DESIGN AND FABRICATION OF AUTOMATIC WALL PAINTING MACHINE USING LEAD SCREW

N. Prithiviraj 1 , N. Balakrishnan 2 , K.A.Kirupa 3 , P.Manikandan 4 , N.Naveenraj 5 , R.Parthiban 6

1 Assistant Professor, Mechanical Engg, Gnanamani College of Technology, Anna University, Namakkal - 637018

2 Professor, Head of Mechanical Engg, Gnanamani College of Technology, Anna University, Namakkal – 637018

3, 4, 5, 6 UG Scholar, Engg, Gnanamani College of Technology, Anna University, Namakkal – 637018

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.

Keywords: *Painting, Robot, human painters, difficult and hazardous*

I.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. This automatic wall painting robot is not designed using complicated components. This robot is simple and portable. The robot is designed using few steels, conveyor shaft, spray gun and a controller unit to control the entire operation of the robot. This robot is compact because of high speed and pressure capabilities they have.

They also have a very small weight to power output ratio and predictable performance ie ., losses are minimum due to less number of moving parts and so gives expected performance. Due to elegant and simple control systems it can control noise vibration and does silent operation and no vibration is produced. It has longer life, flexibility and it is efficient and dependable, and the installation is simple and the maintenance is also easy.

Some of the conditions that have to be considered while using this robot is that the system is operates in pneumatics, so it needs air tank or compressor and the electric shock is always there, which makes the machines ugly and dust and dirt are adhering to them. The life of the parts like seals, packing and gaskets etc., are very short but, they are essential to prevent leakage so that the system becomes costlier .The construction of the automatic wall painting robot consists of two main parts.

- Frame stand
- Wheel Building and construction

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The construction of the automatic wall painting robot consists of two main parts. There are

1. Mobile platform
   - Frame stand
   - Wheel
   - DC motor
   - Battery
   - Control unit
2. Spray gun mount
   - IR sensor
   - Solenoid valve
   - Sprocket
   - Flow control valve
   - Spray gun

II.PROPOSED SYSTEM

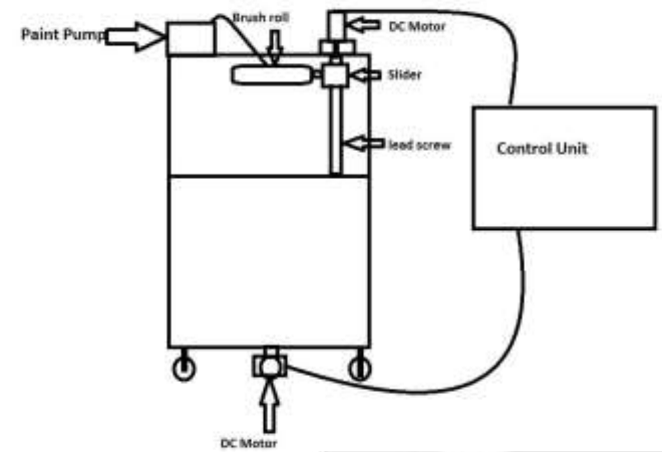

Fig 1 Proposed system

BLOCK DIAGRAM

The AC voltage, typically 220V RMS, is connected to a transformer, which steps that AC voltage down to the level of the desired DC output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a DC voltage. This resulting DC voltage usually has some ripple or AC voltage variation.

A regulator circuit removes the ripples and also remains the same DC value even if the input DC voltage varies, or the load connected to the output DC voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

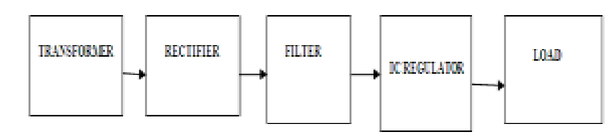

Fig 2 Block Diagram of Power Supply

TRANSFORMER

The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op–amp. The advantages of using a precision rectifier are it will give a peak voltage output as DC, the rest of the circuits will give only RMS output.

BRIDGE RECTIFIER

When four diodes are connected as shown in the figure, the circuit is called as a bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners.

