

Man Free Wall Painting Robot

Sonali Patil¹, Mayuri Khobragade², Rishuja Khobragade³, Shital Nikose⁴, Hanumanta Banjare⁵, Abhijit Wahane⁶, Prof. Mr. Prashant Rahate⁷

^{1,2,3,4,5,6} Student, Department of Mechanical Engineering, NIT Polytechnic, Nagpur, Maharashtra, India

⁷ Assistant Professor, Mechanical Department, NIT Polytechnic, Nagpur, Maharashtra, India

Abstract- Nowadays robots are widely used in many applications such as military, medical application, factories, entertainment, automobile industries etc. However, the application of robot is still not widely implemented in construction industry. In construction industry, robots are designed to increase speed and improve the accuracy of construction field operations. The painting chemicals can cause hazards to the human painters such as eye and respiratory system problems. 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 chance to eliminate or remove human infection, 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.

Index terms- Automation, Wall Painting Robot, Construction, Spray Painting, Safety

1. INTRODUCTION

In spite of the advances in the robotics and its wide spreading applications, painting also considered to be the difficult process as it also has to paint the whole building.[1] Also 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 labour 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.[2] It can also be used to do hazardous and dangerous jobs in construction. For example, currently house painting is done manually. This process can be simplified using a special dedicated robot. It is very difficult and trouble some for human being to work in an upright

position, especially for painting and cleaning in the ceiling for a long time. Painting in an upright position is also very dangerous for the eyes. To overcome this difficulty, a wall painting robot system is proposed, designed and developed. The testing results indicate that the performance of the painter robot is better compared with that of using manual painting technique. This project aims to develop the interior and exterior 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 Frame, Motor, spray and a controller unit to control the entire operation of the robot. They have medium weight and expected performance. Due to 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. The development of service robots became popular recently due to the fact that the society needs robots to relax humans from tedious and dangerous jobs. In Egypt, as well as other developing countries, the increasing population stimulates the construction-related activities such as interior finishing and painting. Painting is classically done by humans and generally requires exhaustive physical efforts and involves exposure to dangerous chemicals. Chemicals can seriously impair the vision, respiratory system and general health of the human painter. These factors make painting an ideal candidate process for automation.[1] Now days for painting purpose we required more labours so those painting work get costly. This automatic painting robot will reduce human exposure to difficult and hazardous environment which will solve most of problems connected with safety.

OBJECTIVE OF PROJECT

The actual targets for development of the wall Painting robot, in order to solve the for mentioned situation, were set as follows:

- To make robot structure simple to enable easy mounting as well as for safety.
- To perform only painting in a single colour.
- To avoid hazard effect of paint on human body.
- The Painting Section is limited in height.
- Accurate and Smooth Painting.
- To minimize time requirement for painting work.

2. LITERATURE REVIEW

Kundan Jawale et. al. [1] In this paper author describe the Design and Development of a Wall Painting Robot for the Houses Wall. The painter 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, the X-axis, the Y-axis, the Z-axis module and the end-effectors module were designed and fabricated properly. 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.

P. Keerthana et. al. [2] In this paper author describe the Automatic Wall Painting Robot. 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. 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.

Chavan shubham balasaheb et. al. [3] In this paper author describe the Automatic Wall Painting Robot. The painter robotic system has achieved optimum benefits with regard to reliability, safety appearance, and ease of use. In terms of software development, the author had written a control program for the painter robot. This was indicated by the performance of the painter robot. Each movement of the painter robot was successfully controlled by the control

program. It can be reprogrammed easily to cope with any changes in the process. A conclusion can be made that the painter robotic system had been successfully.

3. BLOCK DAIGRAM

The block diagram gives a brief idea about various important parts of the wall painting robot. Here the important parts of the robot are controller, motor, battery, sprayer, micro controller. Micro controller is brain of the robot which will control the entire system. Battery is the power supply for the system. Four motors are used to motion of automatic wall painting robot and one motor is used to the movement of spray.

