IJFEAT

INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

SEMI-AUTOMATIC WALL PAINTING ROBOT.

[1]Doshi Gaurav,[2]Khan Farhan,[3]Golande Shrikant,[4]Dhumal Rushikesh,[5]Prof N.N.More

[1]*Student, Department of Mechanical Engg, SKNSITS Lonavala, Maharashtra, India,**gauravdoshi5@gmail.com***
[2]*Student, Department of Mechanical Engg, SKNSITS Lonavala, Maharashtra, India **fnkhan.khan2@gmail.com***
[3]*Student, Department of Mechanical Engg, SKNSITS Lonavala, Maharashtra, India , **shrikantgolande12@gmail.com***
[4]*Student, Department of Mechanical Engg, SKNSITS Lonavala, Maharashtra, India, **rushikeshdhumal96@gmail.com***
[5]*Assitant Professor,Department of Mechanical Engg, SKNSITS Lonavala, Maharashtra, India,*
nnmore.sknsits@sinhgad.edu

Abstract

The primary aim of the project is to design, develop and implement Semi-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. In this project the painting is possible in vertical as well as horizontal direction. The both movements are achieved by motor drive.

Key Words: *ArduinoRobot, Manipulator, etc.*

---------- *** ----------

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 labours in the construction industry are not sufficient. This insufficient labours 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 labour 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.

This Semi-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.

1.1 History of Robot

Computer controlled industrial machine tools such as CNC falls into the robot category and can be defined as a robot as well but in some people resist to call CNC as robot and are defined as CNC machines only. (John J. Craig, 1989) Robots are primarily concerned with generating specific motion of the robot joints, simultaneously allowing tooling or sensors to perform certain functions, either when the arm is moving or at specific operational configurations. The arm and attached tooling may perform the operations themselves (such as painting) or carry parts to other devices which perform the operations.

Newer technologies are concerned with robot interactions with parts such that interaction forces and torques can be controlled. This technology will permit more robot applications in assembly, which promises to be a growing application arena for robotics.

1.2Fundamentals of Robot

A workspace of a robot is a three dimensional collection of points which the wrist of the robot can reach. However, when the joints corresponding to the three major axes have different combinations, the robot work-space is different. Therefore the classification of industrial robot manipulator is often done to the first three joints corresponding to the major axes, though there are many other classification method based on control manners, application, and kinematic structural.
(Articulated Robot, Spherical Robot, Rectangular Robot)

2. Problem Definition

Generally the existing system which are used for wall painting are very expensive, costly and mostly industrial one. These are not accurate enough for full-proof use for wall painting. Hence we aim of developing a system that can be used at personal level, manipulate automatically, can be more accurate and can give the desired output

Table-1: Components with Specifications.

Components	Power Supply	Specification
Arduino microcontroller	5V DC	8 bit 16 MHz
Relay circuit	12V DC	
Servo motors (JHONSONS)	12V DC	60 rpm 10 rpm
Transistors	12V DC	BC547 series
L.C.D	12V DC	16X2 series
Resistors	12V DC	1kΩ

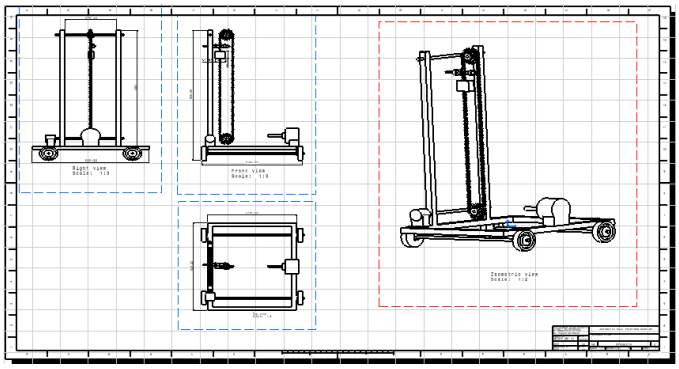

Fig-1: Semi-Automatic Wall Painting Robot

3. Components Used:-

Frame Stand and Wheel:-

The frame stand is the steel welded in such a way that it can carry the whole equipment. The steels are welded strongly in welding laboratory with an idea to carry the entire robot with the control unit, battery and DC motor in the mobile platform and the solenoid valve and spray gun in the roller shaft .Four wheels are attached to the frame stand in order to move the robot in the direction specified. The movement of these wheels are controlled by the DC motor rotation which is controlled by the microcontroller.

It is obvious that if either the movement of front or back wheels are controlled automatically the movement of the other one will be controlled. Therefore, in this robot the movement of the back wheels are controlled using the DC motor such that the movement of entire robot is controlled.

DC motor:-

DC motors are part of the electric motors using DC power as energy source. These devices transform electrical energy into mechanical energy. The basic principle of DC motors is same as electric motors in general, the magnetic interaction between the rotor and the stator that will generate spin. DC motors are widely used in speed and direction control because control of these motors are easier than other motors. The motion of a DC motor is controlled using a DC drive. DC drive changes the speed and direction of motion of the motor. Some of the DC drives are just a rectifier with a series resistor that converts standard AC supply into DC and gives it to the motor through a switch and a series resistor to change the speed and direction of rotation of the motor. But many of the DC drives have an inbuilt microcontroller that provides programmable facilities, message display on LCD, precise control and also protection for motors.

Bearings:-

A bearing is a machine element that constrains relative motion between moving parts to only the desired motion. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis; or, it may prevent a motion by controlling the vectors of normal forces that bear on the moving parts. Bearings are classified broadly according to the type of operation, the motions allowed, or to the directions of the loads (forces) applied to the parts.

