Journal of Science and Technology
ISSN: 2456-5660 Volume 06,Special Issue 01, August 2021,

www.jst.org.in *DOI: https://doi.org/10.46243/jst.2021.v6.i04.pp580-585*

Automatic Exterior Wall Painting Machine

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To Cite this Article

Goutam Pise and Kunal Wankhade, "Automatic Exterior Wall Painting Machine", Journal of Science and Technology, Vol. 04, Issue 04, July-August 2019, pp.:580-585.

Article Info

Received: 25-06-2019 *Revised: 10-06-2019* *Accepted: 14-06-2019* *Published: 18-06-2019*

Abstract: In today's world, robots are under various applications such as national defense, medical industry, automobile sector etc. But if construction industries are considered then in that industries robots are not used. The robots are used to increase the efficiency and reduce the time in all the fields. It can also be used to do hazardous and dangerous jobs in any field. Now a days, the wall painting is carried out manually. This process can be automated by using robot. It is a difficult task to paint the wall. So, to overcome this difficulty we are manufacturing of exterior wall painting robot which is help to reduce accidents as well as increase accuracy. The components of our project are decided. The 3d model will be drawn with the help of Catia software. All the components are manufactured and then assembled together. The experimental testing will be carried out after the final assembly will be done. The result and conclusion will be drawn after the experimental testing. The painting chemicals could provide hazards to the human painters such as vision and respiratory system problems. Also, the procedure of painting that requires repeated work and hand movement makes it boring, time and effort consuming. When construction labors and robots are properly implemented in building tasks, the entire construction process can be efficiently managed and savings in human effort and time are obtained as a result. The automatic exterior wall painting machine has been design manufactured for painting walls efficiently. It saves human power and time as well as labor cost. It gives the facility to reduce human exposure to hazardous environment.

Key Words: Painting robot, automatic system, robotics, painting machine

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. To make this work easier and safer and also to reduce the number of labors, automation in painting was introduced. 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 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. This project aims to develop the exterior wall painting robot. This automatic exterior 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, gaskets etc., are very short but, they are essential to prevent leakage so that the system becomes costlier. 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. Before literature survey we have the concept design and idea so we just want to confirm and check that our design is unique and realistic and cost-effective. So in "AUTOMATIC WALL PAINTING ROBOT" by P.Keerthanaa , K.Jeevitha, V.Navina ,G.Indira , S.Jayamani. Their design is can implement only in indoor but our design is can implement for external wall painting and their wall painting Robot is have height limitation difficult to transport because they use Gear chain mechanism because of that it's needs support pole(bar). So, we don't have height limitation and easy to transport. and in "Development of an Exterior Wall Painting Robot Capable of Painting Walls with Indentations and Protrusions" by Shin Terauchi, Toshikazu Miyajima, Takezo Miyamoto, Kazuhiko Arai and Seiichiro Takizawa. They use crane that is so expensive for building like 3 to 10 floors and needs skilled workers and time consuming and difficult to transport. So in our case we didn't need skilled workers and easy to install easy to transport.

