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AUTOMATED WALL PAINTING ROBOT

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Abstract— Painting is automatic in many automobile industries and factories, but yet to reach for commercial purpose like painting the house wall. So in this paper we introduce a robot to paint the wall automatically with minimum human interface. The machine which we make are more efficient and precise than humans. In this paper we have used a basic components to design this machine. A lever arm to move the sprayer vertically and a pixy camera for image processing. Pixy Camera board is used for image processing. Here image processing is used to detect any error on the wall.Sensors are used to detect the wall distance and detect any obstacles if present. Thousands of building are built every day in overcrowded countries like India, so to paint those building requires a large human work force to do it. So to reduce the human effort we are proposing this system which could paint faster and better than humans.

Keywords— IOT, GPS, Metal detector, landmines.

1.INTRODUCTION

1. Fast globalization and interconnectivity create the major driving force in creating and enhancing chance. Therefore, the society has to acquire new trends of innovation to prosper in their ways of life. The community has revolutionized due to the interconnectivity greatly compared to some years back when usage of technology did not exist. Saving human labor numbers and timing are only the two main advantages; besides them we must consider the opportunity to reduce or eliminate human exposure to difficult and hazardous environments, and to improve the quality of such works which would solve most of the problems connected with safety when many activities occur at the same time. 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. These factorsmotivate the development of an automated robotic painting system. Valuable experiments were led to verify how convenient is carrying on painting works through robots. The task of painting is a time consuming one. Automation in this field would at least substitute humans inapplying the paint, thus saving the valuable labor hours of working. Also, the fact that long exposure to paint and varnishes damages the human health has been proving. So the advent ofautomation will help to get rid of this hazard. The automated painting robot was to be designed with the vision to facilitate easy wall painting. Results of comparisons at full scale between labor and robotized execution showed that there are significant savings in labor, depending on the labor rate, when auxiliary work is considerably lessened. Through the performance of full scale experiments, it was possible to show that robots are always more profitable than human work when highly autonomous robots are adopted. The feasibility of highly autonomous robots is shown by a number of papers which pictured the reduction of auxiliary work from labor.

1.Automation is the use of machines, control systems and information technologies to improve productivity in the production of goods and delivery of services. The appropriate reason for applying automation is to boost up productivity and quality beyond that possible with current human labor levels so as to realize economies of scale, and realize predictable quality levels. The inappropriate application of automation, which arises most often, is a tendency to eliminate

1. MOTIVATION AND OBJECTIVE

Motivation: The motivation behind automated wall painting robots revolves around increasing efficiency, improving quality and consistency, ensuring safety, reducing costs, and leveraging technological advancements to streamline the painting process.

Objective: An automated wall painting robot is to streamline the painting process, improve efficiency, accuracy, and safety, and ultimately provide a cost-effective solution for large-scale painting tasks.

2.LITERATURE SURVEY

1.B.Kayalvizhi , V.Seetha, B.Lavanya, P.ParuthiIlam vazhuthi, Development of robot for automatic wall painting, writing, drawing and crack detection , International Journal of Advanced Research in Electronics, Communication & Instrumentation Engineering and Development, Volume: 2 Issue: 1 Apr,2016,ISSN_NO: 2347 -7210.

We had discussed the new prototype that aims to design, develop and implement Automatic Wall Painting Robot which helps to achieve less human interaction and low cost painting equipment. Despite the advances in robotics and its wide spreading applications, interior wall painting has shared little in research activities. Despite the fact that the utilization of spreading robotized frameworks for inside painting was at that point indicatedto be attainable and helpful, a ton of tests must be completed later on to convey an exceedingly self-governing robot for inner part painting. A new approach is proposed using raspberry pi, the robot which can be operated by both manual and autonomous. The autonomous robot can be controlled using an android mobile where the application was installed. The existing approach gives feasible analysis for time and labor. It is not easy to correlate the work and people because painting an elevated building is very risk and time consuming. In this paper, the robot is mounted on equipment which permits it to move up anddown, left and right along the exterior walls of a building. It is also equipped with sensors which measure indentations and protrusions in the wall surface and making it possible for painting.

IR is used to enhance the current approach to detect cracks on the wall and gives indication such that we can rectify in prior from elongation of damage. In addition, it is very effective on time management and completes it without an error and would offer the opportunity to reduce or eliminate human exposure to difficult and hazardous environments. Finally, it is expected that the conceptual model of the wall painting robot would be efficiently used in various applications in wall finishing and maintenance of other architectural and civil structures such as commercial buildings, tower sand high-rise storage tanks.

2. Mohamed T. Sorour, Mohamed A. Abdellatif, Ahmed A. Ramadan, and Ahmed A.Abo-Ismail, Development of Roller-Based Interior Wall Painting Robot , International Journal of Mechanical, Aerospace, Industrial, Mechatronic andManufacturing Engineering Vol:5, No:11, 2011.