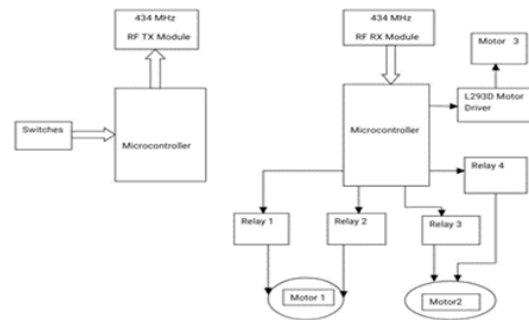


Fig. No. 3.1 Block Diagram of wall Painting Robot

Above block diagram shows that remote control section consists of microcontroller with RF Tx module. Switches which are associated with different function are interfaced with microcontroller. Microcontroller sends the serial data through RF 434 MHz module. The transmitter module takes serial input and transmits these signals through RF. On the other side receiving end RF module receives the signal from transmitting end and sends data serially to the microcontroller. ATmega32 microcontroller is used in both sides. Receiving end microcontroller operate four 12V DC relay which are associated with machine's forward, reverse, left and right motion. Four relay are responsible for two DC motor which are associated with machine's movement. Wall painting mechanisms drive by DC motor. For this we should have to run DC motor in both clockwise and anticlockwise direction. For this we use motor driver IC L293D. Microcontroller drives DC motor in both directions using L293D motor driver IC. Microcontroller send control signal to the L293D IC and IC drive DC motor in both direction.

4. COMPONENT DESCRIPTIONS

1. Frame stand:

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.



Fig. No. 4.1 Frame Stand

2. Wheel:

Four wheels are attached to the frame stand in order to move the robot in the direction specified. The movements of these wheels are controlled by the DC motor rotation which is controlled by the microcontroller. Since it is obvious that if either the movement of front or back wheels is controlled automatically the movement of the other one will be controlled. Therefore, in this robot the movements of the back wheels are controlled using the DC motor such that the movement of entire robot is controlled.

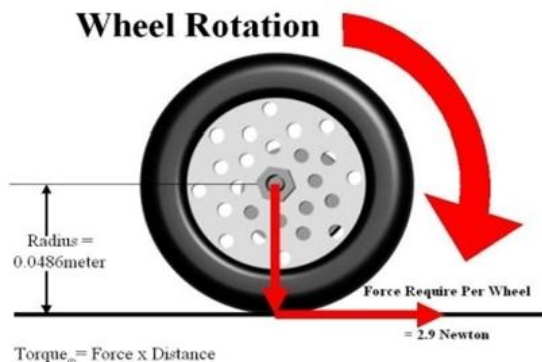


Fig. No. 4.2 Wheel

3. 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.



Fig. No. 4.3 Motor

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.

4. Battery:

In order to provide supply to the controller unit battery is used. Lead acid battery is used in this project. The lead-acid battery is a rechargeable battery. Despite having a very low energy-to-weight ratio and a low energy-to volume ratio, their ability to supply high surge current means that the cells maintain a relatively large power-to-weight ratio. These features, along with their low cost, make them attractive for use in motor vehicles to provide the high current required by automobile starter motors.



Fig. No. 4.4 Battery

5. Printed Circuit Board:

Printed Circuit Board (PCB) is used to mechanically support and electrically connect electronic components using conductive path ways, tracks or signal traces etched from copper sheet laminated on to a non-conductive substrate.

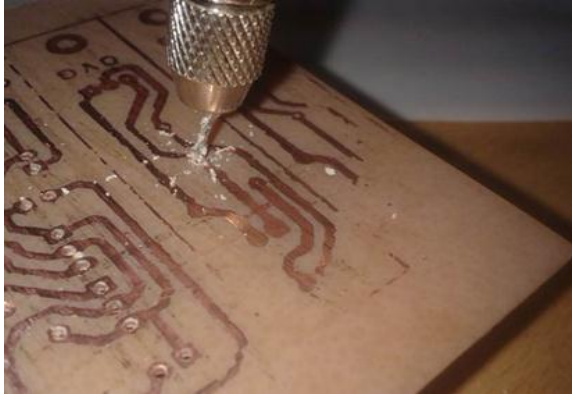


Fig. No. 4.5 Printed Circuit Board (PCB)

6. Drum and Rope:

Drum are the means by which powers transmitted to the rope and thence to the object to be moved for the rope to pick up this power efficiently and to transmit it properly to the working end. Installation must be carefully controlled.

7. Spray:

Spray painting is a painting technique where a device sprays a coating (paint, ink, varnish, etc.) through the air onto a surface. The most common types employ compressed gas usually air to atomize and direct the paint particles.

