Wall Painting Robot

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FINAL YEAR PROJECT REPORT

We hereby recommend that the dissertation prepared under our supervision by: { Umar Mukhtar NUST201200955BSMME11112F, Mubashar Ahmad NUST201201450BSMME11112F, Salman Sakandar NUST201200566BSMME11112F, Yasir Mustafa NUST201200210BSMME11112F } Titled: {Wall Painting Robot} be accepted in partial fulfillment of the requirements for the award of Bachelors of Engineering in Mechanical Engineering degree with (____ grade)
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Dean/Principal

Declaration

I/We certify that this research work titled "*FYP Title"* is my own work. The work has not been presented elsewhere for assessment. The material that has been used from other sources it has been properly acknowledged / referred.

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Copyright Statement

Dedicated to my parents

Acknowledgments

In making of this project, we had to take the help and guideline of some respected persons, who deserve our greatest gratitude. The completion of this project gives us much Pleasure. We would like to show our gratitude to **Mr. FAHAD ISLAM, Lecturer, SMME NUST and Dr. YASIR AYAZ, HOD Robotics , SMME NUST for** giving us fruitful guideline for project completion through numerous consultations. We would also like to expand our deepest gratitude to all those who have directly and indirectly guided us in writing this assignment.

Many people, especially our classmates and team members themselves, have given valuable comment suggestions on this proposal which gave us an insight to improve our project. We thank all the people for their help directly and indirectly to complete our project.

Abstract

The primary aim of the project is to design, develop and implement Automatic Wall Painting Robot which helps to achieve low cost painting equipment. Despite the advances in robotics and its wide spreading applications, interior wall painting has shared little in research activities. The painting chemicals can cause hazards to the human painters such as eye and respiratory system problems. Also the nature of painting procedure that requires repeated work and hand rising makes it boring, time and effort consuming. When construction workers and robots are properly integrated in building tasks, the whole construction process can be better managed and savings in human labour and timing are obtained as a consequence. In addition, it would offer the opportunity to reduce or eliminate human exposure to difficult and hazardous environments, which would solve most of the problems connected with safety when many activities occur at the same time. These factors motivate the development of an automated robotic painting system.

Table of Contents

Symbols

F	Force (N)
m	Mass(kg)
a	Acceleration(m/s^2)
A	Area (m^2)
p	Density (kg/m^3)
v	Velocity (m/s)
P	Power(W)
E	Energy(J)
I	Current(A)
f	Frequency(Hz)
C	Capacitance(F)
R	Resistance(Ohm)
V	Voltage(V)

Objective:-

A wall painting robot to paint the walls efficiently and in less time. It uses an advanced control system to ensure good quality in painting and saving time. It will help in achieving some more benefits:

- Saving Time.
- Heaqlthcare for Labors.
- Painting with constant thickness.
- Can be commercialised.
- Reduced Labor Work.

Chapter 1

Introduction:-

Building and construction is one of the major industries around the world. In this fast moving life construction industry is also growing rapidly. But the labors in the construction industry are not sufficient. This insufficient labors in the construction industry is because of the difficulty in the work. In construction industry, during the work in tall buildings or in the sites where there is more risky situation like interior area in the city. There are some other reasons for the insufficient labor which may be because of the improvement the education level which cause the people to think that these types of work is not as prestigious as the other jobs.

The construction industry is labor-intensive and conducted in dangerous situations; therefore the importance of construction robotics has been realized and is grown rapidly. Applications and activities of robotics and automation in this construction industry started in the early 90‟s aiming to optimize equipment operations, improve safety, enhance perception of workspace and furthermore, ensure quality environment for building occupant. After this, the advances in the robotics and automation in the construction industry has grown rapidly.

Despite the advances in the robotics and its wide spreading applications, painting is also considered to be the difficult process as it also has to paint the whole building. To make this work easier and safer and also to reduce the number of labors automation in painting was introduced. The automation for painting the exterior wall in buildings has been proposed. Above all these the interior wall painting has shared little in research activities. The painting chemicals can cause hazards to the painters such as eye and respiratory system problems. Also the nature of painting procedure that requires repeated work and hand rising makes it boring, time and effort consuming. These factors motivate the development of an automated robotic painting system. This project aims to develop the interior wall painting robot.

Chapter 2
Literature Review:-

What is the need in society that your idea will fulfill ?

A wall painting robot with a purpose of saving painting labor form unhygienic emissions involved in painting & to generate wealth for Pakistani labor by locally manufacturing the robots and commercializing the product in local as well as global market.To enhance technological exports of Pakistan.

