BITS F441 ROBOTICS

DESIGN AND FABRICATION OF A STEWART PLATFORM

BITS Pilani
Hyderabad Campus

Candidates

JULOORI AMOGH - 2020AAPS0422H
TANAY RANJAN - 2020A3PS0483H
THATHAPUDI SANJEEV PAUL - 2020AAPS0120H
BHAVYA JAIN - 2020A7PS0240H

Components List

1. Arduino UNO with cable

Components List

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2. MG995 Servo x 6

3. Servo Horn x 6

Components List

4. Rod End Bearing Spherical Joints - 6mm x 12

Components List

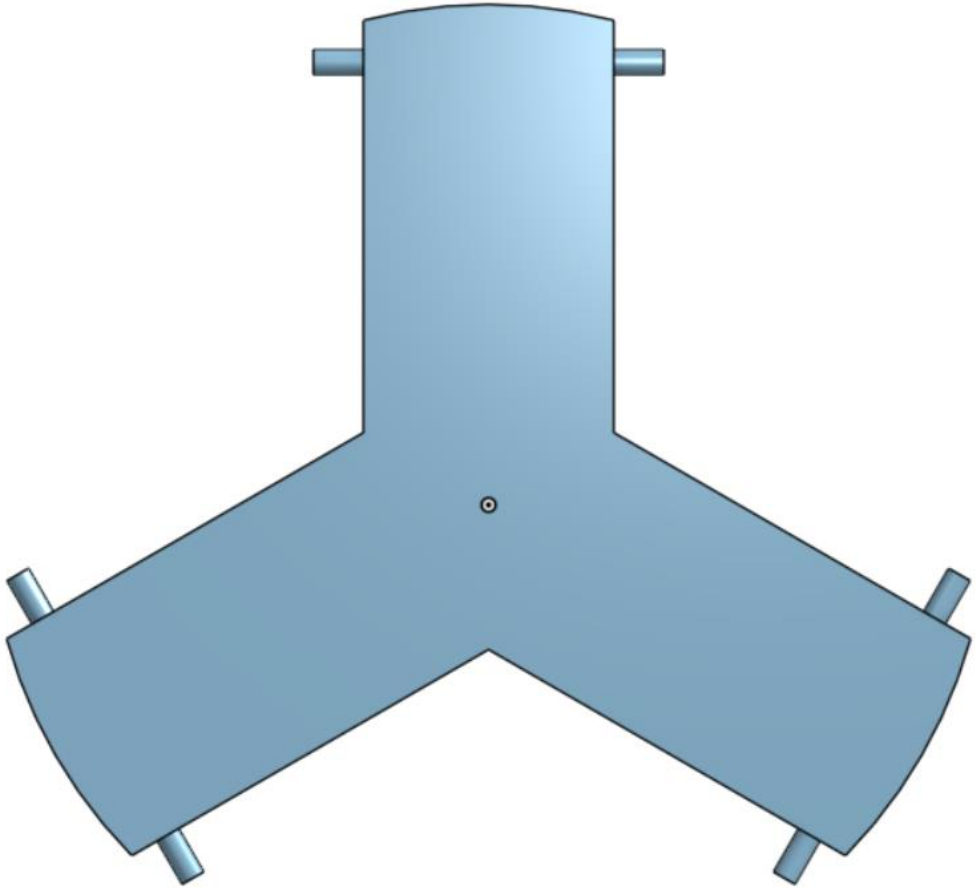
5. Metal shafts with threading - 6mm x 6

