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RESEARCH ARTICLE OPEN ACCESS

DESIGN AND FABRICATION OF AUTOMATIC WALL PAINTING MACHINE

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ABSTRACT:

An automatic wall painting machine was designed to improve painting applications' efficiency, accuracy, and consistency, was developed in response to the painting industry's requirement for automation. In this project, the primary objective is to develop and build an automated system that can paint walls with minimal human help. The device moves across a wall's surface area on its own using a mix of sensors, motors, and robotic arms. It modifies its pace and paint flow in real time based on data. While its intuitive interface makes it simple to set for various wall sizes and paint kinds, a feedback mechanism guarantees consistent coverage. The device is made to work in both home and business settings, greatly cutting down on labour expenses and time while also raising the calibre of the final output. Furthermore, safety features are incorporated to guard against mishaps and guarantee the machine's robustness under varied operating circumstances. Through increased production and a superior finish, this project's innovative approach to large-scale wall painting through automation aims to transform the sector.

Keywords — Automatic wall painting , Smart painting robot , Painting efficiency improvement.

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I. INTRODUCTION:

The painting of walls are the complicated and time consuming process in construction industries, is the need for automation of the painting process which is more important in industry. The time and cost to be reduced by design and fabrication of automatic wall painting machine.

Conventional wall painting techniques are time-consuming and involve professional labour for touch-ups, application, and preparation. These issues are addressed by the automated wall painting machine, which uses robots, sensors, and sophisticated control systems to provide reliable, superior outcomes faster. Conventional wall painting techniques are time-consuming and involve professional labour for touch-ups, application, and preparation. These issues are addressed by the automated wall painting machine,[11]. which uses robots, sensors, and sophisticated control systems to provide reliable, superior outcomes faster.

The core objective of this project is to develop an efficient, cost-effective, and user-friendly system that can navigate large wall surfaces, apply paint accurately, and handle various wall types and paint materials. This machine will not only streamline the painting process but also contribute to reducing the risks associated with manual painting, such as health hazards from inhaling fumes or potential injuries due to ladders or scaffolding.

Through this project, we aim to push the boundaries of automation in the construction industry, improving the overall efficiency of wall

painting while maintaining a high standard of finish.

The components and materials used for the fabrication are frame stand, wheel, DC motor and control unit.

The spray nozzle setup consist of microcontroller setup, lead screw, storage tank, spur gear and spray nozzle. The block diagram of automatic wall painting machine is shown in fig.1 .[7].

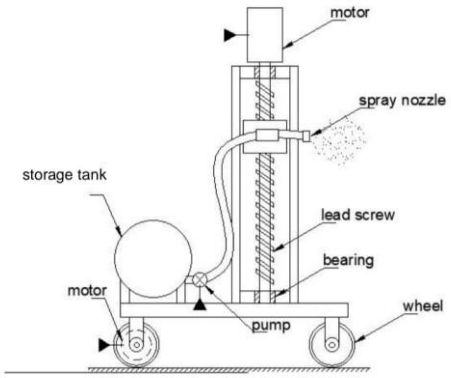

Fig.1: Block diagram

II. LITERATURE REVIEW :

1. **Amagad Muneer,Zhan Dairabayev (2021) [1]** studied for the painting automation, in automotive industry.[6] However, there is an urgent demand for a mobile robot that can travel to paint household interior walls. The objective of this project is to develop and implement a mobile robot with autonomous painting capabilities. The current speed was selected as the most suitable without compromising the workflow to ensure flawless, high-quality painting. Although it is at a tolerable 0.07 m/s, the spraying gun structure's pace might be increased.

2. **Abdulrahman Yahya (2020) [2]** designed and construct an automated robot that can apply different colours to walls. An automatic painting system built into the robot's design paints two different colours using spray guns and an air compressor. Techniques for installing spray guns horizontally and vertically have also been devised.

3. **Rajesh Kannan Megalingam[3] (2020)** learned about the painting on interior walls. It is quite labour intensive and time-consuming. Human manual labour was replaced with robotic painting to improve accuracy, efficiency, and save expenses.In this robot, the cascade lift system assists in raising the paint sprayer to the required heights. With two degrees of freedom and wheels with dc motors attached to the base, the robot can move effortlessly in all six directions.[11].

