CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Fuzzy controllers have the advantages that can deal with nonlinear systems and use the human operator knowledge .Here we tested it with a linear system of second order with known parameters. In order to compare it with one classical controller we simulated the same system controller by PID .PID controller has only three parameters to adjust. Controlled system shows good results in terms of response time and precision when these parameters are well adjusted.

A mathematical model of the Satellite Dish system was developed by using physical and electrical laws.A simplified mathematical model was derived by system parameters. The controller parameters values (Kp , Ki and Kd) were obtained by using manual tuning method from practical model so as to perform best system response. From experimental results, it is found that the best controller parameters which gave the best response of the system are : Kp= 4.7198, Ki=54.2762 and Kd =0.06912 . The accuracy of the system is tested adjusting the position of the Satellite Dish at two different points and it found that the accuracy doesn't affected by changing the set point .

5.2 Recommendations

The main recommendation of project are:

1. It is recommended that the system can be controlled by more advanced control techniques, like neural network, genetic algorithms and Neuro-fuzzy, and compere results with PID and FLC controllers.
2. Develop Satellite Dish system to control the servo position into full rotation to apply it in more field applications.
3. Searching for the satellite by just only frequency is consuming time. To speed up the research we must determine the coordinate of the satellite in addition to frequency.

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APPENDIX A

```
% MATLAB m.file for PID controller
clear all
clc
num = [3.839];
den = [.004 0.34 1];
m = tf(num ,den);
H=[1];
servomotor=feedback(m,H);
n=servomotor;
Kp = 4.7198;
Ki = 54.2762;
Kd = 0.06912;
PIDcontroller= pid(Kp,Ki,Kd)
c=PIDcontroller;
y=tf(1,1);
step(y)
hold on
grid on
mc = feedback(c*m,H)
servo=stepinfo(n)
servoPID=stepinfo(mc)
step(mc)
axis([0 13 0 2])
hold on
grid on
```

APPENDIX B

% Arduno code

```
#include <IRremote.h>

int RECV_PIN = 7;

IRrecv irrecv(RECV_PIN);

decode_results results;

const int ledPin =  9;

const int led1Pin =  8;

const int pingPin = 12;

const int ping1Pin = 13 ;

const int pinjPin = 10;

const int pinj1Pin = 11;

int i;int x;int x1;int y =0;int z;long s;

void setup()

{ pinMode(ledPin, OUTPUT);

     pinMode(led1Pin, OUTPUT);

  Serial.begin(9600);

   irrecv.enableIRIn(); }

void loop() {

   if (irrecv.decode(&results))

    {Serial.println(results.value, HEX);

     irrecv.resume();

    long int decCode = results.value;

    Serial.println(decCode);}

switch(results.value)

{ case 551520375:

a();

  break;

  case 551504055:

a1();

  break;
```

```
  case 551536695:
  for (i=0 ;i<62 ;i++)