Components List

6. LM2596S DC-DC Buck Converter x 3

Components List

7. 3D Printed Platform



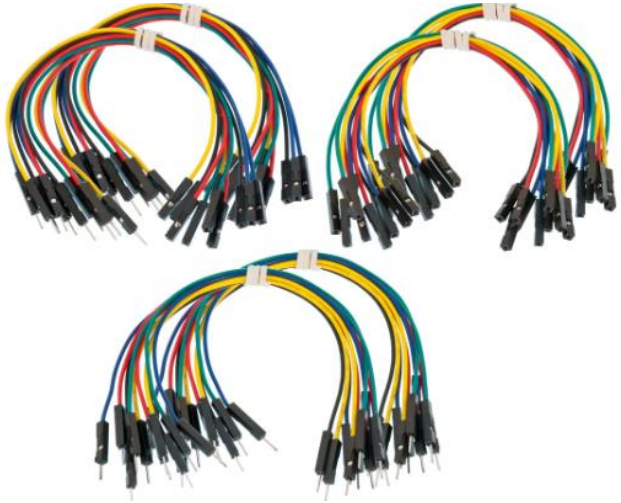
Components List

8. Wooden Base - 40x30 cm
9. Power Source AC-DC 12V-2A supply

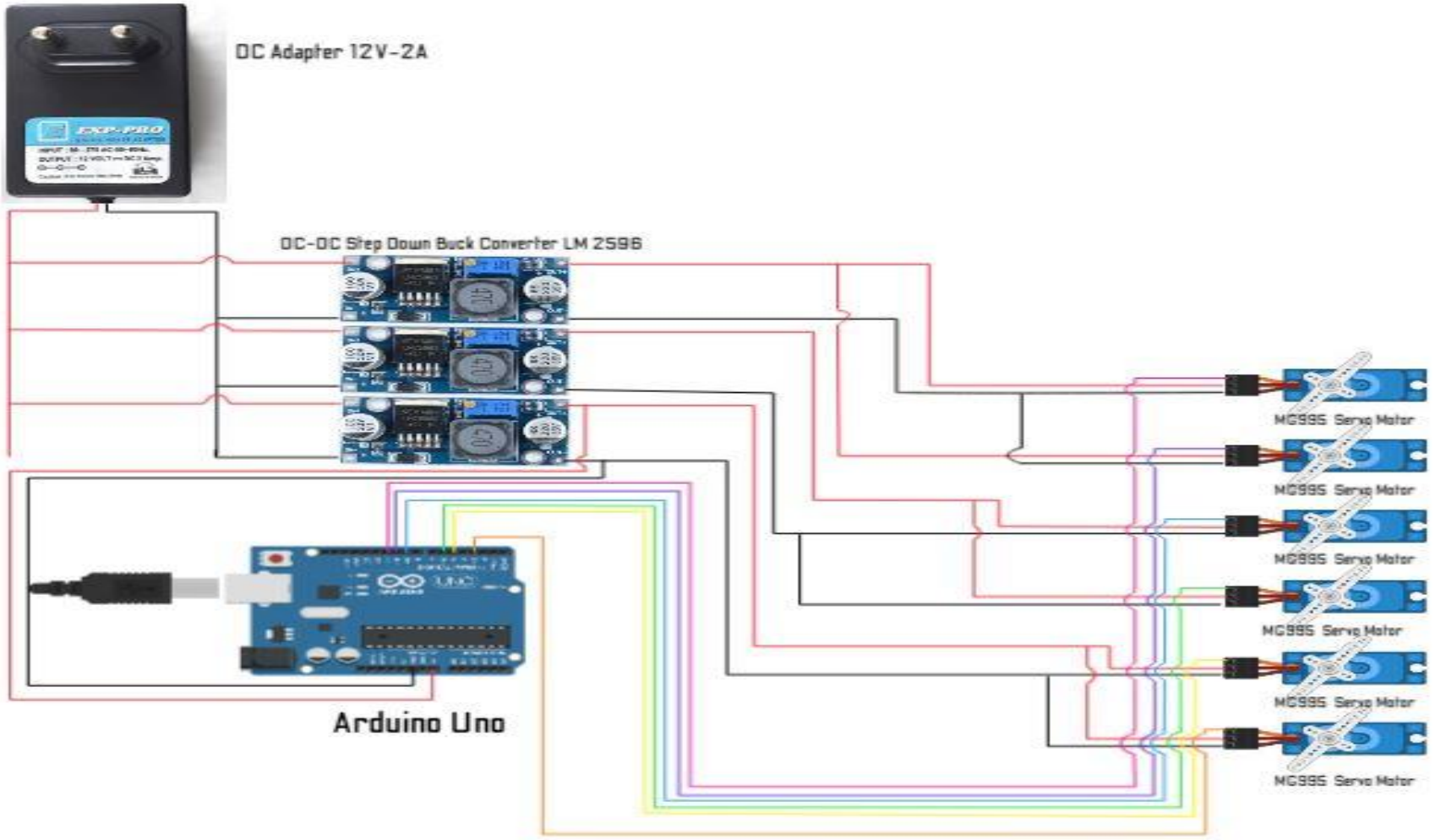
Components List

10. Screws and nuts- M3 with 3
    printed 6mm->3mm
    connectors x 6

11. Jumper Wires



Circuit Diagram



Types of Motion

Using the Arduino IDE, we have been able to establish four four different types of motion:

1. Vertical Motion
2. Twisting Motion
3. Circular Motion in a horizontal plane
4. Phase Difference or Sine wave motion

Vertical Motion

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Code:

```
// To include the Servo library
#include <Servo.h>
Servo Servo1;
Servo Servo2;
Servo Servo3;
Servo Servo4;
Servo Servo5;
Servo Servo6;

// Servo Pin numbers
int servoPin1 = 5;
int servoPin2 = 6;
int servoPin3 = 9;
int servoPin4 = 11;
int servoPin5 = 10;
int servoPin6 = 3;

void setup() {
  // Servo pins setup
  Servo1.attach(servoPin1);
  Servo2.attach(servoPin2);
  Servo3.attach(servoPin3);
  Servo4.attach(servoPin4);
  Servo5.attach(servoPin5);
  Servo6.attach(servoPin6);
}
```

```
void loop() {
   //To move the platform vertically up and down
  int i = 0;
  int j = 0;
  while(i <= 90) {
    j =180 - i;
    Servo1.write(i);
    Servo2.write(j);
    Servo3.write(i);
    Servo4.write(j);
    Servo5.write(i);
    Servo6.write(j);

    delay(25);

    i += 1;
  }
//  Servo1.write(45);
//  Servo2.write(135);
//  Servo3.write(45);
//  Servo4.write(135);
//  Servo5.write(45);
//  Servo6.write(135);
  while(i >= 0) {
    j =180 - i;
    Servo1.write(i);
    Servo2.write(j);
    Servo3.write(i);
    Servo4.write(j);
    Servo5.write(i);
    Servo6.write(j);

    delay(25);

    i -= 1;
  }

}
```

Vertical Motion

Video:

Twisting Motion:

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Code:

```
#include <Servo.h>

Servo Servo1;
Servo Servo2;
Servo Servo3;
Servo Servo4;
Servo Servo5;
Servo Servo6;

int servoPin1 = 5;
int servoPin2 = 6;
int servoPin3 = 9;
int servoPin4 = 11;
int servoPin5 = 10;
int servoPin6 = 3;

void setup() {
  // put your setup code here, to run once:
  Servo1.attach(servoPin1);
  Servo2.attach(servoPin2);
  Servo3.attach(servoPin3);
  Servo4.attach(servoPin4);
  Servo5.attach(servoPin5);
  Servo6.attach(servoPin6);
}
```

```
void loop() {
  // put your main code here, to run repeatedly:
  int i = 45;
  int theta = 15;
  while(i <= 45+theta) {
    Servo1.write(i);
    Servo2.write(90+i);
    Servo3.write(i);
    Servo4.write(90+i);
    Servo5.write(i);
    Servo6.write(90+i);

    delay(75);

    i++;
  }

  while(i >= 45-theta) {
    Servo1.write(i);
    Servo2.write(90+i);
    Servo3.write(i);
    Servo4.write(90+i);
    Servo5.write(i);
    Servo6.write(90+i);

    delay(75);

    i--;
  }
```