II. Literature Survey

[1] "DEVELOPMENT OF WALL PAINTING ROBOT" by Takuya Gokyu, Masayuki Takasu, Sumio Fukuda Tokyu Construction Co. Ltd. Wall painting as well as inspection works for structures, so far, have been performed manually through use of scaffolds or gondolas provisionally built all around the subject wall, which, therefore, having raised many problems such as high personal risks, unclean work environments, etc. The wall painting robot developed this time can perform, as moving attracted on a wall as being pre-programmed, not only general type of coating in a single color through use of spray guns mounted on the arm but also picture painting in multiple colors based on picture data incorporated in the robot controlling computer. No.2model, an improved type of the above, can perform not only the original functions but also various other works on a wall such as wall cleaning and tile separation sensing through changing of an attachment. As this system is easy in handling, it is applicable to various works for a wide range of structures without limiting work subjects. Wall painting, conventionally, has been carried out by human hands-on scaffolds provisionally built around a subject wall. This, however, not only is a kind of work performed on dangerous elevated spots and in unclean environment but also requires extra work to take down the scaffolds, thus often making it difficult to shorten a construction term or to reduce cost. There were some robots available on the market which were, however, able to perform painting in a single-color. Few of them had wide applicability and their use was rather limited depending on a structure applied. Further, prior to drawing of a picture, a rough sketch needs to be prepared on a wall, taking much time for drawing the original picture as being enlarged. Wall-Surface Operation Robot (No.2 Machine) aims to automate and improve in efficiency a series of renewal works by adding, through changing of an attachment, new functions for cleaning, tile separation sensing and repair work to the original functions of picture painting in a single and multiple colors. The inspection of this example was conducted as a periodic inspection of the10th year for the office building concerned. And, high marketability is expected because of existence of many similar structures. In future, we would like to expand applications of Wall-Surface Operation Robot, not limiting to outer walls of a structure, even to civil structures like dams and bridge piers.

[2] "AUTOMATIC WALL PAINTING ROBOT" by P.Keerthanaa & team. 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 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. 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 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. 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 is not as prestigious as the other jobs.

[3] "AUTOMATIC WALL PAINTING ROBOT" by Chavan Shubham 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

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III. Construction and Working

This is the CATIA screen shot of our project in which we wanted to show the conceptual design of our project which show the real-life implementation of project how the robot climb the wall of multi store buildings. In which yellow wire use for the movement of the robot, through green pipe paint is provided to the nozzel for sparing on the wall of the buildings. on top of robot there is a storage tank used to store the paint. Roller attached to the robot for maintain the specific amount of distance from the wall and the sparing nozzle.

The reciprocating movement of spraying machine is achieved by motor providing the torque to the bottom axle and eventually to the belts attached to the spraying machine (Belt conveyor). The machine will spray the paint which could be water/oil based. Submersible pump provided in the paint tank will maintain pressure as well as discharge of the paint.

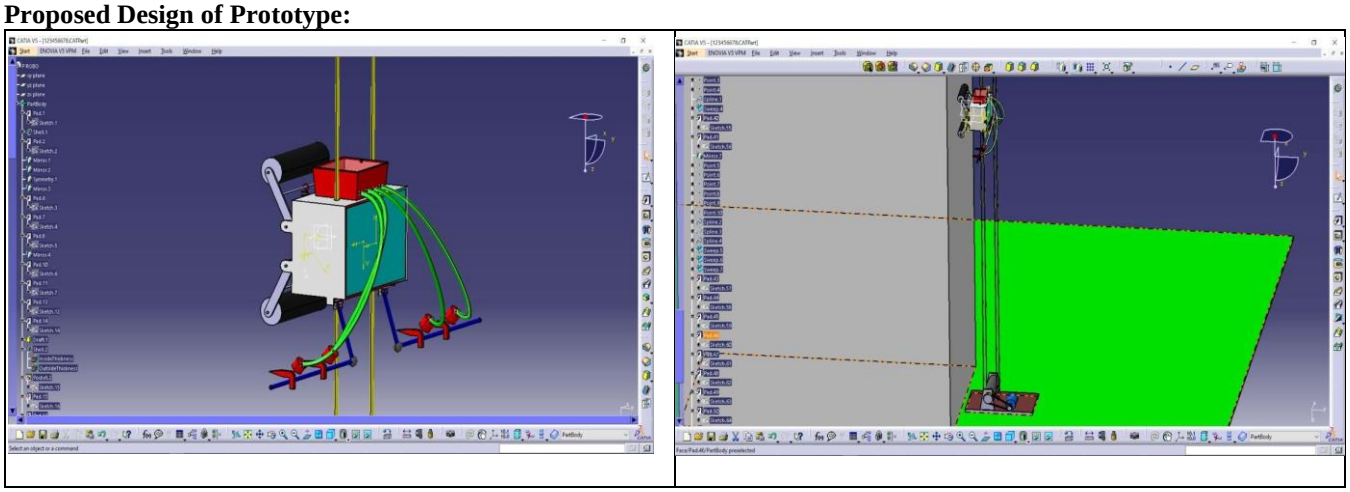
Acrylic (water-based) **wall paint** is the best choice for **outside walls**. This **kind of paint** helps to make the **wall** waterproof, and at the same time it allows moisture that is already in the **wall** to evaporate to the **outside**.

