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An Intelligent Wall Painting and Spraying System

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Abstract--- *Wall painting is a dreary, debilitating and risky procedure which makes it a perfect case for mechanization. The painting had been computerized in the car industry but not for the construction business. There is a solid requirement for a versatile robot that can move to paint inside walls of private structures. In this paper, the calculated structure of a self-sufficient wall painting robot is portrayed comprising of an arm that sweeps the walls vertically and is fitted on a versatile robot base to give the parallel feed movement to cover the work of art region. The objective is to fulfil the criteria of straightforwardness, low weight, easy and quick painting time. The sensors are embodied on the arm and the portable base to modify as far as possible and move in the room territory. A control framework is intended to direct the arm movement and plan the versatile base movement. This paper introduces a procedure for building up a paint robot, which is fit for performing paintwork on an inside wall. This technique combines highlights, for example, identification of the surface harshness, paint consistency, paint thickness forecast, and complex structure designs printing on the wall.*

Index Terms--- *Wall Painting robot, paint thickness estimation, surface harshness detection, Cartesian framework.*

I. INTRODUCTION

The advancement of administration robots got prevalent because the general public needs robots to relax people from monotonous and perilous employment.

In Egypt, just like other developing countries, the expanding populace animates the development related exercises, for example, inside furnishing and painting. Painting is traditionally done by people and requires physical endeavours and includes an introduction to risky synthetic substances.[1] Synthetic substances can truly weaken the vision, respiratory framework and general soundness of the human painter. These components make painting a perfect applicant process for computerization.

More than 100,000 condos are constructed yearly in Egypt, with a normal artwork region of 40 million square meters (in light of a normal 101 m^2 loft zone with 399 m^2 painting zone). The surface territory of painting is progressively because of the redesign work and expected populace increment later on. [2]–[4] This interest forces difficulties that will barely be met utilizing human painters just in the following decade. Subsequently, improvement of a composition machine that can perform the work of art task with least human mediation is required and will improve the nature of painting. The requirement for a self-ruling artistic creation robot is both clear and solid. Robotized painting had been acknowledged effectively in the car business to paint a huge number of vehicles in the mechanical production systems. This industry utilizes splash painting also, the automated framework is fixed in the sequential construction system. The household painting robots ought to be distinctive in the feeling that robots ought

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to have versatility with the goal that it can move to paint the fixed walls. Additionally, the household painter robots should utilize roller rather than splash which is the normal practice in the market to accomplish consumer loyalty.[5]

In open writing, hardly any frameworks were accounted for to serve the assignment of wall painting. A full-scale component for ceil painting was presented by this paper, having 3DOF without considering those of the stage and a working envelope. Roof territory of 43 m2 was painted in 2.3 hours which is 1.2 occasions quicker than manual composition. [6], [7] This robot is cumbersome and has a little workspace and intended to paint the roof as it were. This paper built up a robot for completing assignments of painting, putting, tiling and stonework. They utilized a standard robot arm with 5 DOF (Degrees of Opportunity) with 1.3 m reach and 28 kg payload. Their robot was mounted on 3 wheeled portable robot which gives another 3 DOF.[8], [9]

The robot can move between workstations and sends four balancing out legs at each site. This robot can't be utilized in private structures because of its 502 kg substantial weight. A decrease in painting time of about 69.8% was accounted for wall painting contrasted with human work of art and asserted to increment an extra 19.2% if ceil painting is incorporated. A downsized model for inside wall painting utilizing a multicolour shower was actualized by this paper. They likewise utilized a standard robot arm with 6 DOF, with 0.4m reach and 4 kg payload. They proposed to fix it on a 3 DOF hexapod for horizontal movement however this was not tentatively checked.[8], [10]

This paper depicted a full-scale wall painting robot, made out of a basic two connection controller fitted on a versatile stage. The framework worked however with a moderate artistic creation rate. Their work was roused by the way that painting arm need not be a 6 DOF arm, since it is overqualified for the painting work, and thus it was supplanted with a straightforward 2 connection arm. [11]

In this, paper, we show the applied plan of a new painting robot dependent on the acknowledgment of the disadvantages of the plan of framework depicted in (). The structure alterations are made for both the painting arm and the versatile base to fulfil the framework prerequisite. [12], [13]

II. SYSTEM DESIGN

From the start, we need to own unequivocal expression about the suspicions required for the robot activity and can be abridged as pursues:

- The robot proceeds onward level territory and no tendency.
- 2. The artistic creation wall is vertical, smooth and level with no blocks, for example, windows or on the other hand-holders.
- 3. The artistic creation solvent liquid is provided by a human client to a tank in the robot.
- 4. The walls are painted according to the user via an appropriate interface.