    {digitalWrite(ledPin, HIGH);
     delay(0.5);
      digitalWrite(ledPin, LOW);
      delay(10);}
    delay(300);
     for (i=0 ;i<62 ;i++)
    { digitalWrite(led1Pin, HIGH);
     delay(0.5);
      digitalWrite(led1Pin, LOW);
      delay(10);}
    break; }}
void a()
{ long duration, inches, cm;
    long duration1, inches1, cm1;
  pinMode(pingPin, OUTPUT);
  digitalWrite(pingPin, LOW);
  delayMicroseconds(2);
  digitalWrite(pingPin, HIGH);
  delayMicroseconds(5);
  digitalWrite(pingPin, LOW);
  pinMode(ping1Pin, INPUT);
  duration = pulseIn(ping1Pin, HIGH);
   pinMode(pinjPin, OUTPUT);
  digitalWrite(pinjPin, LOW);
  delayMicroseconds(2);
  digitalWrite(pinjPin, HIGH);
  delayMicroseconds(5);
  digitalWrite(pinjPin, LOW);
  pinMode(pinj1Pin, INPUT);
```

```
 duration1 = pulseIn(pinj1Pin, HIGH);
 inches = microsecondsToInches(duration);
 cm = microsecondsToCentimeters(duration);
  inches1 = microsecondsToInches(duration1);
 cm1 = microsecondsToCentimeters(duration1);
 Serial.print(cm);
Serial.print("cm");
 Serial.println();
 delay(500);
if (cm<30)
{digitalWrite(ledPin, LOW);
digitalWrite(led1Pin, LOW);
x=y;}
else
{ b();
}}
void b()
{for (i=0 ;i<6 ;i++)
   {  digitalWrite(ledPin, HIGH);
     delay(2.5);
      digitalWrite(ledPin, LOW);
      delay(10);}
    delay(50);
    x++;
     Serial.print(x);
Serial.print("xxx");
 Serial.println();
 if (x == 6)
 { x=y;
   delay(50);
   for (i=0 ;i<62 ;i++)
```

```
    { digitalWrite(ledPin, HIGH);
      delay(0.5);
       digitalWrite(ledPin, LOW);
       delay(10); }
  }
  delay(50);
   c();}
void a1()
{long duration, inches, cm;
   long duration1, inches1, cm1;
  pinMode(pingPin, OUTPUT);
  digitalWrite(pingPin, LOW);
  delayMicroseconds(2);
  digitalWrite(pingPin, HIGH);
  delayMicroseconds(5);
  digitalWrite(pingPin, LOW);
  pinMode(ping1Pin, INPUT);
  duration = pulseIn(ping1Pin, HIGH);
   pinMode(pinjPin, OUTPUT);
  digitalWrite(pinjPin, LOW);
  delayMicroseconds(2);
  digitalWrite(pinjPin, HIGH);
  delayMicroseconds(5);
  digitalWrite(pinjPin, LOW);
  pinMode(pinj1Pin, INPUT);
  duration1 = pulseIn(pinj1Pin, HIGH);
  inches = microsecondsToInches(duration);
  cm = microsecondsToCentimeters(duration);
   inches1 = microsecondsToInches(duration1);
  cm1 = microsecondsToCentimeters(duration1);
  Serial.print(cm1);
```

```
 Serial.print("cm");
  Serial.println();
  delay(500);
 if (cm1<30)
{ digitalWrite(ledPin, LOW);
 digitalWrite(led1Pin, LOW);
 x=y;}
else
{ b1(); }}
void b1()
{ for (i=0 ;i<6 ;i++)
    { digitalWrite(ledPin, HIGH);
      delay(2.5);
       digitalWrite(ledPin, LOW);
       delay(10);    }
     delay(50);
     x++;
      Serial.print(x);
 Serial.print("xxx");
  Serial.println();
  if (x == 6)
  {x=y;
    delay(50);
    for (i=0 ;i<62 ;i++)
    {digitalWrite(ledPin, HIGH);
      delay(0.5);
       digitalWrite(ledPin, LOW);
       delay(10);}}
  delay(50);
    c1(); }
void c()
```

```
{ for (i=0 ;i<3 ;i++)
    {digitalWrite(led1Pin, HIGH);
     delay(2.5);
