchronously.*** So, i tried to mimic it.

Now, I will explain how a single leg of the robot move.

For simplicity, lets call the upper motor of leg as M1 and the lower as M2.

Step 1: M2 rotates anticlockwise, say 25 deg

Step 2: M1 rotates anticlockwise, say 20 deg

Step 3: M2 rotates clockwise (little less than the angle turned earlier) , say 23 deg

Step 4: M1 rotates clockwise (little more than the angle turned earlier), say 22 deg.

After Step3, the lower leg will be only it contact with ground on edge of square base. that's the reason the angle is little less than the earlier.

In Step4, the angle it rotated is little greater than than earlier because on this step, the robot will be pushed forward.

Now, we know how a leg works. the same principle goes with other 3 legs. since, a dog's diagonal legs moves synchronously, the same is implemented on the robot. The result is the forward movement.

Robot Behavior:

When the power is supplied, The dog will stand in its still position for 5 secs and the start to walk. if a distance is less than is 10cm, it stops and when removed it continues its motion.

The code for the robot:

```
// 4 LEGGED ROBOT (DOG)

#include<Servo.h>           //For servos
#include <NewPing.h>        //For ultrasonic sensor

#define trigPin 11             //Sensor initalisation
#define echoPin 12
NewPing sonar(trigPin, echoPin);
float duration, distance;

Servo a_up;                 //Motor initalisation
Servo b_up;
Servo c_up;
Servo d_up;
Servo a_down;
Servo b_down;
Servo c_down;
Servo d_down;

// BASE POSITIONS OF LEGS
int a_u = 80;
int b_u = 100;
int c_u = 90;
int d_u = 90;
int a_d = 100;
int b_d = 110;
int c_d = 35;
int d_d = 140;

void setup() {
  a_up.attach(2);
  b_up.attach(4);
  c_up.attach(6);
  d_up.attach(8);
  a_down.attach(3);
  b_down.attach(5);
  c_down.attach(7);
  d_down.attach(10);
```

```
}

//THE DOG STANDS STILL WHEN THIS FUNCTION IS RUNNING
int stand() {
  int a_u = 60;
  int b_u = 100;
  int c_u = 90;
  int d_u = 90;
  int a_d = 100;
  int b_d = 110;
  int c_d = 35;
  int d_d = 140;
  a_up.write(a_u);
  b_up.write(b_u);
  c_up.write(c_u);
  d_up.write(d_u);
  a_down.write(a_d);
  b_down.write(b_d);
  c_down.write(c_d);
  d_down.write(d_d);
}

// THE DOG STARTS TO GO FRONT WHEN THIS FUNCTION IS RUNNING
int walk(int x) {
  int a_u = 80;
  int b_u = 100;
  int c_u = 90;
  int d_u = 90;
  int a_d = 100;
  int b_d = 110;
  int c_d = 35;
  int d_d = 140;
  int steps, i;
  a_up.write(a_u);
  b_up.write(b_u);
  c_up.write(c_u);
  d_up.write(d_u);
  a_down.write(a_d);
  b_down.write(b_d);
  c_down.write(c_d);
  d_down.write(d_d);

  for (steps = 1; steps <= x; steps++)
  {
    duration = sonar.ping();
    distance = (duration / 2) * 0.0343;
    if (distance > 10 )           // CONDITION CHECK
    {
      //LEFT front
      for ( i = 0; i < 25; i++)
      {
        d_d = d_d - 1;
        b_d = b_d + 1;
        d_down.write(d_d);
        b_down.write(b_d);
        delay(10);
      }
      for (i = 0; i < 20; i++)
```

```
        {
          d_u = d_u + 1;
          b_u = b_u - 1;
          d_up.write(d_u);
          b_up.write(b_u);
          delay(10);
        }
        for (i = 0; i < 25; i++)
        {
          d_d = d_d + 1;
          b_d = b_d - 1;
          d_down.write(d_d);
          b_down.write(b_d);
          delay(10);
        }

        for (i = 0; i < 20; i++)
        {
          d_u = d_u - 1;
          b_u = b_u + 1;
          d_up.write(d_u);
          b_up.write(b_u);
          delay(10);
        }
        delay(100);

        // RIGHT front
        for ( i = 0; i < 25; i++)
        {

          a_d = a_d + 1;
          c_d = c_d - 1;
          a_down.write(a_d);
          c_down.write(c_d);
          delay(10);
        }

        for (i = 0; i < 20; i++)
        {
          a_u = a_u - 1;
          c_u = c_u + 1;
          a_up.write(a_u);
          c_up.write(c_u);
          delay(10);
        }

        for (i = 0; i < 25; i++)
        {
          a_d = a_d - 1;
          c_d = c_d + 1;
          a_down.write(a_d);
          c_down.write(c_d);
          delay(10);
        }

        for (i = 0; i < 20; i++)
        {
          a_u = a_u + 1;
```

```
        c_u = c_u - 1;
        a_up.write(a_u);
        c_up.write(c_u);
        delay(10);
      }
    }
    else
    {
      delay(5000);
    }
  }
}


void loop() {
  stand();
  delay(5000);
  walk(20);      // WALK  20 STEPS
}
```

All the files and video explanation is there in the below link:

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