Automatic Wall Painting Robot

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Abstract:
The primary aim of the project is to design, develop and implement Automatic Wall Painting machine 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 machines are properly integrated in building tasks, the whole construction process can be better managed and savings in human labor 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: Building automation; Robotics; Construction; Spray Painting; Safety

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 riskier 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 are 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.

II. LITERATURE REVIEW

Mohamed Abdellatif, Here the author described the working of the autonomous wall painting robot. The conceptual design of a movable painting robot is used for painting interior walls of residential building. The robot uses roller fed with liquid paint and keeps contact with the wall surface. The robot enables the roller to scan vertically as well as horizontally to the painted walls. The robot can maneuver to adjust itself in front of the wall.

S.m.s.Elattar, In this paper they explained that the workers cannot manage robotic arrangement for higher efficiency so the rise of the such process had been made which is affordable, give better accuracy,

Naticchia, A. Giretti, A. Carbonari, the authors have shared that construction of Wall-Surface Operation Robot. plan to automate and increase the efficiency a series of restoration they plan to automate and increase the works by cleaning task. For the picture painting tile separation is done with single and multi-color

III. METHODOLOGY

The construction of Paint Spraying equipment consists of a frame which is used for mounting the components such as D.C motor, Battery, solenoid valves, flow control valve and spur gear arrangement. The stand or base is to carry the whole machine. The whole experimental setup is shown in Fig 1. The machine is run with the help of spur gear mechanism. This total arrangement is to paint the wall continuously along the length and height.

Figure.1.

The movement is controlled through dc motors with the help of Arduino board. Ultrasonic sensors transmit the ultrasonic wave and from the response the movement is been controlled. The compressor with the tank is connected to the AC supply which

provides the air supply, which support spray painting. The paint is stored in the spray gun. A battery is provided for DC Supply to the relay unit and for the working of Arduino board. As the machine switched on, the compressor provides the pumping action and the ultrasonic sensors detect the presence of the wall and starts painting. Once the region had been painted, a manual switch is provided which lowers the spray gun setup. Painting speed can be accordingly adjusted through the knob.

IV. RESULTS AND DISCUSSION

An exterior wall painting robot is modelled and fabricated DC geared motors are used. Apart from that it is controlled by Arduino Uno using GUI. Based on the development and experimental investigations the following results are discussed.

Ultrasonic Sensor Results
The output for the ultrasonic sensor at normal condition. Since the relay operates at 12V, a 12V supply is given from the battery shows the result of Ultrasonic sensor at the presence of wall. When the robot is at certain distance from the wall it can sense the wall and the LED glows to indicate it. Solenoid valve senses these results.

Microcontroller Unit Results
The moving distance and painting distance input. For the robot to start painting the start button has to be pressed. The robot continues to paint till the wall ends by having painting distance as its breadth of the wall.

Experimental Investigation
REDUCTION RATIO/VELOCITY
No of teeth in driving gear =14
No of teeth in driven gear =71
Reduction Ratio -1:5
Speed reduction 1. 2500-500
             2. 500-100
 Stage 3
No of teeth in driving gear =14
No of teeth in driven gear =84
Reduction Ratio -1:6
Speed Reduction 3. 100-16.6
Velocity of machine $V=r*w=0.089*[(2*3.14*16.60)/60]$ $=0.149$ m/s
SPRAYGUN
Capacity of the gun : 350 ml = volume
Assume 100 micron film thickness
Volume = area * thickness
1 ltr = 1000 cc = 1000000 cubic mm
100 microns = 0.1 mm
Area = 1000000/0.1=10000000 sq mm
Area =10 sq meter
Ie 1 ltr can be used for painting 10 sq meter
350 ml can paint 3.5 sq m of area

HERMITICALLY SEALED COMPRESSOR [AC 220 V SUPPLY]
Bore diameter of compressor = 20 mm
Stroke length = 22 mm
Clearance length = 6.5 mm
Swept volume = $3.14/4*(20*10^{-3})^{2*22*10^{\wedge}-3}$
           $=6.91*10^{-6}$ m^3
Clearance volume = $3.14/4*(20*10^{\wedge}-3)^2*6.5*10^{\wedge}-3$

$=2.042*10^{-6}$ m^3
Compression ratio = clearance volume/ swept volume
        $=2.042*10^{-6}/6.91*10^{-6} =0.295$
Compression ratio = inlet pressure/outlet pressure
Inlet pressure (Pi)= 1 Atm = 1.013*10^5 Pa
        =1.013*10^5 N/m^2
Outlet pressure (Po)= 3.4 * 10^5 N/m^2

STORAGE TANK
Diameter of the storage tank = 86*10^{-3} m
Length = 40*10^{-2} m
Volume of tank = 2.32*10^{-3} m^3

BATTERY SPECIFICATION
Battery type: Lead Acid
Output Voltage =12 v
Output Current =40 A/hr.
Required current = 10+10+0.023^{-3}=20.000023 A
Discharge Period of battery = 2hrs

V. CONCLUSION

Automatically paint the wall of given dimension has been designed and implemented. The approach uses ultrasonic transmitter and Ultrasonic 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 overcome 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. An exterior wall painting robot is fabricated it is controlled by Arduino Uno using GUI. Based on the development and experimental investigations following points are summarized:

- Motion simulation is carried out for the exact dimensions of the components.
- As high torque motors will have more vibrations, geared motors are fixed on the ground rather than fixing on the robot itself which leads to reduction in vibrations while operation.
- When pump is switched off paint will not flow back into the container from the roller as the paint in the hose pipe will be seized by the pump which makes the paint to flow immediately for the next location.
- Hazard to human is eliminated as there is no need of painter to be hanged on wall.
- Low cost controller, Arduino Uno is utilized in order to control the robot.

VI. FUTURE SCOPE

Sensors can be used to measure the vibrations inside the robot
Frame can be re-designed in order to cover corners of the wall
Painting application can be extended for cleaning by replacing

roller with the wiper Multi-color based painting can be integrated Encoders can be fixed at the motors to position the robot accurately at desired location. With the higher supporting column, robot can be used for painting an even larger section of wall. The automatic painting robot is thus useful in applying the first coat of paint on the wall (primer) where uniformity is not the main constraint. The robot can be used for painting all sorts of wall surfaces, as it does not involve actual contact with the wall surface. Also with better precision control over the quality of painting, the robot can be used in industry along production lines, for object spray painting. A distinct but possible application can be to water the plants along a stretch of road. The pain in the container will then have to be replaced with water.

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