      digitalWrite(led1Pin, LOW);
      delay(10);}
    delay(300);
    d(); }
void d()
{long duration, inches, cm;
   long duration1, inches1, cm1;
  pinMode(pingPin, OUTPUT);
  digitalWrite(pingPin, LOW);
  delayMicroseconds(2);
  digitalWrite(pingPin, HIGH);
  delayMicroseconds(5);
  digitalWrite(pingPin, LOW);
  pinMode(ping1Pin, INPUT);
  duration = pulseIn(ping1Pin, HIGH);
   pinMode(pinjPin, OUTPUT);
  digitalWrite(pinjPin, LOW);
  delayMicroseconds(2);
  digitalWrite(pinjPin, HIGH);
  delayMicroseconds(5);
  digitalWrite(pinjPin, LOW);
  pinMode(pinj1Pin, INPUT);
  duration1 = pulseIn(pinj1Pin, HIGH);
  inches = microsecondsToInches(duration);
  cm = microsecondsToCentimeters(duration);
   inches1 = microsecondsToInches(duration1);
  cm1 = microsecondsToCentimeters(duration1);
  Serial.print(cm1);
```

```
 Serial.print("cm, ");
 Serial.print(cm);
Serial.print("cm");
 Serial.println();
 delay(50);
 if (cm<30)
{ digitalWrite(ledPin, LOW);
 digitalWrite(led1Pin, LOW);   }
else
{ for (i=0 ;i<3 ;i++)
   {digitalWrite(led1Pin, HIGH);
     delay(2.5);
      digitalWrite(led1Pin, LOW);
      delay(10);}
     delay(300);
 k(); } }
void k()
{ long duration, inches, cm;
   long duration1, inches1, cm1;
 pinMode(pingPin, OUTPUT);
 digitalWrite(pingPin, LOW);
 delayMicroseconds(2);
 digitalWrite(pingPin, HIGH);
 delayMicroseconds(5);
 digitalWrite(pingPin, LOW);
 pinMode(ping1Pin, INPUT);
 duration = pulseIn(ping1Pin, HIGH);
  pinMode(pinjPin, OUTPUT);
 digitalWrite(pinjPin, LOW);
 delayMicroseconds(2);
 digitalWrite(pinjPin, HIGH);
```

```
 delayMicroseconds(5);
 digitalWrite(pinjPin, LOW);
 pinMode(pinj1Pin, INPUT);
 duration1 = pulseIn(pinj1Pin, HIGH);
 inches = microsecondsToInches(duration);
 cm = microsecondsToCentimeters(duration);
  inches1 = microsecondsToInches(duration1);
 cm1 = microsecondsToCentimeters(duration1);
 Serial.print(cm1);
 Serial.print("cm, ");
 Serial.print(cm);
Serial.print("cm");
 Serial.println();
 delay(50);
 if (cm<30)
{digitalWrite(ledPin, LOW);
 digitalWrite(led1Pin, LOW);
}
 else
 {for (i=0 ;i<3 ;i++)
   {digitalWrite(led1Pin, HIGH);
    delay(2.5);
     digitalWrite(led1Pin, LOW);
     delay(10);  }
   delay(300);
 l();
 } }
void l()
{ long duration, inches, cm;
   long duration1, inches1, cm1;
 pinMode(pingPin, OUTPUT);
```

```
 digitalWrite(pingPin, LOW);
 delayMicroseconds(2);
 digitalWrite(pingPin, HIGH);
 delayMicroseconds(5);
 digitalWrite(pingPin, LOW);
 pinMode(ping1Pin, INPUT);
 duration = pulseIn(ping1Pin, HIGH);
  pinMode(pinjPin, OUTPUT);
 digitalWrite(pinjPin, LOW);
 delayMicroseconds(2);
 digitalWrite(pinjPin, HIGH);
 delayMicroseconds(5);
 digitalWrite(pinjPin, LOW);
 pinMode(pinj1Pin, INPUT);
 duration1 = pulseIn(pinj1Pin, HIGH);
 inches = microsecondsToInches(duration);
 cm = microsecondsToCentimeters(duration);
  inches1 = microsecondsToInches(duration1);
 cm1 = microsecondsToCentimeters(duration1);
 Serial.print(cm1);
 Serial.print("cm, ");
 Serial.print(cm);
Serial.print("cm");