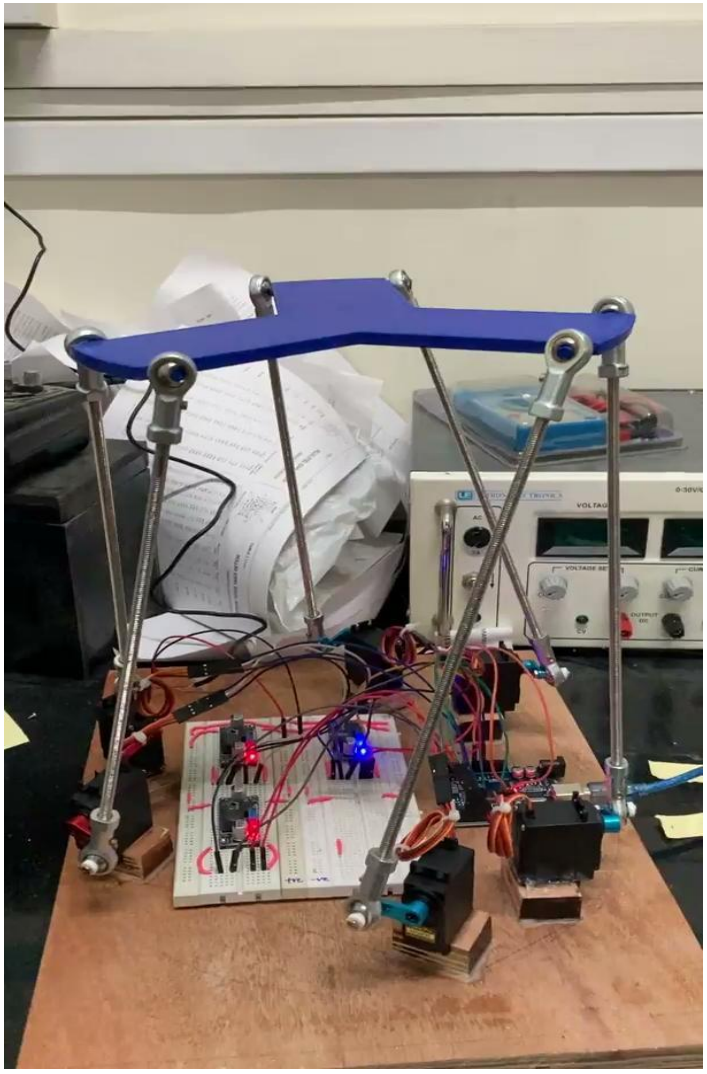
```
  while(i <= 45) {
    Servo1.write(i);
    Servo2.write(90+i);
    Servo3.write(i);
    Servo4.write(90+i);
    Servo5.write(i);
    Servo6.write(90+i);

    delay(75);

    i++;
  }
}
```

Twisting Motion:

Video:



Horizontal Circular Motion:

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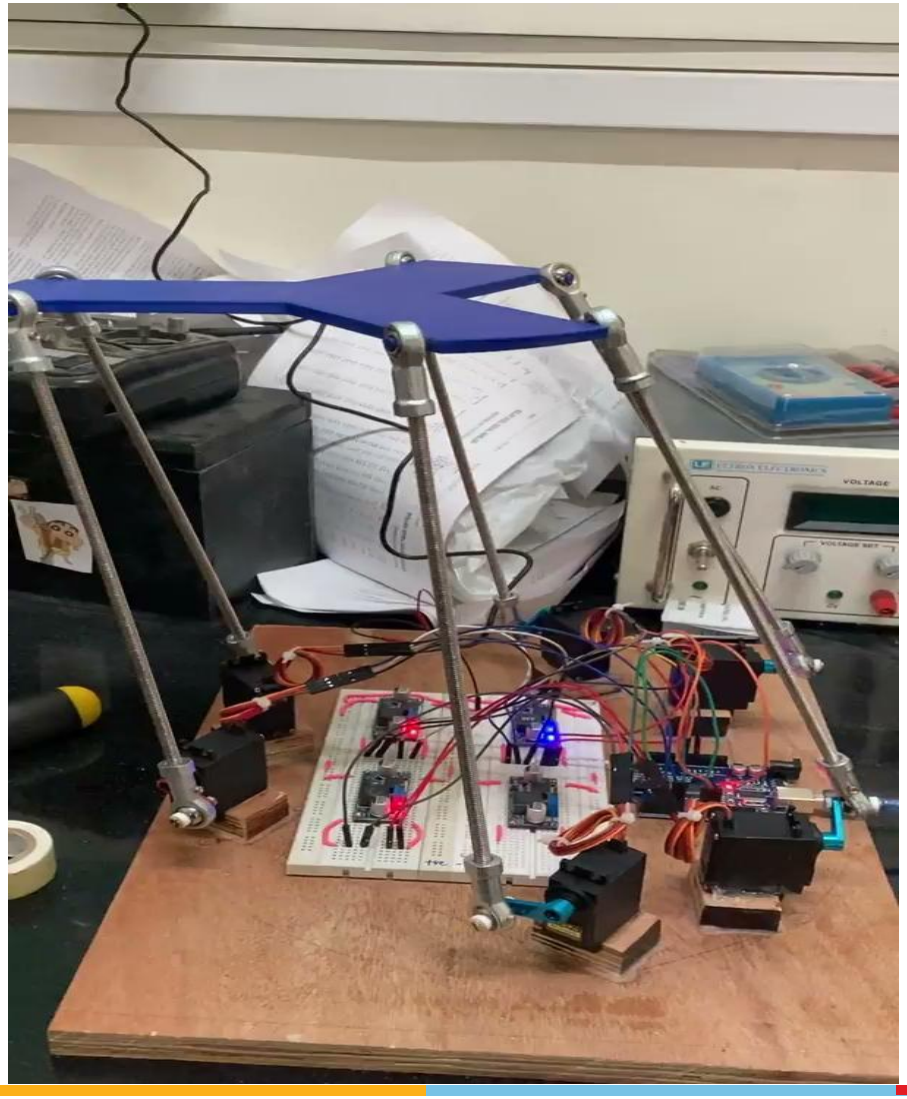
Code:

```
#include <Servo.h>

Servo Servo1;
Servo Servo2;
Servo Servo3;
Servo Servo4;
Servo Servo5;
Servo Servo6;

int servoPin1 = 5;
int servoPin2 = 6;
int servoPin3 = 9;
int servoPin4 = 11;
int servoPin5 = 10;
int servoPin6 = 3;

void setup() {
  // put your setup code here, to run once:
  Servo1.attach(servoPin1);
  Servo2.attach(servoPin2);
  Servo3.attach(servoPin3);
  Servo4.attach(servoPin4);
  Servo5.attach(servoPin5);
  Servo6.attach(servoPin6);
}

void loop() {
  int i = 45;
  while(i <= 90) {
    Servo1.write(90-i);
    Servo2.write(90+i);
    Servo3.write(45);
    Servo4.write(135);
    Servo5.write(i);
    Servo6.write(180-i);

    delay(75);
    i++;
  }

int counter = 0;
  while(counter < 5) {
    i = 0;
    while(i <= 45) {
      Servo1.write(i);
      Servo2.write(180-i);
      Servo3.write(45+i);
      Servo4.write(135-i);
      Servo5.write(90-2*i);
      Servo6.write(90+2*i);

      delay(75);
      i++;
    }

    i = 0;
    while(i <= 45) {
      Servo5.write(i);
      Servo6.write(180-i);
      Servo1.write(45+i);
      Servo2.write(135-i);
      Servo3.write(90-2*i);
      Servo4.write(90+2*i);

      delay(75);
      i++;
    }

    i = 0;
    while(i <= 45) {
      Servo3.write(i);
      Servo4.write(180-i);
      Servo5.write(45+i);
      Servo6.write(135-i);
      Servo1.write(90-2*i);
      Servo2.write(90+2*i);

      delay(75);
      i++;
    }

    counter++;
  }

  i = 0;
  while(i <= 45) {
    Servo1.write(i);
    Servo2.write(180-i);
    Servo3.write(45);
    Servo4.write(135);
    Servo5.write(90-i);
    Servo6.write(90+i);

    delay(75);
    i++;
  }
}
```