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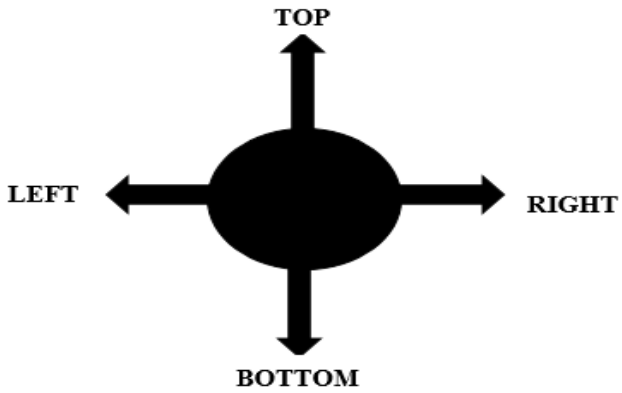

Figure 1: Motion of the Robot

The movement necessities of the robot arm have appeared in Fig.1 which demonstrates the essential need to move the robot wheel vertically for painting and the requirement for flat movement to reach the wall and to leave from the wall. [8], [14], [15]

Figure 1 shows the movement necessities of the robot for the arrangement of the entire robot and moving. The robot needs to move parallel to the wall to make parallel feed movement and to move typical to the wall to begin and leave the composition procedure.

The robot rotation is necessary to change the robot direction against the wall. The framework prerequisites and determinations can likewise be condensed as pursues, the robot should:

- Paint the walls from top to bottom in a vertical style.
- Be steady and not to flip over during painting or on the other hand moving.
- Paint the walls and the roofs.
- Have painting speed greater than human painter (0.15m 2/min).
- Have lightweight, under 35 kg (barring painting fluid), with the goal that it may be conveyed by a solitary human.
- Have a foldable structure to fit into a solitary sack for the human to convey advantageously.
- Have a straightforward interface for non-specialized clients.
- Have reasonable cost so painting expense doesn't surpass half of the expense of human painters.

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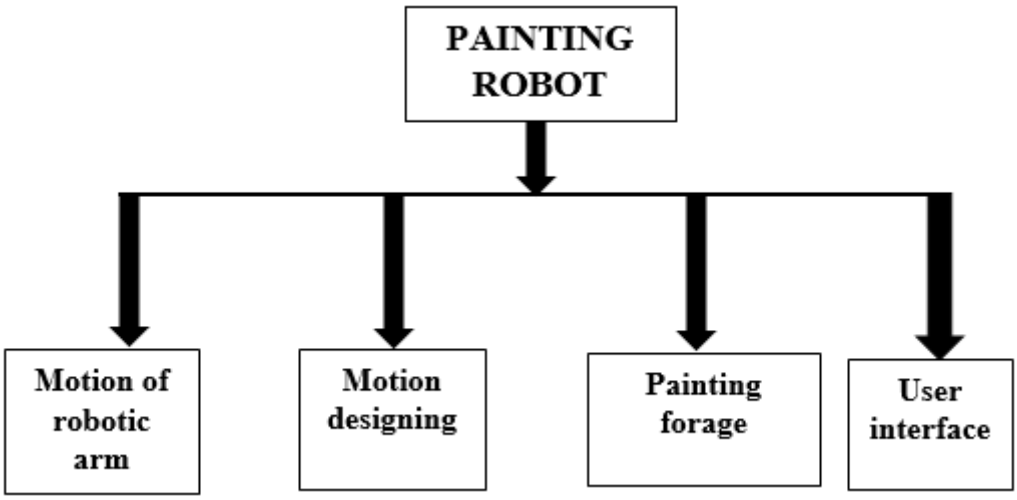

Figure 2: Block Diagram of the Robotic System

The motion of the robotic arm: From figure 2, it is clear that the arm is necessary to move in four directions to paint a wall. For the arm, and alluding to Fig.1, the required movement is 2DOF, vertical movement and movement into the heading ordinary to the wall surface. There are a few answers for such movement, for example, making a basic multi-connect component for the vertical straight movement. The typical movement can be made by the arm component or through the base. The basic two connection systems utilized in will be utilized yet supplanting moderate venturing engines with quick dc servo engines.[16][17]–[19]

