Project Report

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Abstract:

The robot I have made is a six legged robot that can walk, avoid obstacle and also perform a small trick on signaling it. The robot is a model of spider.

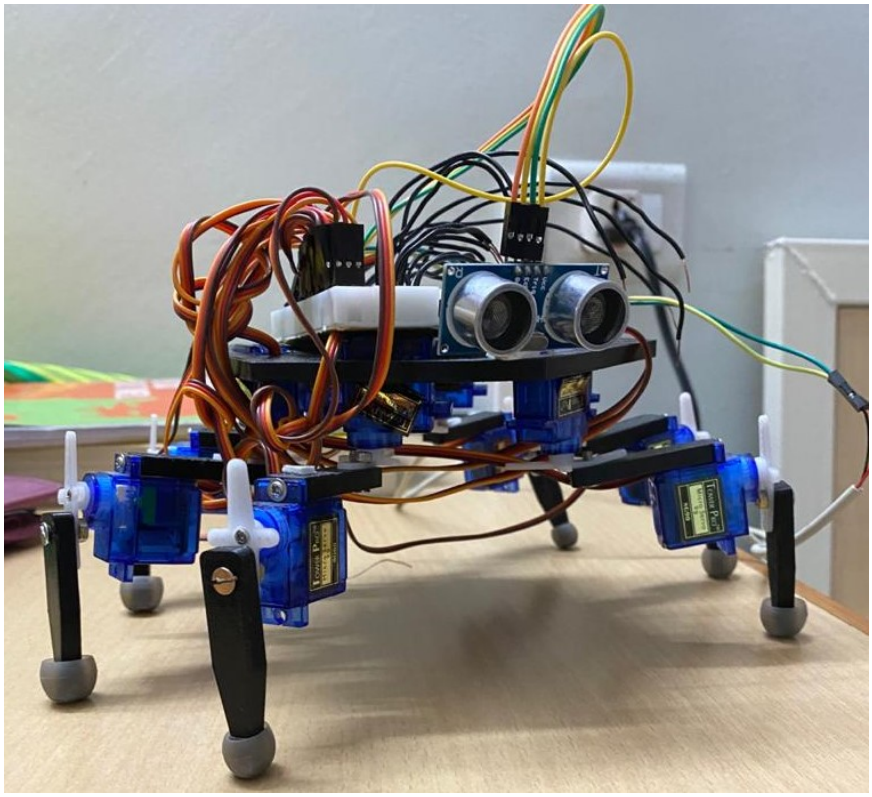
Materials used:

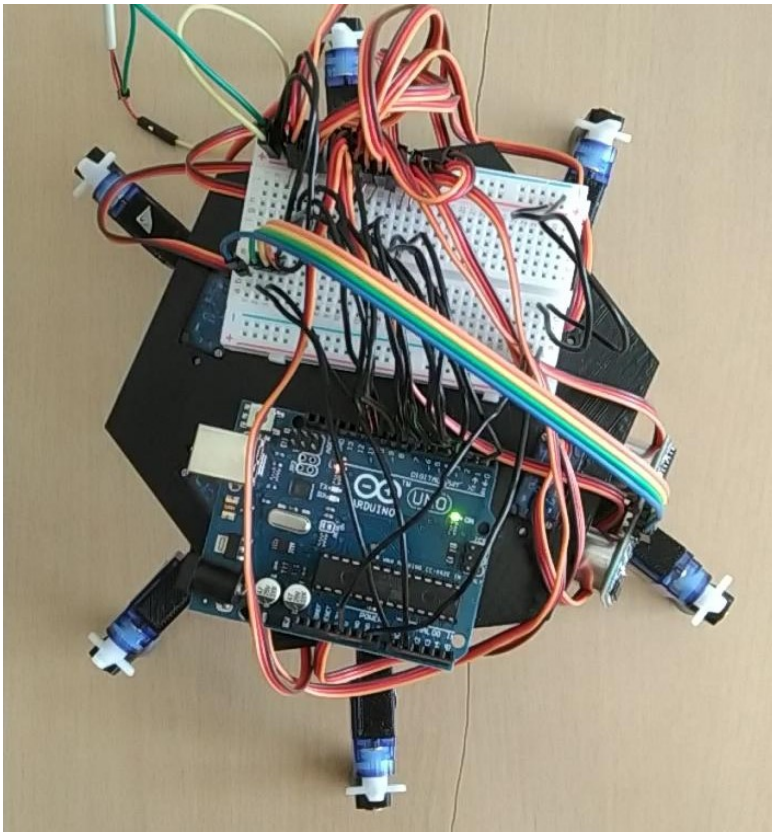
1) Micro servos (sg90) - 12
2) Arduino Uno
3) Ultra sonic sensor
4) Mini bread board
5) Battery - power bank

Model:

The model of the robot is a initially made using freecad and then it was 3D printed.