 Serial.println();
 delay(50);
 if (cm<30)
{  digitalWrite(ledPin, LOW);
 digitalWrite(led1Pin, LOW);   }
else
{  for (i=0 ;i<3 ;i++)
   {digitalWrite(led1Pin, HIGH);
```

```
      delay(2.5);
       digitalWrite(led1Pin, LOW);
       delay(10);}
     delay(300);
  m(); } }
void m()
{  long duration, inches, cm;
    long duration1, inches1, cm1;
  pinMode(pingPin, OUTPUT);
  digitalWrite(pingPin, LOW);
  delayMicroseconds(2);
  digitalWrite(pingPin, HIGH);
  delayMicroseconds(5);
  digitalWrite(pingPin, LOW);
  pinMode(ping1Pin, INPUT);
  duration = pulseIn(ping1Pin, HIGH);
   pinMode(pinjPin, OUTPUT);
  digitalWrite(pinjPin, LOW);
  delayMicroseconds(2);
  digitalWrite(pinjPin, HIGH);
  delayMicroseconds(5);
  digitalWrite(pinjPin, LOW);
  pinMode(pinj1Pin, INPUT);
  duration1 = pulseIn(pinj1Pin, HIGH);
  inches = microsecondsToInches(duration);
  cm = microsecondsToCentimeters(duration);
   inches1 = microsecondsToInches(duration1);
  cm1 = microsecondsToCentimeters(duration1);
  Serial.print(cm1);
  Serial.print("cm, ");
  Serial.print(cm);
```

```
 Serial.print("cm");
  Serial.println();
  delay(50);
  if (cm<30)
 {  digitalWrite(ledPin, LOW);
  digitalWrite(led1Pin, LOW);    }
 else
 { for (i=0 ;i<40;i++)
    {digitalWrite(led1Pin, HIGH);
      delay(0.5);
       digitalWrite(led1Pin, LOW);
       delay(10);  }
     delay(300);
  a(); } }
void c1()
{ for (i=0 ;i<3 ;i++)
    { digitalWrite(led1Pin, HIGH);
      delay(2.5);
       digitalWrite(led1Pin, LOW);
       delay(10);  }
     delay(300);
     d1(); }
void d1()
{  long duration, inches, cm;
  pinMode(pingPin, OUTPUT);
  digitalWrite(pingPin, LOW);
  delayMicroseconds(2);
  digitalWrite(pingPin, HIGH);
  delayMicroseconds(5);
  digitalWrite(pingPin, LOW);
  pinMode(ping1Pin, INPUT);
```

```
 duration = pulseIn(ping1Pin, HIGH);
  pinMode(pinjPin, OUTPUT);
 digitalWrite(pinjPin, LOW);
 delayMicroseconds(2);
 digitalWrite(pinjPin, HIGH);
 delayMicroseconds(5);
 digitalWrite(pinjPin, LOW);
 pinMode(pinj1Pin, INPUT);
 duration1 = pulseIn(pinj1Pin, HIGH);
 inches = microsecondsToInches(duration);
 cm = microsecondsToCentimeters(duration);
  inches1 = microsecondsToInches(duration1);
 cm1 = microsecondsToCentimeters(duration1);
 Serial.print(cm1);
 Serial.print("cm, ");
 Serial.print(cm);
Serial.print("cm");
 Serial.println();
 delay(50);
 if (cm1<30)
{ digital Write (ledPin, LOW);
 Digital Write (led1Pin, LOW);     }
else
{ for (i=0 ;i<3 ;i++)
   {digital Write(led1Pin, HIGH);
     delay(2.5);
      digital Write(led1Pin, LOW);
      delay(10); }
     delay(300);
 k1(); } }
void k1()
```

```
{ long duration, inches, cm;
   long duration1, inches1, cm1;
 pinMode(pingPin, OUTPUT);
 digitalWrite(pingPin, LOW);
 delayMicroseconds(2);
 digitalWrite(pingPin, HIGH);
 delayMicroseconds(5);
 digitalWrite(pingPin, LOW);
 pinMode(ping1Pin, INPUT);
 duration = pulseIn(ping1Pin, HIGH);
  pinMode(pinjPin, OUTPUT);
 digitalWrite(pinjPin, LOW);
 delayMicroseconds(2);