s a general rule, **1 litre of paint** will **cover** between 6 and 6.5 metres squared of wall

- Cover an 8 ft. x 10 ft. wall in 5 minutes or less

The average person will spend 10 minutes **painting** for every **100 square feet** of room. However, the entire process, including prep work and drying time, can **take** 2-3 days

Proposed Design of Prototype:



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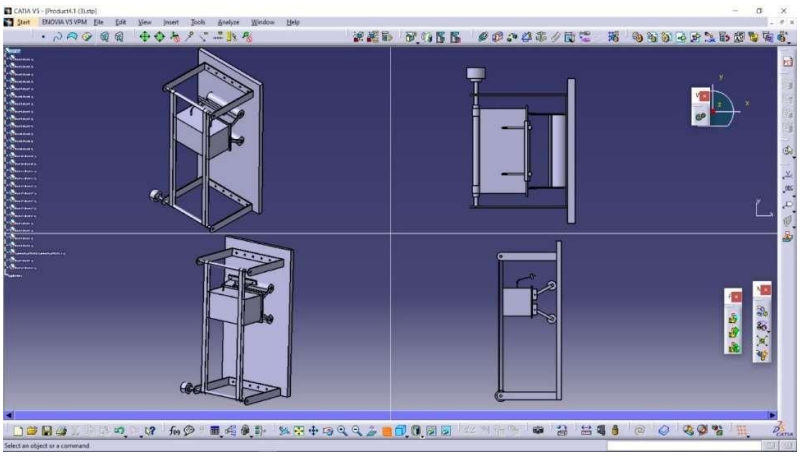


IV. Design Calculation

Assume the load coming on motor
Wt. of paint = 3kg
Wt. of box = 6kg
Wt. of roller = 1kg
Total wt. = 10kg
load = 10*9.81= 98.1 ~ 100
$\tau = F * r = 10* 9.81 * 0.2$
$\tau = 19.62$ Nm

Motor Calculation

DC motor: Take motor of 0.5 HP
Voltage = 12V, Speed = 80RPM
HP / 1.314 = KW, So 0.5 HP / 1.341 = 0.73 KW
We know that, P = 373 W
$P = 2*\pi*N*T/60$
T = 44.5Nm

Belt velocity

The speed of the belt can be calculated
$v = \pi * d_1 * n_1 / 60$
$= \pi *40 * 80 / 60$
= 167.55 mm/s
= 0.16755 m/s

Belt length

The length of the belt is dependent on the diameters of both pulleys and the distance.
Between their centres D:
$L = (d_1 * \pi / 2) + (d_2 * \pi / 2) + 2D + ((d_1 - d_2)^2 / 4D)$
Where D = 1490
L = (20 * 3.14 / 2) + (45 *3.14 / 2) + 2 * 1490 + ((40-40)2 / 4 * 1490)
L = 3105.66 mm

Belt tension

The tension in the belt is dependent on the belt velocity and the transmitting power
F = P / v
F = 100 / 0.167 = 598.802 N

Belt Torque

T1 = P / (2 * π * n1 / 60)
= 100 / (2 * 3.14 * 80 / 60)
= 11.94 Nm

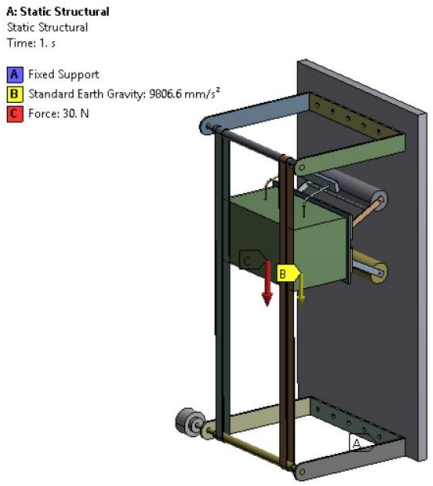
V. Static Analysis of Exterior Wall Painting