The robot has a base which is hexagonal in shape in which six servo motors sit facing downwards. The six servo motors are placed symmetrically. To each servo motor, there is attached an other servo motor whose axis of rotation is perpendicular to the first servo, to which a leg is attached. So every leg has 2 servo motors which are perpendicular to each other giving it 2 degrees of freedom. There is also an ultrasonic sensor which is used for obstacle detection.





Robot Features:

- ***Walking:***

  For purpose of explanation let's call the servos attached to the base as "up servos" and the servos attached to them as "down servos".

  Forward motion is accomplished by holding the up servos stationary while moving alternate down servos. The alternate down servos (which form a triangle) move the leg by an angle of 50 degrees. While the 3 legs are in air, the other 3 legs are still maintaining the balance of the robot. Among the 3 legs two legs push the robot towards right and the other pushes it towards left cancelling each other's effect and pulling the robot forward. As the 3 legs in air come down they pull the robot forward because of friction. The friction is achieved by inserting ear buds to the legs. After the first set of legs come down the other set moves up and the cycle continues.

- ***Turning:***

  Turning is achieved by moving 3 legs in the same direction instead of one pushing towards right and others pushing towards left which produces a turning effect. Similarly the other 3 legs are also moved in same direction that turns the robot even further.

- ***Obstacle detection:***

  As the robot moves forward, if any object is less than 20 cm from it in it's path, it turns left until there is no obstacle in front of it. After turning the robot continues walking forward.

- ***Trick:***

  The robot also performs sort of a dance when it detects any object within 5cm from it. It is achieved by moving all the legs in same direction and bringing them back and again moving them is opposite direction.

Robot Functioning:

When the robot is turned on it comes to it's base position and then starts walking straight until it detects an obstacle within 20cm from it. When it detects an obstacle it stops walking and turns left until there is no obstacle in front of it. When there is no obstacle it'll again start moving straight. Whenever it detects an obstacle within 5cm from it then it dances and again continues moving forward.