Let us assume that the transformer is working properly and there is a positive potential, at point A and a negative potential at point B. The positive potential at point A will forward bias D3 and reverse bias D4. The negative potential at point B will forward bias D1 and reverse D2. At this time the D3 and D1 are forward biased and will allow current flow to pass through them; D4 and D2 are reverse biased and will block current flow. The path for current flow is from point B through D1, up through RL, through D3, through the secondary of the transformer back to point B. This path is indicated by the solid arrows. Waveforms (1) and (2) can be observed across D1 and D3.One-half cycle later the polarity across the secondary of the transformer reverse, forward biasing D2 and D4 and reverse biasing D1 and D3. The current flow will now be from point A through D4, up through RL, through D2, through the secondary of T1, and back to point A. This path is indicated by the broken arrows. Waveforms (3) and (4) can be observed across D2 and D4. The current flow through RL is always in the same direction. In flowing through RL this current develops a voltage corresponding to that shown waveform (5). Since current flows through the load (RL) during both half cycles of the applied voltage, this bridge rectifier is a full-wave rectifier.

One advantage of a bridge rectifier over a conventional full-wave rectifier is that with a given transformer the bridge rectifier produces a voltage output that is nearly twice that of the conventional full-wave circuit.

This may be shown by assigning values to some of the components shown in views A and B. Assume that the same transformer is used in both circuits.

The peak voltage developed between points X and y is 1000 volts in both circuits. Since only one diode can conduct at any instant, the maximum voltage that can be rectified at any instant is 500 volts. The maximum voltage that appears across the load resistor is nearly-but never exceeds-500 v0lts, as a result of the small voltage drop across the diode. In the bridge rectifier shown in view B, the maximum voltage that can be rectified is the full secondary voltage, which is 1000 volts. Therefore, the peak output voltage across the load resistor is nearly 1000 volts. With both circuits using the same transformer, the bridge rectifier circuit produces a higher output voltage than the conventional full-wave rectifier circuit.

IC VOLTAGE REGULATORS

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustable set voltage. The regulators can be selected for operation with load currents from hundreds of Milli amperes to tens of amperes, corresponding to power ratings from milliwatts to tens of watts. A fixed three-terminal voltage regulator has an unregulated DC input voltage, VI, applied to one input terminal, a regulated DC output voltage, Vo, from a second terminal, with the third terminal connected to ground. The series 78 regulators provide fixed positive regulated voltages from 5 to 24 volts. Similarly, the series 79 regulators provide fixed negative regulated voltages from 5 to 24 volts.

- For IC's, Micro Controller, LCD --------- 5 volts
- For alarm circuit, op-amp, relay circuits ---------- 12 volts

DC MOTOR

Almost every mechanical movement that we see around us is accomplished by an electric motor. Electric machines are a means of converting energy. Motors take electrical energy and produce mechanical energy. Electric motors are used to power hundreds of devices we use in everyday life. Motors come in various sizes. Huge motors that can take loads of 1000's of Horsepower are typically used in the industry. Some examples of large motor applications include elevators, electric trains, hoists, and heavy metal rolling mills. Examples of small motor applications include motors used in automobiles, robots, hand power tools and food blenders. Micro-machines are electric machines with parts the size of red blood cells, and find many applications in medicine. Electric motors are broadly classified into two different categories: DC (Direct Current) and AC (Alternating Current). Within these categories are numerous types, each offering unique abilities that suit them well for specific applications. In most cases, regardless of type, electric motors consist of a stator (stationary field) and a rotor (the rotating field or armature) and operate through the interaction of magnetic flux and electric current to produce rotational speed and torque. DC motors are distinguished by their ability to operate from direct current. There are different kinds of D.C. motors, but they all work on the same principles. In this chapter, we will study their basic principle of operation and their characteristics. It's important to understand motor characteristics so we can choose the right one for our application requirement.

III.LIST OF MATERIALS

FACTORS DETERMINING THE CHOICE OF MATERIALS

The various factors which determine the choice of material are discussed below.

1. **Properties:**

The material selected must posses the necessary properties for the proposed application. The various requirements to be satisfied Can be weight, surface finish, rigidity, ability to withstand environmental attack from chemicals, service life, reliability etc.

The following four types of principle properties of materials decisively affect their selection

a. Physical
b. Mechanical
c. From manufacturing point of view
d. Chemical

The various physical properties concerned are melting point, thermal Conductivity, specific heat, coefficient of thermal expansion, specific gravity, electrical conductivity, magnetic purposes etc.