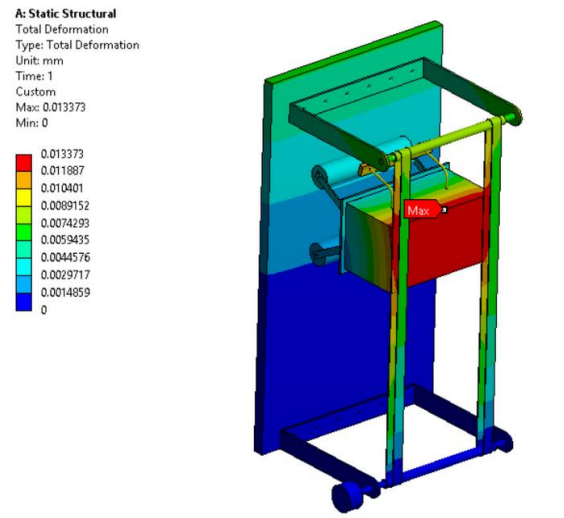
Boundary Condition

A - Fixed Support at Bottom Side
B - Apply Standard Earth Gravity

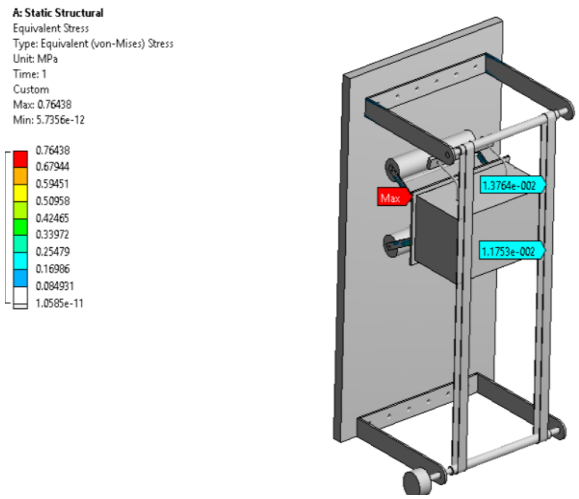
C - Apply Weight of Paint on the System

3 kg X 9.81 = 30 N

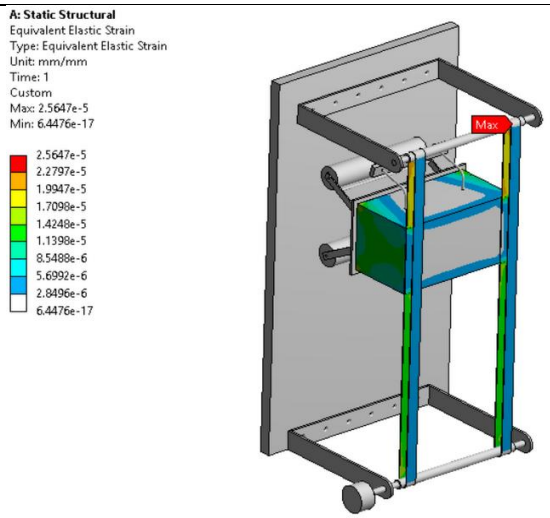




Maximum deformation induced in body is 0.013373mm



Maximum stress induced 1.1753e-002MPa



The strain induced is 25.64micron

VI. Conclusion:

As we know that building and construction industry nowadays growing rapidly also the height of buildings also increased so while painting such a multi-story building life risk factor of labor is high also the more time required for the painting the wall of the buildings. So, our project has neglected the labors safety, reduced the time required for painting and also minimized the use of paint.

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