The development of an autonomous robot for painting the interior walls of buildings. The robot consists of a painting arm with an end effector roller that scans the walls vertically anda mobile platform to give horizontal feed to paint the whole area of the wall. The painting arm has a planar two link mechanism with two joints. Joints are driven from a stepping motor through a ball screw-nut mechanism. Four ultrasonic sensors are attached to the mobile platform and used to maintain a certain distance from the facing wall and to avoid collision with side walls. When settled on adjusted distance from the wall, the controller starts the painting process autonomously. Simplicity, relatively low weight and short painting time were considered in our design. Different modules constituting the robot have been separately tested then integrated. Experiments have shown successfulness of the robot in its intended tasks.

3. Shin Terauchi , Toshikazu Miyajima, Takezo Miyamoto, Kazuhiko Arai and Seiichiro Takizawa, Development of an Exterior Wall Painting Robot Capable of Painting Walls with Indentations and Protrusions, Automation and Konotics in Loflstrucuun, 1993 Elsevier Science Publishers 13. V.

We had discussed the development of an exterior wall painting robot for the purpose of automating this painting operation. The robot is mounted on equipment which permits it to move up and down, left and right along the exterior walls of a building. It is computer controlled and is activated simply by the operator pressing a switch on the control panel located on the ground. The robot is capable of painting a four square meter wall surface (4 m long X 1 m high) at one time. It is also equipped with sensors which measure indentations and protrusions in the wall surface, making it possible for it to paint exterior walls with windows, pillars or other indentations or protrusions.

Kundan Jawale, Ramesh Kumar, Vishal Kale, Design and Development of a Wall Painting Robot for the Houses Wall , International Journal of Multidisciplinary Researchand Development.

4.We had studied 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. 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 troublesome for human being to work in an upright position, especially for painting, cleaning and screwing 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. Mohamed T. Sorour, Mohamed A. Abdellatif, Ahmed A. Ramadan, and AhmedA.AboIsmail,Development of Roller-Based Interior Wall Painting Robot ,

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2. Methodology

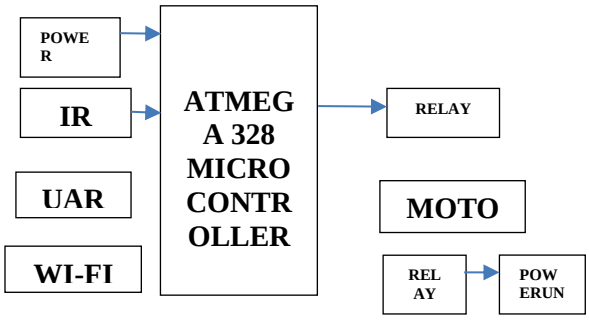

Fig.2 Methodology

3. Hardware Components and Description

A. Arduino Uno

The Arduino Uno is a popular microcontroller board that features an ATmega328P microcontroller. It offers a range of digital and analog input/output pins, communication interfaces like USB, UART, I2C, and SPI, and multiple power supply options. The board can be programmed using the Arduino programming language and IDE, making it accessible to beginners and experienced users alike. With its expandability and widespread community support, the Arduino Uno is widely used in various projects, including robotics, automation, and Internet of Things (IoT) applications.

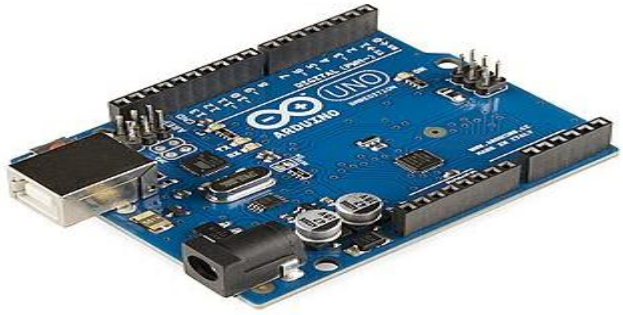

Fig.3 Arduino Uno

A. WI-FI Module

The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by Shanghai-based Chinese manufacturer Expressive Systems. The chip first came to the attention of western makers in August 2014 with the ESP-01 module, made by a third-party manufacturer Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at

the time there was almost no English-language documentation on the chip and the commands it accepted. The very low price and the fact that there were very few external components on the module, which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation. The ESP8285 is an ESP8266 with 1 MiB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi. The successor to these microcontroller chips is the ESP32.

