Wais Shahbaz
Mr.Ratkaj
TEJ3MI-01
June 11, 2017

Hexapod Walker
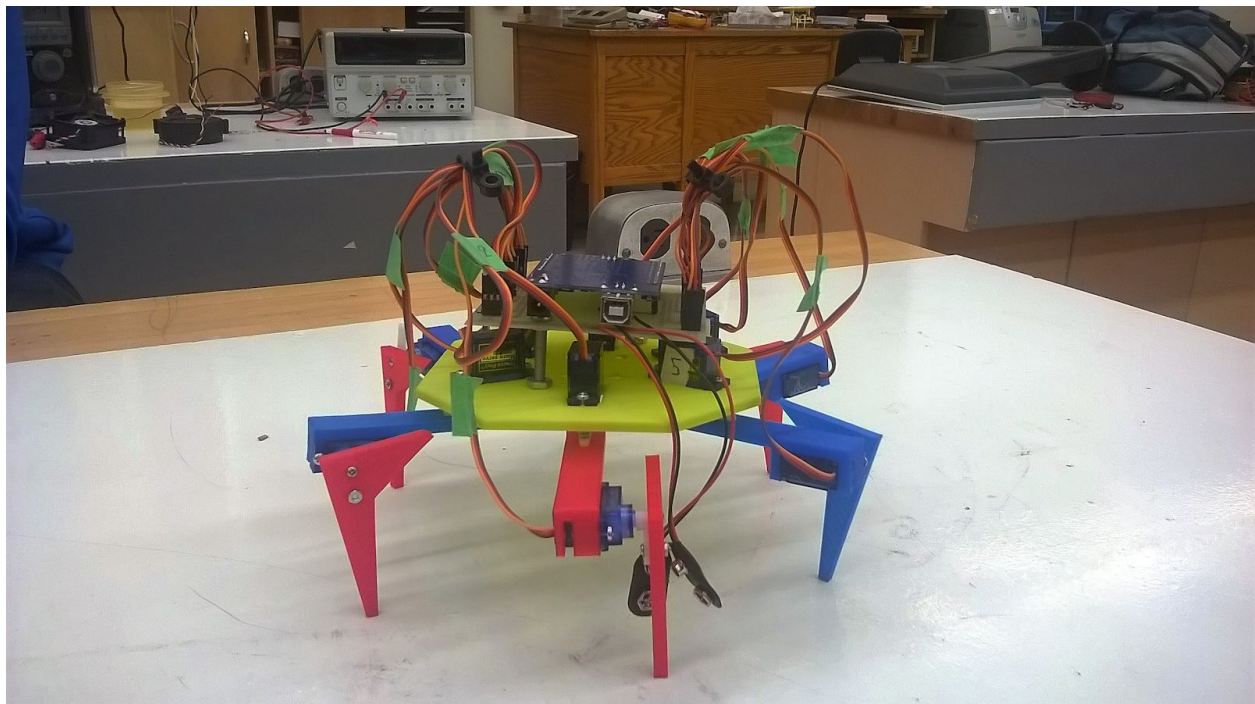

Table of Contents:

THERE ARE NO VIDEOS IN THIS DOCS, IT IS EXTERNALLY LINKED

Introduction:

Technology has improved to greater levels at this day and age, allowing for higher tier robots to be built. The purpose of this project is to build a 6 legged robot using tripod gaits to walk, and the hexapod will walk autonomously with no help (self standing). It will take a lot of effort and it is projected to be complete by the end of the year, with the exception of some slight deficiencies due to human error. When it is complete, it will be able to walk indefinitely on batteries and an arduino.
which will be attached to a PCB board and connected to all of the servos which control

Engineering:

Using 12 servos for all of the movement, and 3D printed parts for the robot (base x1, upper leg x6 and lower legs x6), the hexapod walker will be designed similar to a spider with 6 legs, with each leg getting an upper leg part and lower leg part. The base will have a PCB drilled into it which will connect a mounted arduino to control all of the 12 servos to allow for movement. For each leg, a servo will be mounted to the base, and then at the end of the base mounted servo, a upper leg part will be attached to the end of the servo to allow for horizontal movement. Then, at the end of the upper leg part, another servo will be attached with the lower leg part attached to the end of it to allow for vertical movement, creating a leg with movement in 4 directions which will allow for movement of the hexapod with 6 of them. Bolts and nuts will be used to connect the parts to each other.
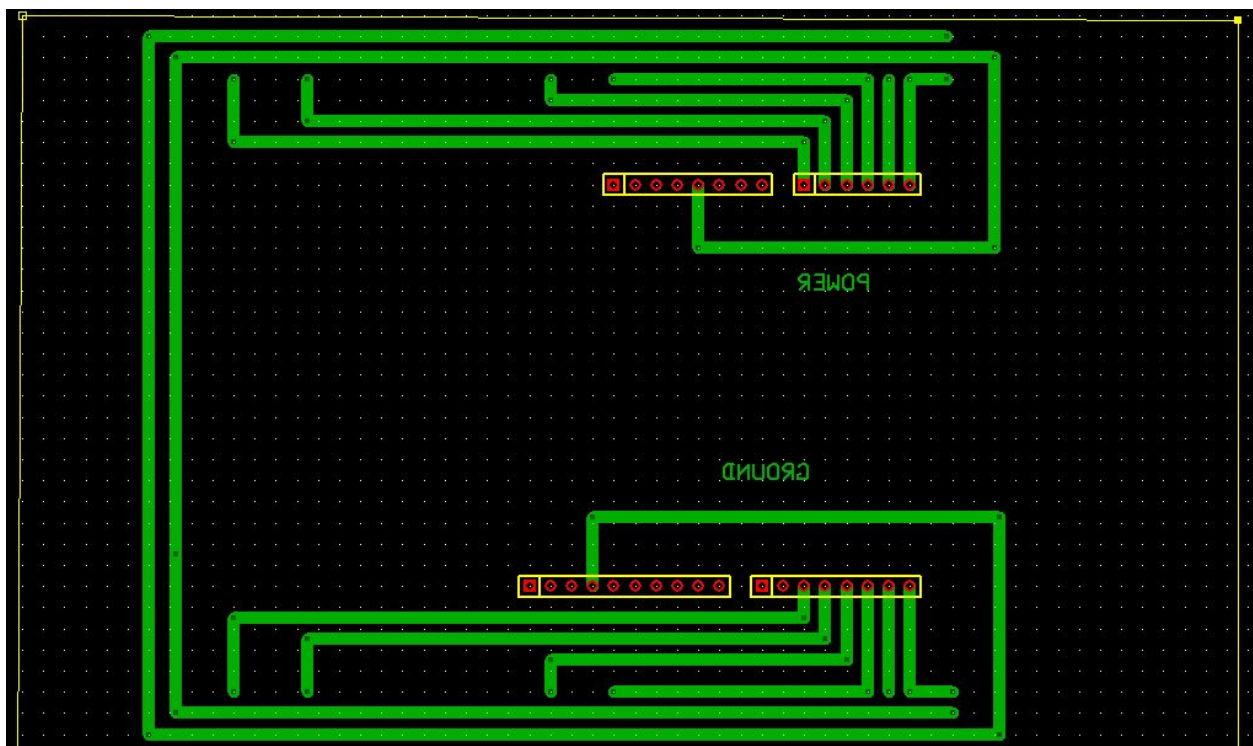
Development:

After months of drafting possible 3D parts for the hexapod, a set of 3 types of parts (base, upper leg, lower leg) were developed to be printed to create the hexapod. After many struggles due to the 3D printer's printing errors, all of the parts were finally developed and the hexapod was then built. The PCB built connects the used pins of an arduino to all the servos, so it is a board comprised only of copper trace and sips. Once the hexapod was developed, it took a few days to finalize code that was pre drafted before the building of the hexapod walker, and it was walking in a few days after being physically built. Although, due to the breaks and engineering problems, the finalization of the hexapod was delayed, but it was completed after correcting the errors and breaks.

Conclusion:

Overall, the developing this hexapod walker was a great experience as it tested my computer engineering abilities to the peak of its level. I learned a lot from this project and enjoyed creating the hexapod walker. I look forward to creating a greater piece of technology next year - I hope you've got something in mind for me to create next year Mr.Ratkaj.

Below there is the development of the board (incorrect version as there is no connection to power - it was corrected in the circuit by adding a jumper wire).

Below is the development of the code:

PREDRAFT:
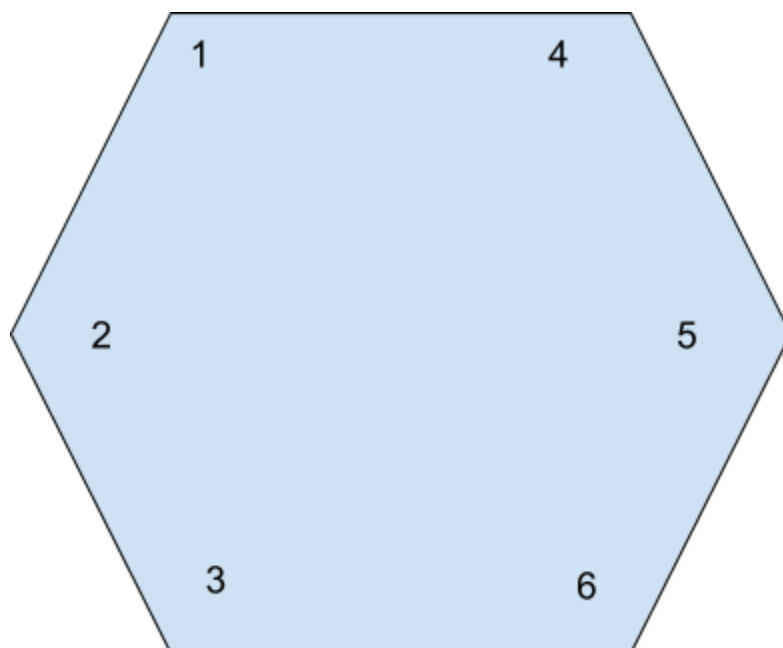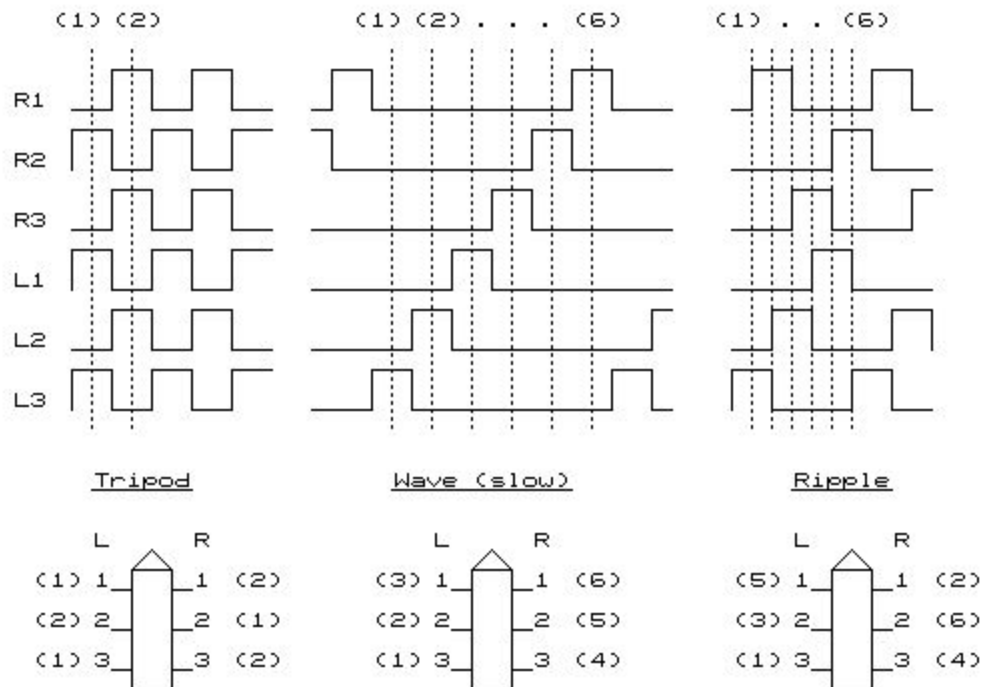
//TRIPOD GAIT

#include <Servo.h>

```
//the moving pins variables
int x=0;
int y=0l

void setup()
{
        //declare all pins for leg servos
        xleg1.attach(1);
        yleg1.attach(2);

        xleg2.attach(3);
        yleg2.attach(4);

        xleg3.attach(5);
        yleg3.attach(6);

        xleg4.attach(7);
        yleg4.attach(8);

        xleg5.attach(9);
        yleg5.attach(10);

        xleg6.attach(11);
        yleg6.attach(12);
}

void loop()
{
        //first set of legs move (1,3,5)
        firstSet();
        //second set of legs move (2,4,6)
        secondSet();

}

void firstSet()
{
        //make the first set of legs move (1,3,5)
        //make them all move up
        for (y=0; y<=30; y++);
        {
                yLeg1.write(y);
```

```
                yLeg3.write(y);
                yLeg5.write(y);
                delay(10);
        }
        //make them all move to the right (foward)
        for (x=0; x<=30; x++);
        {
                xLeg1.write(x);
                xLeg3.write(x);
                xLeg5.write(x);
                delay(10);
        }
        //make them all move down
        for (y=30; y>=0; y--);
        {
                yLeg1.write(y);
                yLeg3.write(y);
                yLeg5.write(y);
                delay(10);
        }
        //make them all move to the left (back)
        for (x=30; x>=0; x--);
        {
                xLeg1.write(x);
                xLeg3.write(x);
                xLeg5.write(x);
                delay(10);
        }
}

void secondSet()
{
        //make the second set of legs move (2,4,6)
        //make them all move up
        for (y=0; y<=30; y++);
        {
                yLeg2.write(y);
                yLeg4.write(y);
                yLeg6.write(y);
                delay(10);
        }
        //make them all move to the right (foward)
        for (x=0; x<=30; x++);
```

```
        {
                xLeg2.write(x);
                xLeg4.write(x);
                xLeg6.write(x);
                delay(10);
        }
        //make them all move down
        for (y=30; y>=0; y--);
        {
                yLeg2.write(y);
                yLeg4.write(y);
                yLeg6.write(y);
                delay(10);
        }
        //make them all move to the left (back)
        for (x=30; x>=0; x--);
        {
                xLeg2.write(x);
                xLeg4.write(x);
                xLeg6.write(x);
                delay(10);
        }
}
```