The various Mechanical properties Concerned are strength in tensile, Compressive shear, bending, torsional and buckling load, fatigue resistance, impact resistance, elastic limit, endurance limit, and modulus of elasticity, hardness, wear resistance and sliding properties.

The various properties concerned from the manufacturing point of view are,

- Cast ability
- Weld ability
- Surface properties
- Shrinkage
- Deep drawing etc.

2. Manufacturing case:

Sometimes the demand for lowest possible manufacturing cost or surface qualities obtainable by the application of suitable coating substances may demand the use of special materials.

3. Quality Required:

This generally affects the manufacturing process and ultimately the material. For example, it would never be desirable to go casting of a less number of components which can be fabricated much more economically by welding or hand forging the steel.

4. Availability of Material:

Some materials may be scarce or in short supply, it then becomes obligatory for the designer to use some other material which though may not be a perfect substitute for the material designed. The delivery of materials and the delivery date of product should also be kept in mind.

5. Space consideration:

Sometimes high strength materials have to be selected because the forces involved are high and space limitations are there.

6. Cost:

As in any other problem, in selection of material the cost of material plays an important part and should not be ignored.

Sometimes factors like scrap utilization, appearance, and non-maintenance of the designed part are involved in the selection of proper materials.

SPECIFICATIONS AND DRAWINGS

1. Solenoid Valve Technical data

Max pressure range : 0-10 x 10^{5} N/m²
Type : 3/2
Quantity : 1
Voltage : 230V A.C
Frequency : 50 Hz
Size : 1/8”

2. Flow control Valve Technical Data

Port size : 0.635 x 10^{-2} m
Pressure : 0-8 x 10^{5} N/m²
Media : Air
Quantity : 1

3. Hose Connectors Technical data

Max working pressure : 10 x 10^{5} N/m²
Temperature : 0-100 º C
Fluid media : Air
Material : Brass
Thread : 1/8”

4. Hoses Technical date

Max pressure : 10 x 10^{5} N/m²
Outer diameter : 6 mm = 6 x 10^{-3}m
Inner diameter : 3.5 mm = 3.5 x 10^{-3}m

Density = Mass/volume=> Mass = Volume∉density

Components & Weight:

1. Base:
-Horizontal Members = 2.3023Kg ∉2= 4.60 Kg =45.126N-Cross Members = 1.438 Kg∉2= 2.877 Kg=28.22N
-Wooden Plate = 0.89 Kg = 8.73 N
Total Weight = 45.126+28.22+8.73= 82.07 N
2. Vertical Channel :
-2 Vertical Channels = 8.70 Kg = 85.347 N
3. Shaft on top of Channel Consisting 2 motors =
0.4436Kg = 4.3517N
4. Guided Pulley:
-Pulley= 0.05386Kg = 0.528 N
5 Moving Platform :
-Air Compressor = 1.5 Kg = 14.715N
-Motor, Sketch Mechanism for Nozzle = 0.2218Kg = 2.1758N
-Wooden plate = 0.145Kg =1.422 N
-Paint Tank = 500 gm = 4.905N
-Aluminum Strip = 0.440 Kg = 4.32N
Total Weight = 14.715+ 2.1758+ 1.422+ 4.905+ 4.32= 27.53 N
Total Weight = 82.07 + 85.347+ 4.3517+ 0.528+ 27.53= 199.826
N⊐200 N

MERITS
- Cost of production is low
- No need to purchase heavy machinery
- Reduces threat to human life
- Manual assistance is not required

DEMERITS
- Rust
- Motor Control high cost

APPLICATIONS
- Industrial Usage
- Domestic Wall Painting

CONCLUSION

Automatically paint the wall of given dimension has been designed and implemented. The approach uses IR transmitter and IR receiver to detect the presence of wall. The microcontroller unit to control the movement of the DC motor. The robot eliminates the hazards caused due to the painting chemicals to the human painters such as eye and respiratory system problems and also the nature of painting procedure that requires repeated work and hand rising makes it boring, time and effort consuming. The robot is cost effective, reduces work force for human workers, reduces time consumption. The pitfall of the project is that the robot continues painting even after the end of the wall hence it can be over come by adding some indicating objects such as buzzers. In the future the painting robot can be enhanced by using image processing in order to scan the objects and obstacles that are present in the wall so that those objects can be automatically omitted while painting.

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