Horizontal Circular Motion:

Video:



Phase Difference Motion:

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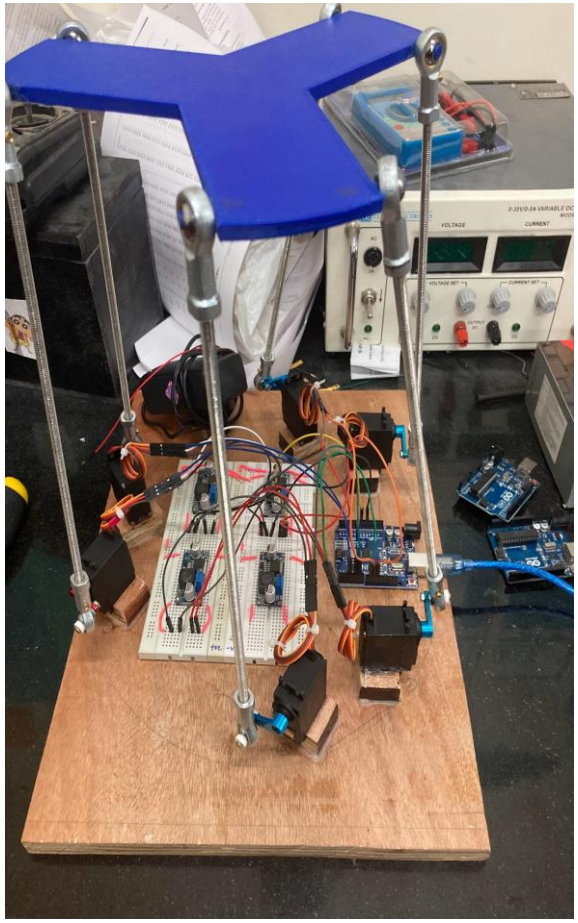
Code:

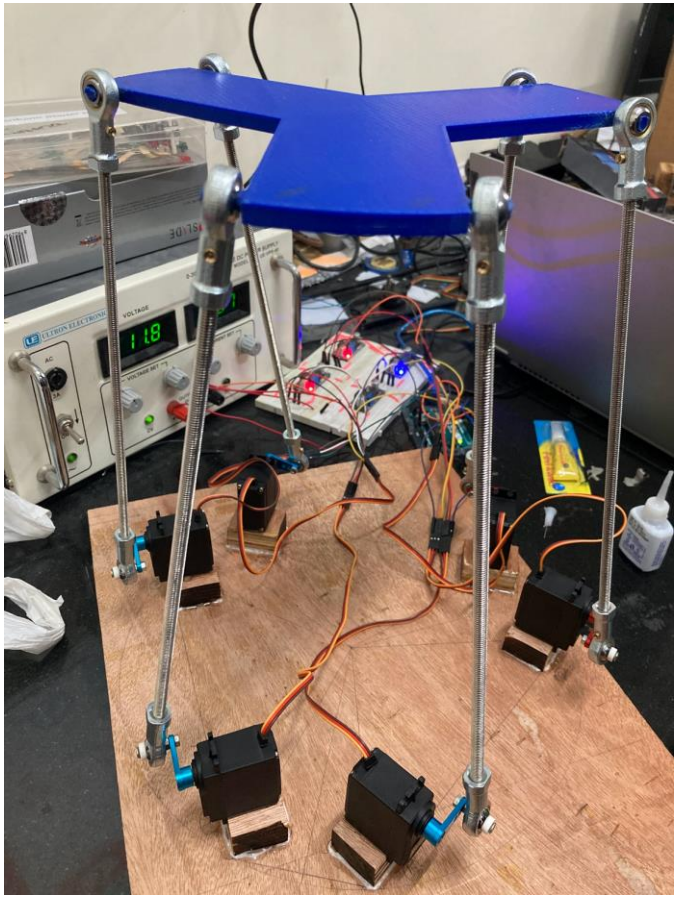
```
#include <Servo.h>

Servo Servo1;
Servo Servo2;
Servo Servo3;
Servo Servo4;
Servo Servo5;
Servo Servo6;

int servoPin1 = 5;
int servoPin2 = 6;
int servoPin3 = 9;
int servoPin4 = 11;
int servoPin5 = 10;
int servoPin6 = 3;

void setup() {
  // put your setup code here, to
run once:
  Servo1.attach(servoPin1);
  Servo2.attach(servoPin2);
  Servo3.attach(servoPin3);
  Servo4.attach(servoPin4);
  Servo5.attach(servoPin5);
  Servo6.attach(servoPin6);
}

void loop() {
  int i = 45;
  while(i <= 90) {
    Servo1.write(90-i);
    Servo6.write(90+i);
    Servo3.write(45);
    Servo2.write(135);
    Servo5.write(i);
    Servo4.write(180-i);

    delay(50);
    i++;
  }
int counter = 0;
  while(counter < 5) {
    i = 0;
    while(i <= 45) {
      Servo1.write(i);
      Servo6.write(180-i);
      Servo3.write(45+i);
      Servo2.write(135-i);
      Servo5.write(90-2*i);
      Servo4.write(90+2*i);

      delay(50);
      i++;
    }

    i = 0;
    while(i <= 45) {
      Servo5.write(i);
      Servo4.write(180-i);
      Servo1.write(45+i);
      Servo6.write(135-i);
      Servo3.write(90-2*i);
      Servo2.write(90+2*i);

delay(50);
      i++;
    }

 i = 0;
    while(i <= 45) {
      Servo3.write(i);
      Servo2.write(180-i);
      Servo5.write(45+i);
      Servo4.write(135-i);
      Servo1.write(90-2*i);
      Servo6.write(90+2*i);

      delay(50);
      i++;
    }

    counter++;
  }

  i = 0;
  while(i <= 45) {
    Servo1.write(i);
    Servo6.write(180-i);
    Servo3.write(45);
    Servo2.write(135);
    Servo5.write(90-i);
    Servo4.write(90+i);

    delay(50);
    i++;
  }
}
```

Phase Difference Motion:

Video:

Images of the setup





THANK YOU