CODE TO TEST SINGLE LEG MOVEMENT BEFORE BUILD:

```
#include <Servo.h>
Servo legservo;// create servo object to control a servo
Servo kneeservo;
// twelve servo objects can be created on most boards

int legpos = 0;    // variable to store the servo position
int kneepos = 0;

void setup() {
  legservo.attach(11);  // attaches the servo on pin 9 to the servo object
  kneeservo.attach(9);
}

void loop()
{
  //MAKE LEG MOVE TO SIDE
```

```
    for (legpos = 0; legpos <= 180; legpos += 1) { // goes from 0 degrees to 180 degrees
      // in steps of 1 degree
      legservo.write(legpos);              // tell servo to go to position in variable 'pos'
      delay(15);                    // waits 15ms for the servo to reach the position
    }

//MAKE KNEE MOVE UP AND DOWN
    for (kneepos = 0; kneepos <= 180; kneepos += 1) { // goes from 0 degrees to 180 degrees
      // in steps of 1 degree
      kneeservo.write(kneepos);            // tell servo to go to position in variable 'pos'
      delay(15);                    // waits 15ms for the servo to reach the position
    }
    for (kneepos = 180; kneepos >= 0; kneepos -= 1) { // goes from 180 degrees to 0 degrees
      kneeservo.write(kneepos);            // tell servo to go to position in variable 'pos'
      delay(15); \
    }


    for (legpos = 180; legpos >= 0; legpos -= 1) { // goes from 180 degrees to 0 degrees
      legservo.write(legpos);              // tell servo to go to position in variable 'pos'
      delay(15);                    // waits 15ms for the servo to reach the position
    }

//MAKE KNEE MOVE UP AND DOWN
    for (kneepos = 0; kneepos <= 180; kneepos += 1) { // goes from 0 degrees to 180 degrees
      // in steps of 1 degree
```

REVISED PRE DRAFT CODE TO MAKE A SINGLE LEG MOVE

```
#include <Servo.h>

Servo yLeg; //to move entire leg up and down
int y = 0;
Servo xLeg; //to move entire leg left and right
int x = 0;



void setup() {
  // put your setup code here, to run once:
  xLeg.attach(2);
```

```
  xLeg.write(90);
  yLeg.attach(1);
  yLeg.write(90);

}

void loop() {
  // put your main code here, to run repeatedly:
  //MAKE LEG MOVE TO RIGHT
   for (x = 90; x <= 170; x += 1)
   {
    xLeg.write(x);
    delay(15);
   }

   //MAKE LEG MOVE UP
   for (y = 120; y <= 172; y += 1) // goes from 0 degrees to 30 degrees in steps of 1 degree
   {
    yLeg.write(y);            // tell servo to go to position in variable 'pos'
    delay(15);                   // waits 15ms for the servo to reach the position
   }

  //MAKE LEG MOVE TO LEFT
   for (x = 170; x >=90; x -= 1)
   {
    xLeg.write(x);
    delay(15);
   }

   //MAKE LEG MOVE DOWN
   for (y = 172; y >= 120; y -= 1)
   {
    yLeg.write(y);
    delay(15);
   }

}
```