4. **B Sai Krishna (2019)[4]** stated that, the chemicals used in painting may cause respiratory and visual problems for human artists. Additionally, the repetitive nature of painting and the need for hand lifting make the process tedious and time-consuming.

5. **N Prithiviraj (2018)[5]** stated that the, building and construction are among the world's most important industries. This industry is expanding quickly in the context of this fast-paced industrial expansion. Additionally, the printing business falls within the category of technology electronics and is more on the opposite end of the spectrum. In wall printing, the electronics and commodities industries converge. Many things are indicated by printed walls, and this would take a talented painter with knowledge of colour matching, mixing, and dimensioning. [12].

III. MATERIAL SELECTION:

1. Battery

Batteries are used to store the energy produced by solar power. This particular lead-acid battery has a 12V, 2.5A capacity. This battery has low cost secondary cell and is used the most in trade. Grey lead material is used as negative plate and chocolate brown lead peroxide (PbO2) is used as positive plate. Both the plates are kept in H2SO4 solution.

The electrical current is obtained by the chemical reaction of both plates with the generation of water in the electrolyte.

A lead-acid cell's chemical changes that take place as it discharges and recharges.

2. DC Motor

The field system, armature core and the armature winding are the important parts of the DC motor. A DC motor is used to connect the wheel for the movement of spray nozzle.

3. Bearing

An apparatus that permits restricted relative motion typically rotation or linear movement between two parts is called a bearing. Generally speaking, bearings may be categorized according to the motions they allow and how they work. For high speeds, wear reduction, and efficiency, low friction bearings are often required. Essentially, a bearing may reduce friction by introducing and containing a fluid between surfaces, either because of its kind or because of its composition.

4. Control Unit

The term microcontroller refers to a complete microprocessor system built on a single integrated circuit. The creation of microcontrollers was prompted by the need for microprocessors in inexpensive products. The cost of developing basic products that utilize the capabilities of microprocessors to achieve their goals is greatly reduced when a whole microprocessor system is assembled into a single chip. This is because microprocessors are a natural method to implement various commodities. This suggests that people often bring up the idea of employing a microprocessor for low-cost products. But ordinary 8-bit microprocessor-based systems, including those that employ Z80 and 8085, are expensive. A few more circuits are needed for the 8085 and Z80 systems to form a microprocessor system. Each part has costs.

In today's world, microcontrollers are used in many intelligent products. Microcontrollers and keyboards, for example, are found in most personal computers. Circuits for scanning, debouncing, matrix decoding, and serial transmission are replaced by it. Toys, electric drills, microwaves, VCRs, and a host of other low-cost consumer and business products are all built on microcontrollers.

5. DC Pump

The power is given to the DC pump through the battery. It is used to pump the paint from the storage tank to the nozzle. The pressure of the fluid is increased by the pump.

IV. FABRICATE MODEL :

1. Finished model

The fabricated model of automatic wall painting machine is as shown in fig.2 .

Fig. 2: Finished model

In order to provide a completely working and effective painting solution, the Automatic Wall Painting Machine's manufacturing setup combines mechanical, electrical, and control components. A sturdy frame, a rail system for seamless mobility, a robotic arm with a spray nozzle that can be adjusted, and a paint delivery system to guarantee even paint flow are among the mechanical parts. To manage accurate movement, paint flow, and operational control, electrical components including motors, sensors, and a control system (such as a microprocessor or PLC) are incorporated. Using CAD software to design and plan the system, acquiring materials, machining, assembling the parts, and wiring the electrical system are all steps in the manufacturing process.[8]. While quality checks enable smooth operation, testing and calibration are essential to ensuring appropriate performance and safety.