Motion designing: The versatility requires fitting the arm on a portable base, furthermore, alluding to Fig.2, it is required to have 3 DOF as shown that is two planar moving bearings and one for the revolution to modify robot present comparative with the wall surface. In this way, it is smarter to utilize the three-wheel or four-wheel course of action. Albeit three-wheel course of action appears to be a decent decision, in the feeling of simpler control, yet due to the expected high stacking on the wheels whether due to weight or dynamic powers of painting, the wheel slippage will be hazardous. Subsequently, four freely determined wheels are the favored decision despite the fact that this will muddle the control calculation, in any case, it will guarantee reasonable framework mobility during the canvas procedure.[20]–[23]

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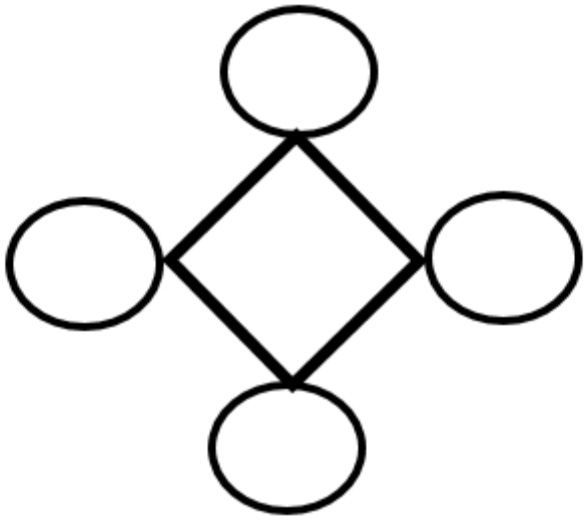

Figure 3: Wheels Arrangement of the Robot

Painting forage:

A standard business module is utilized that makes programmed painting solvent liquid feed to the robot. The duty of ensuring enough measure of painting solvent liquid and controlling its shading is left for the human client at this stage, however, it may be improved later on to produce a few messages for the client when the solvent liquid is below the cut-off points. The feed painting component works on a stockpile of DC voltage and siphons the liquid through a hose to the robot.

Graphical User Interface (GUI)

The UI ought to be made graphical for ease of utilization, particularly for non-specialized clients. A touch screen with fundamental capacity and test blunder message alarms is structured. A basic PC104 modern PC will be utilized together with a touch screen.

The significant necessities of the interface are to:

- The wall is pointed out that is needed to paint, controlling the number of paint layers.
- Choice to set the canvas speed for contemplations identified with quality and paint consistency.
- Setting the wall.[16], [24]
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III. RESULT AND CONCLUSION:

The framework accordingly proposed above is relied upon to fathom the significant test that a paint robot may look on the best way to execute a plan on a given wall. Additionally, the methods utilized by the framework are relied upon to give a vastly improved paint completing when taking a shot at walls with shifting unpleasantness. The framework fundamentally has two degrees of opportunity, along with the z hub and along either the x or the y hub.

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The framework is required to improve the general cost elements of the work of artwork. Despite what might be expected, the time factor of the paint application when contrasted with the people chipping away at the equivalent depends enormously on the kind of paint activity to be performed. On the off chance that the paint is to applied similarly as a solitary paint over the total wall, the framework is required to perform quicker when contrasted with the human work, yet to the extent, executing complex structures are concerned, the time factor is relied upon to be higher due to the different bend arranging, along which the painting activity is to be performed.