DEVELOPMENT OF THE REAL HEXAPOD CODE

Arduino number (#)	Arduino Pin (servo number
1	D0
2	D1
3	D2
4	D3
5	D4
6	D5
7	A0
8	A1
9	A2
10	A3
11	A4
12	A5

```
//day 1
//I will use this program to program each motion of the hexapod, each in a function...
/* leg 1 composed of servo1 and servo2, using variables a and b
 * leg 2 composed of servo3 and servo4, using variables c and d
 * leg 3 composed of servo5 and servo6, using variables e and f
 * leg 4 composed of servo7 and servo8, using variables g and h
 * leg 5 composed of servo9 and servo10, using variables i and j
 * leg 6 composed of servo11 and servo12, using variables k and l
 * WE ARE TRYING GENERAL ACCURACY OF MOVEMENTS (EXACT AMOUNT OF
DEGREES FOR EACH SERVO)
 */

#include <Servo.h>

//initialize each servo on the number its labelled: odds control horizontal movements, even
control vertical movements
Servo servo1;
Servo servo2;
Servo servo3;
Servo servo4;
Servo servo5;
Servo servo6;
Servo servo7;
Servo servo8;
Servo servo9;
Servo servo10;
Servo servo11;
Servo servo12;

int a,b,c,d,e,f,g,h,i,j,k,l,z;

void setup() {
  //set each servo to pin its at, and start it at specific initial value: all vertical will be standing
  servo1.attach(0);
  servo1.write(120);
  servo2.attach(1);
  servo2.write(100);
  servo3.attach(2);
  servo3.write(90);
  servo4.attach(3);
  servo4.write(100);
  servo5.attach(4);
  servo5.write(90);
```

```
    servo6.attach(5);
    servo6.write(145);
    servo7.attach(14);
    servo7.write(90);
    servo8.attach(15);
    servo8.write(67);
    servo9.attach(16);
    servo9.write(90);
    servo10.attach(17);
    servo10.write(96);
    servo11.attach(18);
    servo11.write(90);
    servo12.attach(19);
    servo12.write(59);

}

void loop() {
  //run function 1
  function1();

}

void function1(){
  //make legs 1,3,5 rise, go foward, and go down

  //to make servos 2,6,10 rise
  for (b=100, f=145, k=96, z=0; z<30; b--, f--, k++, z++)
  {
    servo2.write(b);
    servo6.write(f);
    servo10.write(k);
  }
  //to make servos 1,5,9 move back
  for (a=120, e=90, i=90, z=0; z<60; a++, e++, i++, z++)
  {
    servo1.write(a);
    servo5.write(e);
    servo9.write(i);
  }
  //to make servos 2,6,10 lower
  for (b=70, f=115, k=126, z=0; z<30; b++, f++, k--, z++)
  {
```

```
    servo2.write(b);
    servo6.write(f);
    servo10.write(k);
  }
}
```

```
//day 2
//I will use this program to program each motion of the hexapod, each in a function...
/* leg 1 composed of servo1 and servo2, using variables a and b
 * leg 2 composed of servo3 and servo4, using variables c and d
 * leg 3 composed of servo5 and servo6, using variables e and f
 * leg 4 composed of servo7 and servo8, using variables g and h
 * leg 5 composed of servo9 and servo10, using variables i and j
 * leg 6 composed of servo11 and servo12, using variables k and l
 * WE ARE TRYING GENERAL ACCURACY OF MOVEMENTS (EXACT AMOUNT OF
DEGREES FOR EACH SERVO)
 */

#include <Servo.h>

//initialize each servo on the number its labelled: odds control horizontal movements, even
control vertical movements
Servo servo1;
Servo servo2;
Servo servo3;
Servo servo4;
Servo servo5;
Servo servo6;
Servo servo7;
Servo servo8;
Servo servo9;
Servo servo10;
Servo servo11;
Servo servo12;

int a,b,c,d,e,f,g,h,i,j,k,l,z;

void setup() {
  //set each servo to pin its at, and start it at specific initial value: all vertical will be standing
  servo1.attach(0);
  servo1.write(120);
  servo2.attach(1);
  servo2.write(100);
  servo3.attach(2);
  servo3.write(90);
  servo4.attach(3);
  servo4.write(100);
  servo5.attach(4);
  servo5.write(90);
```

```
    servo6.attach(5);
    servo6.write(145);
    servo7.attach(14);
    servo7.write(90);
    servo8.attach(15);
    servo8.write(67);
    servo9.attach(16);
    servo9.write(90);
    servo10.attach(17);
    servo10.write(96);
    servo11.attach(18);
    servo11.write(90);
    servo12.attach(19);
    servo12.write(59);

}

void loop() {

  function1();
  //function2();
  //function3();

}

void function1(){
  //make legs 2,4,6 push back while making legs 1,3,5 rise, then make legs 1,3,5 go foward, and
go down

  //to make servos 2,6,10 rise, and make servos 3,7,11 push back
  for (b=100, f=155, j=110,    c=150, g=150, k=150, z=0; z<60; b--, f--, j--,    c--, g--, k--, z++)
  {
    servo2.write(b);
    servo6.write(f);
    servo10.write(j);

    servo3.write(c);
    servo7.write(g);
    servo11.write(k);
    delay(30);
  }
  //to make servos 1,5,9 go foward
  for (a=120, e=130, i=150, z=0; z<60; a++, e--, i--, z++)
```

```
  {
    servo1.write(a);
    servo5.write(e);
    servo9.write(i);
    delay(30);
  }
  //to make servos 2,6,10 lower
  for (b=40, f=85, j=50, z=0; z<60; b++, f++, j++, z++)
  {
    servo2.write(b);
    servo6.write(f);
    servo10.write(j);
    delay(30);
  }
}

void function2()
{
  //make legs 1,3,5 push back while lifting legs 2,4,6 up

  for (a=180, e=70, i=150,   d=20, h=35, l=10, z=0; z<60; a--, e++, i--,    d++, h++, l++,z++)
  {
    //legs 2,4,6 lifting up
    servo4.write(d);
    servo8.write(h);
    servo12.write(l);

    //legs 1,3,5 pushing back
    servo1.write(a);
    servo5.write(e);