2. Lead Screw

Fig. 3: Lead screw

The Automatic Wall Painting Machine converts rotational motion into linear motion using a lead screw, a mechanical mechanism, enabling accurate operation of the robotic arm and other moving elements .[9]. It consists of a lead screw with a threaded shaft and a nut that moves with the screw as it rotates, is as shown in fig.3. Applications requiring precise positioning and movement control often utilize the lead screw mechanism because it transfers a powerful torque with minimal backlash. To enable smooth and accurate translation of the painting system, lead screws are typically utilized in the rail system of the wall painting machine to drive the movement along the wall.

3. Spray nozzle

Fig. 4: Spray nozzle

An essential part of the Automatic Wall Painting Machine that applies a uniform and even layer of paint to the surface is the spray nozzle, is as shown in fig.4. It ensures excellent results by regulating the paint flow, covering area, and spray pattern. Because most spray nozzles are adjustable, users may change the spray's breadth, pressure, and flow rate based on the kind of wall and paint being applied. Both air-assisted and airless spray nozzles are frequently employed; the former provide high-pressure streams for quicker coverage, while the latter aid in atomising the paint for a finer, more controlled application. In order to minimise overspray and maximise paint efficiency, the nozzle design is crucial.

4. Microcontroller Setup

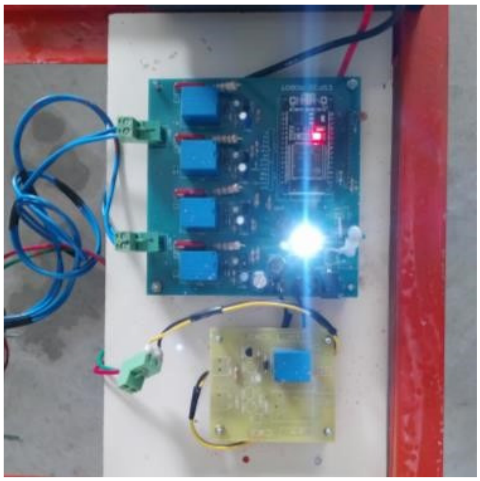

Fig. 5: Microcontroller Setup

The Automatic Wall Painting Machine's microcontroller configuration serves as the main processing unit that manages the whole apparatus, is as shown in fig.5. It is in charge of analysing sensor inputs, managing actuators and motors, and carrying out instructions in accordance with pre programmed logic. Because of their processing capability, networking choices (such as Bluetooth and Wi-Fi), and simplicity of integration with other components, popular microcontrollers like the ESP32, Arduino, and Raspberry Pi are often employed. The microprocessor controls the movement of the robotic arm and paint delivery system [9], modifies spray nozzle settings, and connects with many sensors (such as proximity and pressure) to collect data in real time. Additionally, it connects to the Internet of Things system for remote monitoring and control, enabling operators to

modify machine settings using a web or mobile application[10]

V. RESULT AND DISCUSSION :

Fig.6(a) [BEFORE PAINTING] **Fig.6(b) [AFTER PAINTING]**

By tackling labour-intensive, time-consuming, and dangerous jobs, the Automatic Wall Painting Robot illustrates the possibilities of automation in the construction industry. Through the integration of sensors, control systems, and robotic movement, the robot achieves improved efficiency, consistent paint application, and cost-effectiveness.[11]. Because it is adaptable enough to work on a variety of surfaces and situations, it minimises the need for human intervention while guaranteeing safety and consistency in painting activities. Its energy efficiency and operational range, are the drawbacks that point to potential future advancements like increased mobility, scalability, and intelligent features like AI and IoT integration. This invention offers a viable way to update building procedures, cut expenses, and enhance worker safety. The wall painting before and after painting is shown in fig.6(a) and fig.6(b).

VI. CONCLUSION:

An important development in the field of painting application automation is the creation and design of an automatic wall painting equipment [6]. Through the integration of robotic systems, IOT technologies, and precise spray mechanisms, this work provides a solution that reduces human labour and mistakes while improving wall painting's productivity, accuracy, and safety. A user-friendly and flexible system is ensured by combining IOT for remote monitoring and control with a microprocessor to manage motor motions, sensor data, and spray settings. This machine is a useful tool for both residential and commercial applications since it not only saves time and money but also enhances the uniformity and quality of paint application.

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