Chain Sprocket:-

A sprocket or sprocket-wheel is a profiled wheel with teeth, cogs, or even sprockets that mesh with a chain, track or other perforated or indented material. The name 'sprocket' applies generally to any wheel upon which radial projections engage a chain passing over it. It is distinguished from a gear in that sprockets are never meshed together directly, and differs from a pulley in that sprockets have teeth and pulleys are smooth.

Sprockets are used in bicycles, motorcycles, cars, tracked vehicles, and other machinery either to transmit rotary motion between two shafts where gears are unsuitable or to impart linear motion to a track, tape etc. Perhaps the most common form of sprocket may be found in the bicycle, in which the pedal shaft carries a large sprocket-wheel, which drives a chain, which, in turn, drives a small sprocket on the axle of the rear wheel . Early automobiles were also largely driven by

sprocket and chain mechanism, a practice largely copied from bicycles.

Sprockets are of various designs, a maximum of efficiency being claimed for each by its originator. Sprockets typically do not have a flange. Some sprockets used with timing belts have flanges to keep the timing belt centered. Sprockets and chains are also used for power transmission from one shaft to another where slippage is not admissible, sprocket chains being used instead of belts or ropes and sprocket-wheels instead of pulleys. They can be run at high speed and some forms of chain are so constructed as to be noiseless even at high speed.

Chain Drive

Chain drive is a way of transmitting mechanical power from one place to another. It is often used to convey power to the wheels of a vehicle, particularly bicycles and motorcycles. It is also used in a wide variety of machines besides vehicles.

Most often, the power is conveyed by a roller chain, known as the drive chain or transmission chain, passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. The gear is turned, and this pulls the chain putting mechanical force into the system.

Calculations

Chain design

Chain -06 B

Pitch -9.525mm

i) Roller diameter,d1=6.35 mm

Width' b1=5.72 mm

Transverse pitch p_t=54.85 mm

z1=18

z2=18

ii) Approximate centre distance,

As the stroke length of one spray is decided as 750mm.

Centre distance, a = 750 mm

iii) No of links,

$$L_n=2(a/p)+\frac{z1+z2}{2}+\left(\frac{z1-z2)}{2\pi}\right)*\left(\frac{p}{a}\right)$$

$$=2(750/9.525)+\frac{18+18}{2}+0$$

=175.48 = 176

Design of sprocket

Used chain no.06B

For Z=18

From table no 14.1

Pitch, P=9.525

Width between inner plates, b1=5.72

Roller diameter, d1=6.35

Transverse pitch p_t=10.24

i)pitch circle diameter

$$D=\frac{p}{\sin(180/z)}$$

$$=\frac{9.525}{\sin(180/18)}$$

= 54.85 mm

ii)Top diameter (D_a)

$(D_{a)max}$ =D+1.25p-d1

=54.85+1.25*9.525-6.35

=60.4 mm

iii)Root diameter ,

D_f =D-2r_1

But roller seating radius (r1)

$$(r1)_{max}=0.505d1+0.069\sqrt[3]{d1}$$

$$= 0.505*6.35+0.069\sqrt[3]{6.35}$$

= 3.33 mm

D_f=D-2r1

=54.85-2*3.33

=48.19mm

iv) Tooth flank radius

$$(r_e)_{max} = 0.008d1(Z^2+180)$$

$$= 0.008*6.35\ (18^2+180)$$

= 25.6 mm

$$(r_{e)min} = 0.12d1(Z+2)$$

$$= 0.12*6.35\ (18+2)$$

=15.24

v) Roller seating angle

$(\acute{\alpha})_{max}$=(120-90/Z)

=(120-90/18)

=115

$(\acute{\alpha})_{min}$=(140-90/Z)

=140-90/18

=135

vi) Tooth height above the pitch polygon

(h_a)max=0.625 p-0.5d1+0.8p/Z

=0.625*9.525-0.5*6.35+0.8*9.525/18

=3.2 mm

(h_a)min=0.5(p-d1)

=0.5(9.525-6.35)

=1.58 mm

vii) Tooth side radius (r_x)=p

viii) Tooth width bf1=0.95b1

=0.95*5.72

=5.434 mm

ix) Tooth side relief (ba) =0.1p

=0.1*9.525

=0.9525 mm

Advantages

a) High consistency
b) Better productivity
c) Increased labours safety
d) Less power consumption
e) Minimizes the use of paint.
f) Painting is easier in both directions.

Disadvantages

a) High initial investment

b) The operator needs to have basic knowledge of the system

4. 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 overcomed 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.

REFERENCES

[1] P. Keerthanaa, K. Jeevitha, V. Navina, G. Indira and S. Jayamani, "Automatic Wall Painting Robot", International Journal of Innovative Research in Science, Engineering and Technology, ISSN: 2319-8753, Vol. 2, Issue 7, July 2013, PP 3009-3023.

[2] AndhaleSatish, Ansari Md. Aiman, AshtekarKeshav, AsnewarSwapnil, Prof.Sonawane D. P. and Prof.Bhane A. B., "Automatic Wall Painting Using Lead Screws", International Journal of Emerging Technology and Advanced Engineering, ISSN 2250-2459, Volume 6, Issue 3, March 2016, PP 297-301.

[3] Mohamed Abdellatif, "Design of an Autonomous Wall Painting Robot", Mechatronics and Robotics Dept. Egypt-Japan University of Science and Technology, Alexandria, Egypt, Conference Paper: August 2012, Published in Research Gate, PP 1-7.

[4] Prof. Dinesh B. Shinde, Sanket D. Ingole and Rohit P. Gomase, "Design & Fabrication of Remote Operated 3-Axis Spray Painting Machine", International Journal of Advance Research and Innovative Ideas in Education, ISSN(O)-2395-4396, Vol. 2, Issue 2, 2016, PP 1263-1268