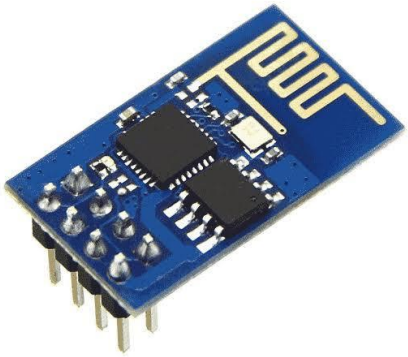

Fig.4 WI-FI Module

B. Dc motors

DC motors are widely used in various applications, including robotics, electric vehicles, industrial machinery, fans, pumps, and household appliances. They offer reliable and controllable mechanical power output, making them a popular choice in many industries.

Fig. 6 DC Motor

C. Power supply

Battery or DC power supply: A reliable and stable 12V power source to power the entire system. Voltage regulators or DC-DC converters: These components regulate and distribute power to different subsystems and components.

D. IR Sensors

An infrared (IR) sensor is an electronic device that measures and detects infrared radiation in its surrounding environment. Infrared radiation was accidentally discovered by an astronomer named William Herchel in 1800. While measuring the temperature of each color of light (separated by a prism), he noticed that the temperature just beyond the red light was highest. IR is invisible to the human eye, as its wavelength is longer than that of visible light (though it is still on the same electromagnetic spectrum). Anything that emits heat gives off infrared radiation. There are two types of infrared sensors: active and passive. Active infrared sensors both emit and detect infrared radiation. Active IR sensors have two parts: a light emitting diode (LED) and a receiver. When an object comes close to the sensor, the infrared light from the LED reflects off of the object and is detected by the receiver. Active IR sensors act as proximity sensors, and they are commonly used in obstacle detection systems (such as in robots).

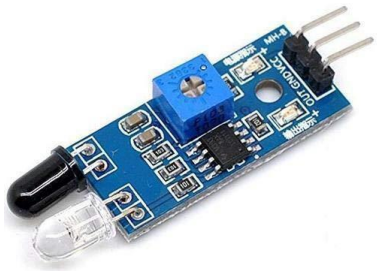

Fig. 7 IR Sensor

WORKING

A. In this section we have described how our idea is converted into prototype. Our prototype has been implemented into two parts i.e., Hardware implementation and Software implementation in Hardware implementation we described how circuit connection is made based on the block diagram and we have explained each component working in the prototype. In Software implementation part we have explained the code which is essential for working.

B. A 12V DC motor is fixed to the mainframe and connected to the driver IC where deriver IC helps in the movements of the DC motor. The motor is connected to the slider assembly for up- down movements. When slider motor moves in clockwise direction slider move in up when the slider moves in anti-clockwise direction slider move in the down direction.

C. We have connected the twin between the motor as well as slider movement because they have to work simultaneously and both depend to each other i.e., whenever we need slider assembly to move up and down, we make the motor to run. We have placed a small clamp in the mainframe which connects the lead rod to the mainframe. Lead rod is vertically mounted such that we can connect the slider assembly. The X-Y movement of the lead rod is maintained by the mainframe movement itself. The actuator of the system is triggered by a servo motor. Sparing the paint to the wall is done with the help of actuators

with the raspberry pi assembly The pi camera is connected to the pin 22 of the Raspberry pi module, with the help of this camera we capture the image of the object and we check whether it is a wall. If the captured object is a wall, then the program moves to the next step. The next step of the code is to check the wall is painted with the specified color or not. For color identification, we have used masking techniques.

D. In this technique, we mask another color check for specified color is on the wall, if it is already present it will show that area as white and all other areas as black vice-versa. If all parts of the wall are white then the painting is already done on that particular wall and it will move to the next position. If the area is not painted it will start to paint the wall with the help of hardware working explained in the above paragraph.

E. Base Frame: The Primary base frame is the base element provided with castor wheels, The primary base is made of mild steel square tube and mild steel plate. It supports the entire assembly of the spray paint system.

F. Vertical motion system: The vertical motion system comprises of the screw and nut, lifter screw held in two ball bearings and nut connected to the carrier. Rotation of screw is converted to translation of the spray paint system u or down Paint storage: Paint storage is done in a small tank of 0.8-to-1.2-liter capacity mounted on the structure. The compressed air is supplied through the chamber to carry the paint to the spray rotor end.

G. Paint application: Paint application is done by means of a spray which is reciprocated in linear guide by crank and connecting rod mechanism operated by motor.

ADVANTAGES

Precision and Accuracy: The automated painting robot is designed to paint walls with high precision and accuracy. The use of sensors and actuators enables the robot to detect obstacles and paint the walls uniformly, resulting in a smooth and consistent finish.

Efficiency: The robot can paint large areas in a shorter period of time than manual painting. This leads to a reduction in labor costs and increases productivity.

Safety: The use of an automated painting robot eliminates the need for workers to climb ladders or use scaffolding, which can be dangerous. This reduces the risk of accidents and injuries.