Who needs it ? How many would benefit ?

Our country is facing a strong decline in Exports. Our unemployment rate demands good jobs. Country needs good startups to improve exports. Society needs employment. Paint industries need good technology. So our beneficiaries include following: -Society/poor people -Country -Paint Industry

How will the solution works

Industry: Robot will bring revolution in Paint Industry, new technology will bring advancements in paint industry. **Society**: Robot manufacturing facility will generate employments for a lot of unemployed people. Country/State: State will benefit as as soon as new technology gets into market and is accepted in global market.Hence, a step to enhance our GDP and exports.

Who are your competitors ? How is your solution different

There is no current competitor in our field. Initially, our target market'll be: "The Paint Industry". Paint Industry will buy our machines and with one time investment they will use these machines to provide services to the customers. We also intend to make it solar powered hence Sustainable.

Chapter 3

Design:-

The construction of the automatic wall painting robot consists of following parts:-

Scissor Mechanism

Hydraulic cylinder

Solenoid valve

Motor

Compressor

Roller

Lead Screws

Ultrasonic sensor

Chapter 4

Scissor Mechanism Analysis

Chapter 4

Scissor Mechanism Analysis

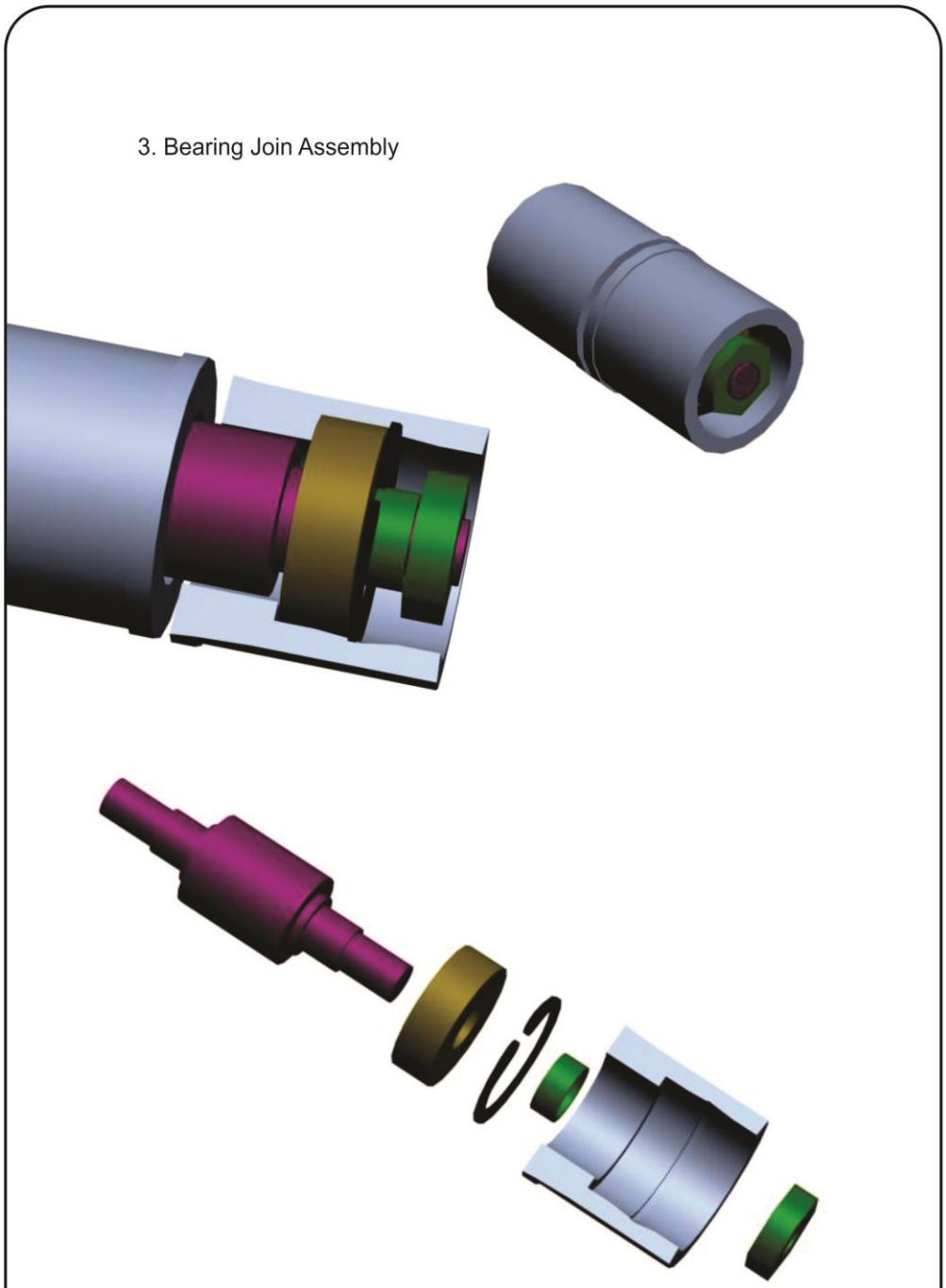
Parts Detail

1. Top Aluminum Plate

2. Top Plate Structure

Chapter 4

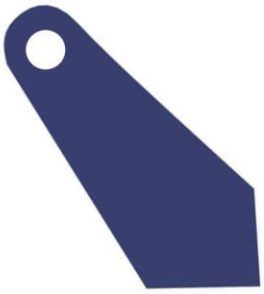
Scissor Mechanism Analysis



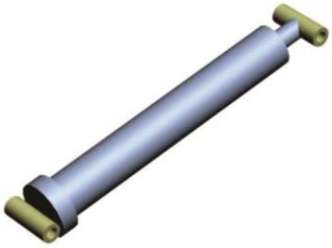
Chapter 4