REFERENCES

[1] A. Jayaraj and H. N. Divakar, "Robotics in Construction Industry," in IOP Conference Series: Materials Science and Engineering, 2018.
[2] R. Kangari, "Robotics Feasibility in the Construction Industry," in Proceedings of the 2nd International Symposium on Automation and Robotics in Construction (ISARC), 2017.
[3] V. Shinde and G. Sarode, "Robotics Application in Construction Industry," Int. J. Eng. Manag. Res. Page Number, no. 2, pp. 16–18, 2018.
[4] P. K. N. NARASIMHA and M. A. VINAY, "AUTOMATION AND ROBOTICS IN THE CONSTRUCTION INDUSTRY - A REVIEW," i-manager's J. Futur. Eng. Technol., vol. 14, no. 3, p. 49, 2019.
[5] R. Kangari and D. W. Halpin, "Automation and Robotics in Construction: A Feasibility Study," in Proceedings of the 5th International Symposium on Automation and Robotics in Construction (ISARC), 2017.
[6] O. Akinradewo, A. Oke, C. Aigbavboa, and M. Mashangoane, "Willingness to adopt robotics and construction automation in the South African construction industry," in Proceedings of the International Conference on Industrial Engineering and Operations Management, 2018, vol. 2018, no. NOV, pp. 1639–1646.
[7] J. O'Brien, "Construction Automation and Robotics in Australia - A State-of-the-Art Review," in Proceedings of the 8th International Symposium on Automation and Robotics in Construction (ISARC), 2017.
[8] T. Bock, "Automation and Robotics in Building Construction," in ISARC proceedings of the 15th International Symposium on Automation and Robotics in Construction : Automation and robotics--todays reality in construction : bauma 98, 2017.
[9] PricewaterhouseCoopers, "The South African construction industry," SA construction, no. December, pp. 4–12, 2013.
[10] Robotics and Automation in Construction. 2012.
[11] V. R. Prasath Kumar, M. Balasubramanian, and S. Jagadish Raj, "Robotics in construction industry," Indian J. Sci. Technol., vol. 9, no. 23, 2016.
[12] S. Cai, Z. Ma, M. Skibniewski, J. Guo, and L. Yun, "Application of automation and robotics technology in high-rise building construction: An overview," in ISARC 2018 - 35th International Symposium on Automation and Robotics in Construction and International AEC/FM Hackathon: The Future of Building Things, 2018.
[13] S. Dritsas and G. S. Soh, "Building robotics design for construction," Constr. Robot., 2018.
[14] A. Warszawski, "Application of Robotics to Building Construction," in Proceedings of the 1st International Symposium on Automation and Robotics in Construction (ISARC), 2017.
[15] R. Heikkil??, M. Malaska, P. T??rm??nen, and C. Keyack, "Integration of BIM and automation in high-rise building construction," in ISARC 2013 - 30th International Symposium on Automation and Robotics in Construction and Mining, Held in Conjunction with the 23rd World Mining Congress, 2013, pp. 1171–1176.
[16] S. Dritsas, · Gim, and S. Soh, "Building robotics design for construction Design considerations and principles for mobile systems," Constr. Robot., vol. 1, p. 3, 2018.
[17] G. Dudek and M. Jenkin, Computational Principles of Mobile Robotics. 2010.
[18] "Computational principles of mobile robotics," Choice Rev. Online, vol. 48, no. 08, pp. 48-4504-48–4504, 2011.
[19] G. E. Castañeda, D. J. Monroy, J. A. Aponte, and O. F. Avilés, "Design and construction of a mobile type rover robotics platform," in 2011 IEEE 9th Latin American Robotics Symposium and IEEE Colombian Conference on Automatic Control, LARC 2011 - Conference Proceedings, 2011.

Received: Sep 2019 | Revised: Oct 2019 | Accepted: Nov 2019

[20] S. Lee, K. Kim, and J. Yu, "Automation in Construction BIM and ontology-based approach for building cost estimation," Autom. Constr., vol. 41, pp. 96–105, 2014.
[21] P. O. Olsson, J. Axelsson, M. Hooper, and L. Harrie, "Automation of building permission by integration of BIM and geospatial data," ISPRS Int. J. Geo-Information, vol. 7, no. 8, 2018.
[22] F. Fedorik, T. Makkonen, and R. Heikkilä, "Integration of BIM and FEA in automation of building and bridge engineering design," in ISARC 2016 - 33rd International Symposium on Automation and Robotics in Construction, 2016, pp. 735–741.
[23] H. Taghaddos, A. Mashayekhi, and B. Sherafat, "Automation of Construction Quantity Take-Off: Using Building Information Modeling (BIM)," in Construction Research Congress 2016: Old and New Construction Technologies Converge in Historic San Juan - Proceedings of the 2016 Construction Research Congress, CRC 2016, 2016, pp. 2218–2227.
[24] E. Fabregas, G. Farias, S. Dormido-Canto, M. Guinaldo, J. Sánchez, and S. Dormido Bencomo, "Platform for Teaching Mobile Robotics," J. Intell. Robot. Syst., vol. 81, no. 1, pp. 131–143, 2016.

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