Versatility: The robot can be programmed to paint different types of surfaces and can be customized to meet the specific requirements of different buildings.

Cost-effectiveness: The use of Raspberry Pi as the control unit makes the system cost- effective and easily accessible. The robot can be built using off-the-shelf components, reducing the cost of development.

APPLICATIONS

Building Maintenance: The automated painting robot can be used for regular maintenance of buildings, keeping the exteriors in good condition.

Large-scale Painting Projects: The robot can be used for large-scale painting projects such as bridges, dams, and industrial structures.

Customization: The robot can be customized to paint logos, designs, or patterns on the exterior walls of buildings, making them more visually appealing.

Time-sensitive Projects: The robot can be used for time-sensitive projects where quick completion is required, such as in the case of emergency repairs or renovation work.

RESULT

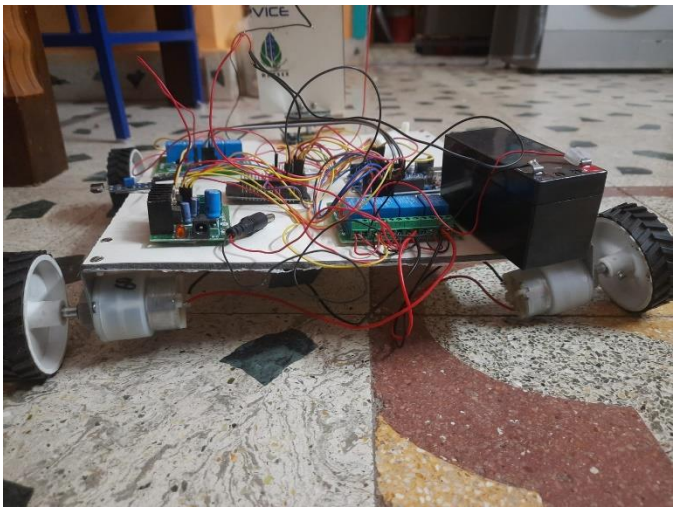

Fig.7 Front view of the robot

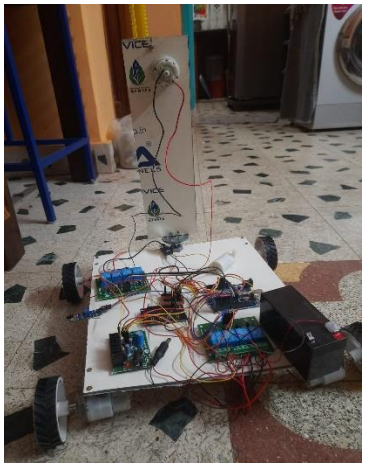

Fig.8 Top view of the robot

The Long-Range Spying Robot and Landmine Detection system with GPS Location Tracking demonstrate improved landmine detection accuracy, enhanced safety for personnel, expedited clearance operations, real-time data transmission and analysis, and versatility for various applications. The system effectively detects and identifies landmines, provides accurate GPS location tracking, and facilitates efficient decision-making for safe clearance.

Conclusion and Future scope

The development of an autonomous wall painting robot using simple components like a sensor, a driver circuit, and a DC motor represents a significant advancement in the field of automated painting. This innovative prototype aims to streamline and optimize the interior wall painting process, making it more accessible and efficient. Unlike other complex interior wall painting robots, this design stands out for its simplicity and ease of implementation. By using basic components and materials that are readily available, the robot can be constructed with relative ease while adhering to the necessary specifications. In addition to the autonomous wall painting robot, a remarkable method has been developed for automatic spray painting of objects with unknown shapes. This machine offers exceptional utility when it comes to painting items of varying shapes and sizes within a remarkably short time frame. The accuracy achieved by this automated system surpasses what can be achieved through manual painting, ensuring precise and consistent results. Furthermore, the utilization of this machine results in substantial savings in labor costs and the overall expenses associated with painting jobs. It significantly reduces the reliance on human labor and the associated time and effort, thereby increasing efficiency and productivity.

The advantages of the automatic painting machine extend beyond cost savings and improved efficiency. It also offers enhanced safety in large-scale painting projects. With its ability to print on huge buildings easily and safely, without posing any hazards to human workers, the machine provides a reliable and secure solution. By minimizing the need for human intervention in hazardous painting tasks, the machine mitigates risks and ensures a safer working environment.

In conclusion, the development of an autonomous wall painting robot and the introduction of an automatic spray-painting machine represent significant advancements in the field of painting technology. These innovations not only improve efficiency, accuracy, and cost-effectiveness but also prioritize safety by reducing human labor and minimizing risks. With their potential to revolutionize the painting industry, these technologies pave the way for more automated and streamlined approaches to painting tasks, benefiting both professionals and individuals undertaking painting projects.

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