Scissor Mechanism Analysis

6. Jack Top Mounting Plate



7. Jack

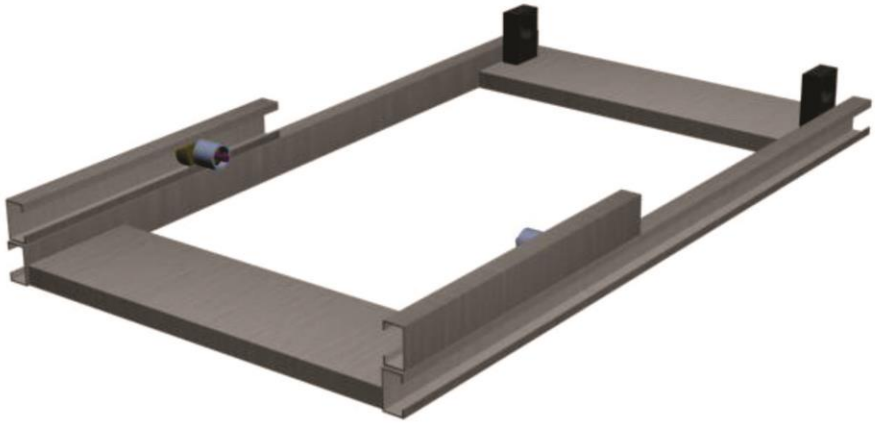


8. Jack Bottom M. I

Chapter 4

Scissor Mechanism Analysis

9. Bottom Structure



10. Straight Wheal

Chapter 4

Scissor Mechanism Analysis

Chapter 5

Hydraulic Pump Calculations:-

- Force required to lift the scissor mechanism = 981N
- Diameter of the piston = 1.5 inch
- Stroke of Piston = 18 inch
- Now to find the pressure
- $P = \frac{F}{A}$
- $A = \pi d^2/4$
- $A = \pi(1.5)^2/4$ = 1.76625 in^2
- P = $\frac{981}{\pi(0.0381)^2/4} = 860.89$kpa = 124.86 psi
- Amount of oil required :-
- Displacement of cylinder = cylinder Area x stroke

  = (1.76625 in^2) x (18 in)
- Volume of the oil = 31.79 in^3
- Pump Delivery in GPM:-
- Pump delivery = (cylinder displacement/time) x 0.2579
- = 0.8198 GPM
- Horse power = PSI x GPM x 0.000583
- = 124.86 x 0.8198 x 0.000583

- = 0.059676 HP

Chapter 6

PH266-01GK Motor Specifications:-

Motor voltage = 6V

Current per phase = 1.2A

Torque= 58.8N

Resistance per ohm = 5ohm

Inductance per phase= 8mH

Rotor inertia = 135gcm^2

Weight = 0.6kg

Chapter 7

Calculations for Lead screw and motor:-

Our lead screw contain 3 threads in one inch

The motor covers single step in 1.8 degrees

Total steps for 1 revolution = 360/ 1.8 = 200

Total steps to cover 1 inch = 200 x 3 = 600

Length of lead screw = 36in

Total steps to cover full length of lead screw = 600 x 36 = 21600

Chapter 8

Ultrasonic sensor (HC-SR04):-

Specifications:-

- High Accuracy
- Ranging Distance : 2cm – 400 cm
- It offers excellent non-contact range detection
- Power Supply :+5V DC
- Working Current: 15mA