Code:

```
#include<Servo.h>
#include<NewPing.h>


    // Setup for the ultrasonic sensor.
#define trigger A0
#define echo A1

NewPing sensor(trigger,echo,400);

    // Setting the base positions for all the motors.
Servo servo1;
int bp1=130;

Servo servo2;
int bp2=60;

Servo servo3;
int bp3=100;

Servo servo4;
int bp4=105;

Servo servo5;
int bp5=65;

Servo servo6;
int bp6=105;

Servo servo7;
int bp7=70;

Servo servo8;
int bp8=90;

Servo servo9;
int bp9=85;

Servo servo10;
int bp10=105;
```

```
Servo servo11;
int bp11=90;

Servo servo12;
int bp12=60;

    // On running setup the robot comes to its standard or base position.
void setup() {
  // For ultrasonic sensor
  Serial.begin(9600);
  pinMode(trigger,OUTPUT);
  pinMode(echo,INPUT);

  servo1.attach(1);
  servo2.attach(2);
  servo3.attach(3);
  servo4.attach(4);
  servo5.attach(5);
  servo6.attach(6);
  servo7.attach(7);
  servo8.attach(8);
  servo9.attach(9);
  servo10.attach(10);
  servo11.attach(11);
  servo12.attach(12);

  servo1.write(bp1);
  servo2.write(bp2);
  servo3.write(bp3);
  servo4.write(bp4);
  servo5.write(bp5);
  servo6.write(bp6);
  servo7.write(bp7);
  servo8.write(bp8);
  servo9.write(bp9);
  servo10.write(bp10);
  servo11.write(bp11);
  servo12.write(bp12);

}

    // Function whic brings the robot to it's base position
void base_pos(){
  servo1.write(bp1);
  servo2.write(bp2);
  servo3.write(bp3);
  servo4.write(bp4);
  servo5.write(bp5);
  servo6.write(bp6);
  servo7.write(bp7);
  servo8.write(bp8);
  servo9.write(bp9);
  servo10.write(bp10);
  servo11.write(bp11);
  servo12.write(bp12);
  }
```

```
    // Function which holds the up servos still
 void stay_still(){
  servo1.write(bp1);
  servo2.write(bp2);
  servo3.write(bp3);
  servo4.write(bp4);
  servo5.write(bp5);
  servo6.write(bp6);
  }

    // Function for one cycle of walking
void walk(){
  int angle = 50;
  int time_delay = 8;

  for(int i=5;i>=0;i--){
      stay_still();
      servo7.write(bp7+i);
      servo9.write(bp9-i);
      servo11.write(bp11+i);
      servo8.write(bp8+i);
      servo10.write(bp10+i);
      servo12.write(bp12-i);
      delay(time_delay);
      }

  for(int i=5;i<angle;i++){
    stay_still();
    servo8.write(bp8-i);
    servo10.write(bp10-i);
    servo12.write(bp12+i);
    delay(time_delay);
  }

  for(int i=angle;i>=5;i--){
    stay_still();
    servo8.write(bp8-i);
    servo10.write(bp10-i);
    servo12.write(bp12+i);
    delay(time_delay);
  }

  for(int i=5;i>=0;i--){
      stay_still();
      servo8.write(bp8-i);
      servo10.write(bp10-i);
      servo12.write(bp12+i);
      servo7.write(bp7-i);
      servo9.write(bp9+i);
      servo11.write(bp11-i);
      delay(time_delay);
    }

  for(int i=5;i<angle;i++){
    stay_still();
    servo7.write(bp7+i);
    servo9.write(bp9-i);
    servo11.write(bp11+i);
```

```
    delay(time_delay);
  }

  for(int i=angle;i>=5;i--){
    stay_still();
    servo7.write(bp7+i);
    servo9.write(bp9-i);
    servo11.write(bp11+i);
    delay(time_delay);
  }
}

    // Function to bend the robot towards right for dance.
void bend_right(){
   int angle = 30;
   int time_delay = 8;
   for(int i=0;i<angle;i++){
    stay_still();
    servo8.write(bp8+i);
    servo10.write(bp10+i);
    servo12.write(bp12+i);
    delay(time_delay);
  }

  for(int i=0;i<angle;i++){
    stay_still();
    servo8.write(bp8+angle);
    servo10.write(bp10+angle);
    servo12.write(bp12+angle);
    servo7.write(bp7+i);
    servo9.write(bp9+i);
    servo11.write(bp11+i);
    delay(time_delay);
  }

  for(int i=angle;i>=0;i--){
    stay_still();
    servo7.write(bp7+i);
    servo9.write(bp9+i);
    servo11.write(bp11+i);
    servo8.write(bp8+i);
    servo10.write(bp10+i);
    servo12.write(bp12+i);
    delay(time_delay);
  }

  base_pos();
}

    // Function to bend the robot towards left for dance.
void bend_left(){
  int angle = 30;
   int time_delay = 8;
   for(int i=0;i<angle;i++){
    stay_still();
    servo8.write(bp8-i);
    servo10.write(bp10-i);
    servo12.write(bp12-i);
```

```
    delay(time_delay);
  }

  for(int i=0;i<angle;i++){
    stay_still();
    servo8.write(bp8-angle);
    servo10.write(bp10-angle);
    servo12.write(bp12-angle);
    servo7.write(bp7-i);
    servo9.write(bp9-i);
    servo11.write(bp11-i);
    delay(time_delay);
  }

  for(int i=angle;i>=0;i--){
    stay_still();
    servo7.write(bp7-i);
    servo9.write(bp9-i);
    servo11.write(bp11-i);
    servo8.write(bp8-i);
    servo10.write(bp10-i);
    servo12.write(bp12-i);
    delay(time_delay);
  }

  base_pos();

}

    // Function for making the robot dance N times.
void dance(int N){
  for(int i=0;i<N;i++){
      bend_right();
      bend_left();
    }

}

    // Function which turns the robot left.
void turn_left(){

  int angle = 50;
  int time_delay = 8;

  for(int i=0;i<angle;i++){
    stay_still();
    servo8.write(bp8-i);
    servo10.write(bp10-i);
    servo12.write(bp12-i);
    delay(time_delay);
  }

  for(int i=angle;i>=0;i--){
    stay_still();
    servo8.write(bp8-i);
    servo10.write(bp10-i);
    servo12.write(bp12-i);
    delay(time_delay);
```

```
  }

  for(int i=0;i<angle;i++){
    stay_still();
    servo7.write(bp7-i);
    servo9.write(bp9-i);
    servo11.write(bp11-i);
    delay(time_delay);
  }

  for(int i=angle;i>=0;i--){
    stay_still();
    servo7.write(bp7-i);
    servo9.write(bp9-i);
    servo11.write(bp11-i);
    delay(time_delay);
  }

}

    // Function which returns the distance of the object from the robot.
float CheckDistance(){
  float duration,distance;
  duration = sensor.ping();
  distance = (duration / 2) * 0.0343;
  return distance;
}

  // The main body of the program.
    // If the obstacle is at a distance gretaer than 20 then walk.
    // If not check if the obstacle is less than 5cm. If so then dance.
    // Else turn until there is no obstacle in the front.

void loop() {
  float dist = CheckDistance();

  if (dist > 20)
    walk();

  else{
    if (dist < 5)
      dance(3);

     else{
      turn_left();
      turn_left();
     }
    }
}
```