    servo9.write(i);
    delay(30);
  }
}

void function3()
{
  //make legs 2,4,6 move foward, and lower

  //make legs move foward
  for (c=90, g=90, k=90, z=0; z<60; c++, g++, k++, z++)
  {
    servo3.write(c);
```

```
    servo7.write(g);
    servo11.write(k);
    delay(30);
   }

  //make legs lower
  for (d=80, h=95, l=70, z=0; z<60; d--, h--, l--, z++)
   {
    servo4.write(d);
    servo8.write(h);
    servo12.write(l);
    delay(30);
   }


  }
```

```
//day3
//I will use this program to program each motion of the hexapod, each in a function...
/* leg 1 composed of servo1 and servo2, using variables a and b
 * leg 2 composed of servo3 and servo4, using variables c and d
 * leg 3 composed of servo5 and servo6, using variables e and f
 * leg 4 composed of servo7 and servo8, using variables g and h
 * leg 5 composed of servo9 and servo10, using variables i and j
 * leg 6 composed of servo11 and servo12, using variables k and l
 * WE ARE TRYING GENERAL ACCURACY OF MOVEMENTS (EXACT AMOUNT OF
DEGREES FOR EACH SERVO)
 */

#include <Servo.h>

//initialize each servo on the number its labelled: odds control horizontal movements, even
control vertical movements
Servo servo1;
Servo servo2;
Servo servo3;
Servo servo4;
Servo servo5;
Servo servo6;
Servo servo7;
Servo servo8;
Servo servo9;
Servo servo10;
Servo servo11;
Servo servo12;

int a,b,c,d,e,f,g,h,i,j,k,l,z;

void setup() {
  //set each servo to pin its at, and start it at specific initial value: all vertical will be standing
 /* servo1.attach(0);
  servo1.write(120);
  servo2.attach(1);
  servo2.write(100);
  servo3.attach(2);
  servo3.write(90);
  servo4.attach(3);
  servo4.write(100);
  servo5.attach(4);
  servo5.write(90);
```

```
  servo6.attach(5);
  servo6.write(145);
  servo7.attach(14);
  servo7.write(90);
  servo8.attach(15);
  servo8.write(67); */
  servo9.attach(16);
  servo9.write(90);
 /* servo10.attach(17);
  servo10.write(96);
  servo11.attach(18);
  servo11.write(90);
  servo12.attach(19);
  servo12.write(59); */

}

void loop() {

  //function1();
  function2();
  //function3();

}

void function1(){
  //make legs 2,4,6 push back while making legs 1,3,5 rise, then make legs 1,3,5 go foward, and
go down

  //to make servos 2,6,10 rise, and make servos 3,7,11 push back
  for (b=100, f=155, j=110,    c=150, g=150, k=150, z=0; z<60; b--, f--, j--,    c--, g--, k--, z++)
  {
    servo2.write(b);
    servo6.write(f);
    servo10.write(j);

    servo3.write(c);
    servo7.write(g);
    servo11.write(k);
    delay(30);
  }
  //to make servos 1,5,9 go foward
  for (a=120, e=130, i=150, z=0; z<60; a++, e--, i--, z++)
```

```
  {
    servo1.write(a);
    servo5.write(e);
    servo9.write(i);
    delay(30);
  }
  //to make servos 2,6,10 lower
  for (b=40, f=85, j=50, z=0; z<60; b++, f++, j++, z++)
  {
    servo2.write(b);
    servo6.write(f);
    servo10.write(j);
    delay(30);
  }
}

void function2()
{
  //make legs 1,3,5 push back while lifting legs 2,4,6 up

  for (a=180, e=70, i=90,   d=100, h=75, l=128, z=0; z<60; a--, e++, i++,    d--, h--, l--, z++)
  {
    //legs 2,4,6 lifting up
    //servo4.write(d);
    //servo8.write(h);
   // servo12.write(l);

    //legs 1,3,5 pushing back
    //servo1.write(a);
    //servo5.write(e);
    servo9.write(i);
    delay(30);
  }
}

void function3()
{
  //make legs 2,4,6 move foward, and lower

  //make legs move foward
  for (c=90, g=90, k=90, z=0; z<60; c++, g++, k++, z++)
  {
    servo3.write(c);
```

```
    servo7.write(g);
    servo11.write(k);
    delay(30);
  }

  //make legs lower
  for (d=40, h=15, l=68, z=0; z<60; d++, h--, l++, z++)
  {
    servo4.write(d);
    servo8.write(h);
    servo12.write(l);
    delay(30);
  }


}
```

```
//day 4
//I will use this program to program each motion of the hexapod, each in a function...
/* leg 1 composed of servo1 and servo2, using variables a and b
 * leg 2 composed of servo3 and servo4, using variables c and d
 * leg 3 composed of servo5 and servo6, using variables e and f
 * leg 4 composed of servo7 and servo8, using variables g and h
 * leg 5 composed of servo9 and servo10, using variables i and j
 * leg 6 composed of servo11 and servo12, using variables k and l
 * WE ARE TRYING GENERAL ACCURACY OF MOVEMENTS (EXACT AMOUNT OF
DEGREES FOR EACH SERVO)
 */

#include <Servo.h>

//initialize each servo on the number its labelled: odds control horizontal movements, even
control vertical movements
Servo servo1;
Servo servo2;
Servo servo3;
Servo servo4;
Servo servo5;
Servo servo6;
Servo servo7;
Servo servo8;
Servo servo9;
Servo servo10;
Servo servo11;
Servo servo12;

int a,b,c,d,e,f,g,h,i,j,k,l,z;

void setup() {
  //set each servo to pin its at, and start it at specific initial value: all vertical will be standing
  servo1.attach(0);
  servo1.write(120);
  servo2.attach(1);
  servo2.write(100);
  servo3.attach(2);
  servo3.write(90);
  servo4.attach(3);
  servo4.write(100);
  servo5.attach(4);
  servo5.write(90);
```

```
    servo6.attach(5);
    servo6.write(145);
    servo7.attach(14);
    servo7.write(90);
    servo8.attach(15);
    servo8.write(67);
    servo9.attach(16);