Working:-

- It sends the sound waves in the water tank and detects reflection of sound waves that is ECHO.
- First of all we needs to trigger the ultrasonic sensor module to transmit signal by using Arduino and then wait to receive ECHO.
- Arduino reads the time between triggering and received ECHO.
- Distance= (travel time/2) * speed of sound

Chapter 9

Roller Movement Code/Stepping motors code :-

```
int wire1=8;

int wire2=9;

int wire3=10;

int wire4=11;

int wire5=4;

int wire6=5;

int wire7=6;

int wire8=7;

int a;

int b;



void setup() {

  //Serial.begin(9600);

pinMode(wire1,OUTPUT);

pinMode(wire2,OUTPUT);

pinMode(wire3,OUTPUT);

pinMode(wire4,OUTPUT);

pinMode(wire5,OUTPUT);
```

```
pinMode(wire6,OUTPUT);
pinMode(wire7,OUTPUT);
pinMode(wire8,OUTPUT);
a=1800;
b=5400;

}

void loop() {
  // put your main code here, to run repeatedly:
   for (int i=0;i<b;i++){
digitalWrite(wire5,HIGH);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(2);

digitalWrite(wire5,LOW);
digitalWrite(wire6,HIGH);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(2);
```

```
digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,HIGH);
digitalWrite(wire8,LOW);
delay(2);


digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
digitalWrite(wire8,HIGH);
delay(2);

digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(20);
  }

 for (int i=0;i<b;i++){
digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
```

```
digitalWrite(wire7,LOW);
digitalWrite(wire8,HIGH);
delay(2);

digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,HIGH);
digitalWrite(wire8,LOW);
delay(2);

digitalWrite(wire5,LOW);
digitalWrite(wire6,HIGH);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(2);


digitalWrite(wire5,HIGH);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(2);
```

```
digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(20);
  }

  for (int i=0;i<a;i++){
digitalWrite(wire1,HIGH);
digitalWrite(wire2,LOW);
digitalWrite(wire3,LOW);
digitalWrite(wire4,LOW);
delay(2);

digitalWrite(wire1,LOW);
digitalWrite(wire2,HIGH);
digitalWrite(wire3,LOW);
digitalWrite(wire4,LOW);
delay(2);

digitalWrite(wire1,LOW);
digitalWrite(wire2,LOW);
digitalWrite(wire3,HIGH);
```

```
digitalWrite(wire4,LOW);
delay(2);



digitalWrite(wire1,LOW);
digitalWrite(wire2,LOW);
digitalWrite(wire3,LOW);
digitalWrite(wire4,HIGH);
delay(2);

digitalWrite(wire1,LOW);
digitalWrite(wire2,LOW);
digitalWrite(wire3,LOW);
digitalWrite(wire4,LOW);
delay(20);
  }

  for (int i=0;i<b;i++){
digitalWrite(wire5,HIGH);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(2);
```

```
digitalWrite(wire5,LOW);
digitalWrite(wire6,HIGH);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(2);

digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,HIGH);
digitalWrite(wire8,LOW);
delay(2);


digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
digitalWrite(wire8,HIGH);
delay(2);

digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
```

```
digitalWrite(wire8,LOW);
delay(20);
  }
   for (int i=0;i<b;i++){
digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
digitalWrite(wire8,HIGH);
delay(2);

digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,HIGH);
digitalWrite(wire8,LOW);
delay(2);

digitalWrite(wire5,LOW);
digitalWrite(wire6,HIGH);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(2);
```

```
digitalWrite(wire5,HIGH);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(2);

digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(20);
  }

  for (int i=0;i<a;i++){
digitalWrite(wire1,HIGH);
digitalWrite(wire2,LOW);
digitalWrite(wire3,LOW);
digitalWrite(wire4,LOW);
delay(2);

digitalWrite(wire1,LOW);
digitalWrite(wire2,HIGH);
digitalWrite(wire3,LOW);
```

```
digitalWrite(wire4,LOW);
delay(2);

digitalWrite(wire1,LOW);
digitalWrite(wire2,LOW);
digitalWrite(wire3,HIGH);
digitalWrite(wire4,LOW);
delay(2);


digitalWrite(wire1,LOW);
digitalWrite(wire2,LOW);
digitalWrite(wire3,LOW);
digitalWrite(wire4,HIGH);