 digitalWrite(pinjPin, HIGH);
 delayMicroseconds(5);
 digitalWrite(pinjPin, LOW);
 pinMode(pinj1Pin, INPUT);
 duration1 = pulseIn(pinj1Pin, HIGH);
 inches = microsecondsToInches(duration);
 cm = microsecondsToCentimeters(duration);
  inches1 = microsecondsToInches(duration1);
 cm1 = microsecondsToCentimeters(duration1);
 Serial.print(cm1);
 Serial.print("cm, ");
 Serial.print(cm);
Serial.print("cm");
 Serial.println();
 delay(50);
 if (cm1<30)
{  digitalWrite(ledPin, LOW);
 digitalWrite(led1Pin, LOW);  }
```

```
 else
 { for (i=0 ;i<3 ;i++)
    { digitalWrite(led1Pin, HIGH);
      delay(2.5);
       digitalWrite(led1Pin, LOW);
       delay(10);}
     delay(300);
  l1(); } }
void l1()
{   long duration, inches, cm;
    long duration1, inches1, cm1;
  pinMode(pingPin, OUTPUT);
  digitalWrite(pingPin, LOW);
  delayMicroseconds(2);
  digitalWrite(pingPin, HIGH);
  delayMicroseconds(5);
  digitalWrite(pingPin, LOW);
  pinMode(ping1Pin, INPUT);
  duration = pulseIn(ping1Pin, HIGH);
   pinMode(pinjPin, OUTPUT);
  digitalWrite(pinjPin, LOW);
  delayMicroseconds(2);
  digitalWrite(pinjPin, HIGH);
  delayMicroseconds(5);
  digitalWrite(pinjPin, LOW);
  pinMode(pinj1Pin, INPUT);
  duration1 = pulseIn(pinj1Pin, HIGH);
  inches = microsecondsToInches(duration);
  cm = microsecondsToCentimeters(duration);
   inches1 = microsecondsToInches(duration1);
  cm1 = microsecondsToCentimeters(duration1);
```

```
 Serial.print(cm1);
 Serial.print("cm, ");
 Serial.print(cm);
Serial.print("cm");
 Serial.println();
 delay(50);
 if (cm1<30)
{  digitalWrite(ledPin, LOW);
 digitalWrite(led1Pin, LOW);   }
else
{ for (i=0 ;i<3 ;i++)
   { digitalWrite(led1Pin, HIGH);
     delay(2.5);
      digitalWrite(led1Pin, LOW);
      delay(10); }
    delay(300);
 m1(); } }
void m1()
{long duration, inches, cm;
   long duration1, inches1, cm1;
 pinMode(pingPin, OUTPUT);
 digitalWrite(pingPin, LOW);
 delayMicroseconds(2);
 digitalWrite(pingPin, HIGH);
 delayMicroseconds(5);
 digitalWrite(pingPin, LOW);
 pinMode(ping1Pin, INPUT);
 duration = pulseIn(ping1Pin, HIGH);
  pinMode(pinjPin, OUTPUT);
 digitalWrite(pinjPin, LOW);
 delayMicroseconds(2);
```

```
 digitalWrite(pinjPin, HIGH);
 delayMicroseconds(5);
 digitalWrite(pinjPin, LOW);
 pinMode(pinj1Pin, INPUT);
 duration1 = pulseIn(pinj1Pin, HIGH);
 inches = microsecondsToInches(duration);
 cm = microsecondsToCentimeters(duration);
  inches1 = microsecondsToInches(duration1);
 cm1 = microsecondsToCentimeters(duration1);
 Serial.print(cm1);
 Serial.print("cm, ");
 Serial.print(cm);
Serial.print("cm");
 Serial.println();
 delay(50);
 if (cm1<30)
{digitalWrite(ledPin, LOW);
 digitalWrite(led1Pin, LOW);   }
else
{for (i=0 ;i<40;i++)
   { digitalWrite(led1Pin, HIGH);
     delay(0.5);
      digitalWrite(led1Pin, LOW);
      delay(10); }
   delay(300);
 a1();} }
long microsecondsToInches(long microseconds)
{return microseconds / 74 / 2;}
long microseconds ToCentimeters(long microseconds)
{ return microseconds / 29 / 2;}
```