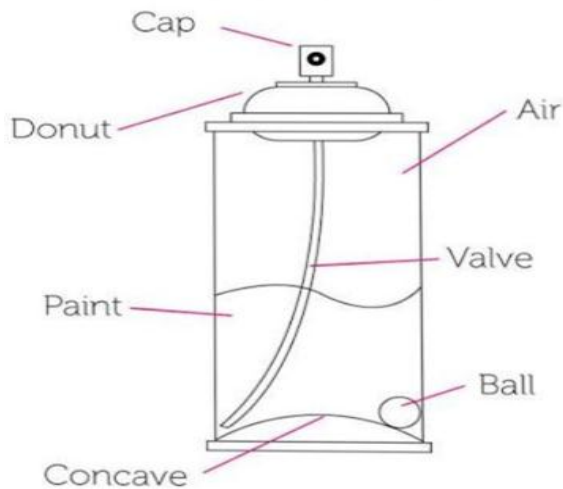


Fig. No. 4.7 Spray

8. Control Unit:

The controller unit is used to control the DC motors and the movement of spray fitted on the channel. Controller unit is provided with the 12V signal and as soon as the supply is ON. The controller sets to setting mode and the moving and painting distance

are given as input to the controller. The controller controls the rotation of DC motor based on the distances given in order to control the wheel and rope movement. When receiver receives the signal, the rope moves and the spray move in up and down position. It contains relays for the control of forward and backward movement of the DC motors.

9. Microcontroller:

The 12V signal from the battery is given to the power supply unit where it gets regulated to 5V. The 5V signal is given to the microcontroller unit. Once the supply is ON, LED gets initialized. The microcontroller sets to setting mode and the moving and painting distance is given as input to microcontroller.

10. Electrical and Electronic System:

There are main parts in the electrical and electronic system of the painter robot. They are: the power supply module, the RF TX module, the Regulator IC, Diodes, Resistors, Capacitors, Relay, ATmega 328 microcontroller, transmitter and receiver, motor drive system, and a control panel. A proper distribution of power supply is required to activate the components of the system. The AC and DC voltage are supplied and distributed as depicted



Fig. No. 4.10 Electrical and Electronic system

Normally, a 12-volt direct current is required for most of the electrical and electronics components. In this project a commercial switching power supply unit is used to convert the AC voltage from the mains source to a 12-volt DC source. The 12-volt convert

to the 5-volt by using of regulator IC and Filter. The 5-volt DC output is distributed to activate the main controller, the limit switches, the start/stop button, the indication light and the motor-driven relay.

5. ACTUAL MODEL



Fig. No. 5.1 Actual Model of Man Free Wall Painting Robot

6. CONSTRUCTION AND WORKING

The construction of Paint Spraying equipment consists of a frame which is used for mounting the components such as D.C motor, Battery, microcontroller setup, control unit and electrical and electronics system. The stand or base is to carry the whole robot. The whole experimental setup is shown in Fig. No. 5.1 i.e. actual model of Wall painting robot. The spray is fixed to the channel and that spray moves in up and down through rope and drum arrangement. Manually start the spray by nut and bolt arrangement. Transmitter and Receiver is used to operate the whole robot movement by switches. This high pass filter is used to eliminate the high frequency signal due to external unwanted signal. In our circuit simple R-C high pass filter circuit is used. The 12V signal from the battery is given to the power supply unit where it gets regulated to 5V through regulator IC. The 5V signal is given to the microcontroller unit. Once the supply is ON, LED gets initialized (On). The microcontroller sets to setting mode and the moving and painting distance is given as input to microcontroller. The microcontroller (by using microcontroller program) and four relay are responsible for two DC Motor which are associated with robot movement. Wall painting mechanism drive by DC Motor. Switches which are associated with different function are interfaced with microcontroller. Microcontroller sends the serial data through RF 434 MHz module. The transmitter module takes serial input and transmits these signals through RF. On the other side receiving end RF module receives the signal from transmitting end and sends data serially to the microcontroller. ATmega32 microcontroller is used in both sides. Receiving end microcontroller operate four 12V DC relay which are associated with machine's forward , reverse ,left and right motion and also spray is moves in up and down motion and painting operation is continues. The steels welded together to carry the entire robot is considered to be the platform which is fitted with four wheels for the movement of robot.

7. CONCLUSION

The design of man free wall painting robot to be used for painting interior and exterior walls of building. The robot is cost effective, reduces work force for human workers, reduce time consumption. This

project is that robot continues painting. The Man Free Wall Painting Robot is achieved the all objectives successfully. Each movement of the painting robot was successfully controlled by the control program. It can reprogrammed easily to cope with any changes in the process. A conclusion can be made that the painting robot 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.

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