delay(2);

digitalWrite(wire1,LOW);
digitalWrite(wire2,LOW);
digitalWrite(wire3,LOW);
digitalWrite(wire4,LOW);
delay(20);
  }
```

```
  for (int i=0;i<b;i++){
digitalWrite(wire5,HIGH);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(2);

digitalWrite(wire5,LOW);
digitalWrite(wire6,HIGH);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(2);

digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,HIGH);
digitalWrite(wire8,LOW);
delay(2);


digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
```

```
digitalWrite(wire8,HIGH);
delay(2);

digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(20);
  }
   for (int i=0;i<b;i++){
digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
digitalWrite(wire8,HIGH);
delay(2);

digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,HIGH);
digitalWrite(wire8,LOW);
delay(2);

digitalWrite(wire5,LOW);
```

```
digitalWrite(wire6,HIGH);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(2);


digitalWrite(wire5,HIGH);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(2);

digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(20);
  }

  for (int i=0;i<a;i++){
digitalWrite(wire1,HIGH);
digitalWrite(wire2,LOW);
digitalWrite(wire3,LOW);
```

```
digitalWrite(wire4,LOW);
delay(2);

digitalWrite(wire1,LOW);
digitalWrite(wire2,HIGH);
digitalWrite(wire3,LOW);
digitalWrite(wire4,LOW);
delay(2);

digitalWrite(wire1,LOW);
digitalWrite(wire2,LOW);
digitalWrite(wire3,HIGH);
digitalWrite(wire4,LOW);
delay(2);


digitalWrite(wire1,LOW);
digitalWrite(wire2,LOW);
digitalWrite(wire3,LOW);
digitalWrite(wire4,HIGH);
delay(2);

digitalWrite(wire1,LOW);
```

```
digitalWrite(wire2,LOW);
digitalWrite(wire3,LOW);
digitalWrite(wire4,LOW);
delay(20);
  }

  for (int i=0;i<b;i++){
digitalWrite(wire5,HIGH);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(2);

digitalWrite(wire5,LOW);
digitalWrite(wire6,HIGH);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(2);

digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,HIGH);
digitalWrite(wire8,LOW);
```

```
delay(2);



digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
digitalWrite(wire8,HIGH);
delay(2);

digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(20);
  }
   for (int i=0;i<b;i++){
digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
digitalWrite(wire8,HIGH);
delay(2);

digitalWrite(wire5,LOW);
```

```
digitalWrite(wire6,LOW);
digitalWrite(wire7,HIGH);
digitalWrite(wire8,LOW);
delay(2);

digitalWrite(wire5,LOW);
digitalWrite(wire6,HIGH);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(2);


digitalWrite(wire5,HIGH);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(2);

digitalWrite(wire5,LOW);
digitalWrite(wire6,LOW);
digitalWrite(wire7,LOW);
digitalWrite(wire8,LOW);
delay(20);
```

```
  }

for (int i=0;i<b;i++){
digitalWrite(wire1,LOW);
digitalWrite(wire2,LOW);
digitalWrite(wire3,LOW);
digitalWrite(wire4,HIGH);
delay(2);

digitalWrite(wire1,LOW);
digitalWrite(wire2,LOW);
digitalWrite(wire3,HIGH);
digitalWrite(wire4,LOW);
delay(2);

digitalWrite(wire1,LOW);
digitalWrite(wire2,HIGH);
digitalWrite(wire3,LOW);
digitalWrite(wire4,LOW);
delay(2);


digitalWrite(wire1,HIGH);
```

```
digitalWrite(wire2,LOW);
digitalWrite(wire3,LOW);
digitalWrite(wire4,LOW);
delay(2);

digitalWrite(wire1,LOW);
digitalWrite(wire2,LOW);
digitalWrite(wire3,LOW);
digitalWrite(wire4,LOW);
delay(20);
  }
  delay(5000);
}
```

Chapter 10

Conclusions:-

The painting robotic system has achieved optimum benefits with regard to reliability, safety appearance, and ease of use. All the objectives set up for this system have been achieved successfully. In terms of mechanical design, A conclusion can be made that the painter robotic system had been successfully created to solve the problem of working in an upright position, which is very troublesome, boring, unhealthy and harmful to a human being if the working period is long.

Chapter 11

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