    servo9.write(90);
    servo10.attach(17);
    servo10.write(96);
    servo11.attach(18);
    servo11.write(90);
    servo12.attach(19);
    servo12.write(59);

}

void loop() {

  function1();
  function2();
  function3();

}

void function1(){
  //make legs 2,4,6 push back while making legs 1,3,5 rise, then make legs 1,3,5 go foward, and
go down

  //to make servos 2,6,10 rise, and make servos 3,7,11 push back
  for (b=100, f=155, j=110,    c=150, g=30, k=150, z=0; z<60; b--, f--, j--,    c--, g++, k--, z++)
  {
    servo2.write(b);
    servo6.write(f);
    servo10.write(j);

    servo3.write(c);
    servo7.write(g);
    servo11.write(k);
    delay(30);
  }
  //to make servos 1,5,9 go foward
  for (a=120, e=90, i=90, z=0; z<60; a++, e--, i--, z++)
```

```
  {
    servo1.write(a);
    servo5.write(e);
    servo9.write(i);
    delay(30);
  }
  //to make servos 2,6,10 lower
  for (b=40, f=85, j=50, z=0; z<60; b++, f++, j++, z++)
  {
    servo2.write(b);
    servo6.write(f);
    servo10.write(j);
    delay(30);
  }
}

void function2()
{
  //make legs 1,3,5 push back while lifting legs 2,4,6 up

  for (a=180, e=30, i=30,   d=100, h=75, l=128, z=0; z<60; a--, e++, i++,    d--, h--, l--, z++)
  {
    //legs 2,4,6 lifting up
    servo4.write(d);
    servo8.write(h);
    servo12.write(l);

    //legs 1,3,5 pushing back
    servo1.write(a);
    servo5.write(e);
    servo9.write(i);
    delay(30);
  }
}

void function3()
{
  //make legs 2,4,6 move foward, and lower

  //make legs move foward
  for (c=90, g=90, k=90, z=0; z<60; c++, g--, k++, z++)
  {
    servo3.write(c);
```

```
    servo7.write(g);
    servo11.write(k);
    delay(30);
  }


  //make legs lower
  for (d=40, h=15, l=68, z=0; z<60; d++, h++, l++, z++)
  {
   //servo4.write(d);
   //servo8.write(h);
    servo12.write(l);
    delay(30);
  }


}
```

```
//day 5
//I will use this program to program each motion of the hexapod, each in a function...
/* leg 1 composed of servo1 and servo2, using variables a and b
 * leg 2 composed of servo3 and servo4, using variables c and d
 * leg 3 composed of servo5 and servo6, using variables e and f
 * leg 4 composed of servo7 and servo8, using variables g and h
 * leg 5 composed of servo9 and servo10, using variables i and j
 * leg 6 composed of servo11 and servo12, using variables k and l
 * WE ARE TRYING GENERAL ACCURACY OF MOVEMENTS (EXACT AMOUNT OF
DEGREES FOR EACH SERVO)
 */

#include <Servo.h>

//initialize each servo on the number its labelled: odds control horizontal movements, even
control vertical movements
Servo servo1;
Servo servo2;
Servo servo3;
Servo servo4;
Servo servo5;
Servo servo6;
Servo servo7;
Servo servo8;
Servo servo9;
Servo servo10;
Servo servo11;
Servo servo12;

int a,b,c,d,e,f,g,h,i,j,k,l,z;
int pause = 15;

void setup() {
  //set each servo to pin its at, and start it at specific initial value: all vertical will be standing
  servo1.attach(0);
  servo1.write(120);
  servo2.attach(1);
  servo2.write(100);
  servo3.attach(2);
  servo3.write(100);
  servo4.attach(3);
  servo4.write(100);
  servo5.attach(4);
```

```
    servo5.write(90);
    servo6.attach(5);
    servo6.write(145);
    servo7.attach(14);
    servo7.write(90);
    servo8.attach(15);
    servo8.write(67);
    servo9.attach(16);
    servo9.write(90);
    servo10.attach(17);
    servo10.write(96);
    servo11.attach(18);
    servo11.write(90);
    servo12.attach(19);
    servo12.write(59);
    delay(10000);

}

void loop() {

  function1();
  function2();
  function3();

}

void function1(){
  //make legs 2,4,6 push back while making legs 1,3,5 rise, then make legs 1,3,5 go foward, and
go down

  //to make servos 2,6,10 rise, and make servos 3,7,11 push back
  for (b=100, f=155, j=110,    c=160, g=30, k=150, z=0; z<60; b--, f--, j--,    c--, g++, k--, z++)
  {
    servo2.write(b);
    servo6.write(f);
    servo10.write(j);

    servo3.write(c);
    servo7.write(g);
    servo11.write(k);
    delay(pause);
  }
```

```
  //to make servos 1,5,9 go foward
  for (a=120, e=90, i=90, z=0; z<60; a++, e--, i--, z++)
  {
    servo1.write(a);
    servo5.write(e);
    servo9.write(i);
    delay(pause);
  }
  //to make servos 2,6,10 lower
  for (b=40, f=85, j=50, z=0; z<60; b++, f++, j++, z++)
  {
    servo2.write(b);
    servo6.write(f);
    servo10.write(j);
    delay(pause);
  }
}

void function2()
{
  //make legs 1,3,5 push back while lifting legs 2,4,6 up

  for (a=180, e=30, i=30,   d=100, h=75, l=128, z=0; z<60; a--, e++, i++,    d--, h--, l--, z++)
  {
    //legs 2,4,6 lifting up
    servo4.write(d);
    servo8.write(h);
    servo12.write(l);

    //legs 1,3,5 pushing back
    servo1.write(a);
    servo5.write(e);
    servo9.write(i);
    delay(pause);
  }
}

void function3()
{
  //make legs 2,4,6 move foward, and lower

  //make legs move foward
  for (c=100, g=90, k=90, z=0; z<60; c++, g--, k++, z++)
```

```
  {
    servo3.write(c);
    servo7.write(g);
    servo11.write(k);
    delay(pause);
  }

  //make legs lower
  for (d=40, h=15, l=68, z=0; z<60; d++, h++, l++, z++)
  {
    servo4.write(d);
    servo8.write(h);
    servo12.write(l);
    delay(pause);
  }


}
```

Additional Code:

```
//60* Semi-Circle code
//day 4
//I will use this program to program each motion of the hexapod, each in a function...
/* leg 1 composed of servo1 and servo2, using variables a and b
 * leg 2 composed of servo3 and servo4, using variables c and d
 * leg 3 composed of servo5 and servo6, using variables e and f
 * leg 4 composed of servo7 and servo8, using variables g and h
 * leg 5 composed of servo9 and servo10, using variables i and j
 * leg 6 composed of servo11 and servo12, using variables k and l
 * WE ARE TRYING GENERAL ACCURACY OF MOVEMENTS (EXACT AMOUNT OF
DEGREES FOR EACH SERVO)
 */

#include <Servo.h>

//initialize each servo on the number its labelled: odds control horizontal movements, even
control vertical movements
Servo servo1;
Servo servo2;
Servo servo3;
Servo servo4;
Servo servo5;
Servo servo6;
Servo servo7;
Servo servo8;
Servo servo9;
Servo servo10;
Servo servo11;
Servo servo12;

int a,b,c,d,e,f,g,h,i,j,k,l,z;
int pause = 15;

void setup() {
  //set each servo to pin its at, and start it at specific initial value: all vertical will be standing
  servo1.attach(0);
  servo1.write(120);
  servo2.attach(1);
  servo2.write(100);
  servo3.attach(2);
```

```
    servo3.write(100);
    servo4.attach(3);
    servo4.write(100);
    servo5.attach(4);
    servo5.write(90);
    servo6.attach(5);
    servo6.write(145);
    servo7.attach(14);
    servo7.write(90);
    servo8.attach(15);
    servo8.write(67);
    servo9.attach(16);
    servo9.write(90);
    servo10.attach(17);
    servo10.write(96);
    servo11.attach(18);
    servo11.write(90);
    servo12.attach(19);
    servo12.write(59);

}

void loop() {

  function1();
  function2();
  function3();

}

void function1(){
  //make legs 2,4,6 push back while making legs 1,3,5 rise, then make legs 1,3,5 go foward, and
go down

  //to make servos 2,6,10 rise, and make servos 3,7,11 push back
  for (b=100, f=155, j=110,    c=160, g=90, k=150, z=0; z<60; b--, f--, j--,    c--, g--, k--, z++)
  {
    servo2.write(b);
    servo6.write(f);
    servo10.write(j);

    servo3.write(c);
    servo7.write(g);
```

```
      servo11.write(k);
      delay(pause);
    }
    //to make servos 1,5,9 go foward
    for (a=180, e=90, i=90, z=0; z<60; a--, e--, i--, z++)
    {
      servo1.write(a);
      servo5.write(e);
      servo9.write(i);
      delay(pause);
    }
    //to make servos 2,6,10 lower
    for (b=40, f=85, j=50, z=0; z<60; b++, f++, j++, z++)
    {
      servo2.write(b);
      servo6.write(f);
      servo10.write(j);
      delay(pause);
    }
  }

void function2()
{
  //make legs 1,3,5 push back while lifting legs 2,4,6 up

  for (a=120, e=30, i=30,   d=100, h=75, l=128, z=0; z<60; a++, e++, i++,    d--, h--, l--, z++)
  {
    //legs 2,4,6 lifting up
    servo4.write(d);
    servo8.write(h);
    servo12.write(l);

    //legs 1,3,5 pushing back
    servo1.write(a);
    servo5.write(e);
    servo9.write(i);
    delay(pause);
  }
}

void function3()
{
  //make legs 2,4,6 move foward, and lower
```

```
//make legs move foward
for (c=100, g=30, k=90, z=0; z<60; c++, g++, k++, z++)
{
  servo3.write(c);
  servo7.write(g);
  servo11.write(k);
  delay(pause);
}

//make legs lower
for (d=40, h=15, l=68, z=0; z<60; d++, h++, l++, z++)
{
  servo4.write(d);
  servo8.write(h);
  servo12.write(l);
  delay(pause);
}


}
```

Final Results: