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Self Operating Paint Bot

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***Abstract*— Painting the wall plays a vital role to fix one's gaze at the building. But we have identified a problem behind every painter is their torment due to exposure to paint. Our project overcomes this issue through automation via IoT. In addition to that, our solution finds a way to calculate the exact amount of paint requirement with the image processing technique. The image of the wall is captured by the camera from which the dimensions of the wall can be found by image processing. Using the area of the wall, paint estimation is done. A 2-dimensional axes arms are used to paint the wall. The live status of the painting can be viewed from anywhere by using IoT.**

***Keywords*—** *Automation, IoT, image processing, paint estimation.*

I. INTRODUCTION

Building and construction are some of the major industries around the world. In this fast-moving life, the construction industry is also growing rapidly. But the labors in the construction industry are not sufficient. This insufficient labors in the construction industry are because of the difficulty in the work. In the construction industry, during the work in tall buildings or in the sites where there is a riskier situation like interior area in the city. There are some other reasons for insufficient labor which maybe because of the improvement of the education level which causes the people to think that these types of work are not as prestigious as the other jobs. The construction industry is labor-intensive and conducted in dangerous situations; therefore, the importance of construction robotics has been realized and is grown rapidly. Applications and activities of robotics and automation in this construction industry started in the early 90‟s aiming to optimize equipment operations, improve safety, enhance the perception of workspace and ensure a quality environment for building occupants. After this, the advances in the robotics and automation in the construction industry has grown rapidly.

II. EASE OF USE

Generally, paint and varnishes are made up of chemical components. So, they generally contain toxic compounds. This may cause a lot of health issues to the painting labors. By inhaling the smell of these compounds, they may get affected by a lot of health issues like asthma, lung cancer, back and neck pain, eye irritation, and even kidney failure. So, to reduce these causes, we require a machine to do all the human activities for painting. Since the world is moving towards automation, we created this automatic wall painting bot

III. DESCRIPTION

Overview

Automatic estimation of paint requirement for the wall which is scanned using the camera. The area of the wall is accurately measured. Using image segmentation, the unnecessary areas other than the wall are removed. Using IoT we may able to see the live status of the wall while it is been under the painting process.

A. Description

The proposal deals with a system that automatically scans the wall and calculates the area and also the required estimation of paint for that particular area. The horizontal and vertical arms are fixed with the DC motors for the movement of arms which is attached with a paint gun. Raspberry Pi acts as the heart of our system. The motor drivers are used for controlling the speed and direction of the motors. So, the paint sprayer moves in the top and bottom direction also in the left and right direction. The IoT system is used to see the live status of the wall while the painting process is carried on.

The project is sub-divided into three different modules. They are,

- Area calculation and Paint estimation
- Main arm for movement
- IoT Module

B. Equations

The following information has to be known to determine the estimation of paint required:

1. The surface area of the surfaces excluding the areas like windows, doors, etc.,
2. Spreading rate of the paint being used.
3. The number of coats required.

Mathematically the paint estimation can be done as given below.

$$\frac{Total\ Surface\ Area \times No\ of\ Coats}{Spreading\ Rate\ of\ Paint} = Total\ Paint\ Required \quad (1)$$

The equation (1) describes the total liters of paint required for the particular scanned area.

IV. Related Works

A. Path Planning Method

[1] This model is mainly based on CAD modeling for the painting process by tracking the path to be painted. This model is meant for both 1D and 2D painting processes. The tracking process usually is done based on two ways

1.Raster pattern
2.Spiral pattern

In the 1D model, the paint distribution is only related to the distance of the point to the tool center. But in the 2D model, it computes the paint distribution based on the location of the point on the flat surface.

The CAD model has many advantages in painting the path traced by the tool, but it lacks while painting the edges and also the connection regions. This technique is mainly employed in the automobile industry where the small automobile parts are processed and the paths are tracked and processed for painting.

B. Automatic Paint Spraying Machine

[2] This proposal mainly aims in the field of Automation, and for developing time and cost-efficient painting system. This proposal is designed for producing a high output efficiency. The paint spray gun is automated to the mainframe of the setup. A 3 phase induction motor is used for the movement of the paint spray gun. The frame of the gun is attached to a pulley mechanism. The pulley is used for increasing the speed twice that of the input. The detection technique is carried out with the IR sensor as the main starting tool. Here two pneumatic pistons are used for actuating the paint cylinder and the other is used for gun movement.

C. Interior painting and designing

[3] The idea proposed here, is to develop a robot that is capable of identifying the roughness of the surface, which is to be painted, to reduce the wastage of paint. This process takes place in five stages :

1.Input stage
2.Detection stage
3.Painting stage
4.Proceed stage

First, the design to be painted is loaded in the processing unit initially. The system also detects the distance of the wall to be painted and by using the Speckle Correlation Technique the roughness of the wall is detected. By image processing, the wall to be painted is been scanned and the distance also calculated. The paint container is fitted with a sensor to detect the viscosity of the paint and also to check the availability of the paint in the container. This proposal mainly speaks about the nozzle of the paint gun. The nozzle is adjusted for the availability of the parameters like the distance of the robot from the wall, viscosity of the paint, etc.,

V PROPOSED MODULE

All the above-described proposals have great efficiency over the ages. But all have minor disadvantages in it. As described in [1] it is based on the CAD technology, mainly used for the automobile industry, but painting the small parts of the car and also the linking parts by tracking the path to be painted id very difficult.

In the proposal [2] and [3] for the painting process, spray guns are been used. The spray gun nozzle is controlled by using the pneumatic pistons but this is too much expensive, also the air compressor with the high-pressure pound is required.

All these minor defects have been taken into account and had to be overcome in our proposal.

Module Description

1.*Area Calculation and Paint Estimation:*

This system uses IMAGE PROCESSING technology. First, the wall which is to be painted is scanned using the cameras which are placed on the bot. the camera scans the image and process it. We are using edge detection algorithms, so the area of the wall is calculated and is displayed. To calculate the required amount of paint we are using the formula to calculate it. The total surface area in meters which is divided by the spreading rate of the paint gives the total amount of paint required. Using segmentation, the unnecessary areas like a window, door,

etc can be removed from the scanning and only the required part is alone scanned and calculated.

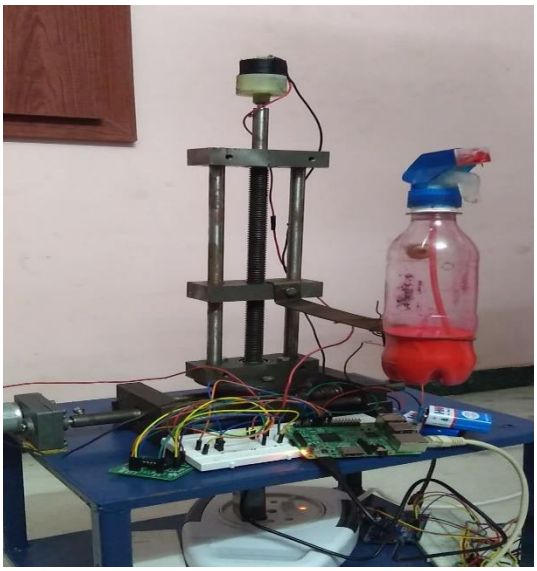

Fig 1: Model Setup

2. *Main Arm for Movement:*

For the moving process, we are using a side shaft motors and a dc geared motor. For the top and down we use side shaft, and for the left-right, we use DC geared motors. The lead screw is attached to the motor and the paint sprayer is placed at the center of the shaft. The motor driver L293 D is used to control the motor operation. When the arm finishes the painting from top to bottom next the vertical arm moved towards the right side and again the horizontal arm moves down. The same process continues until the operation is completed. All these actions are done with the help of the motor driver IC.

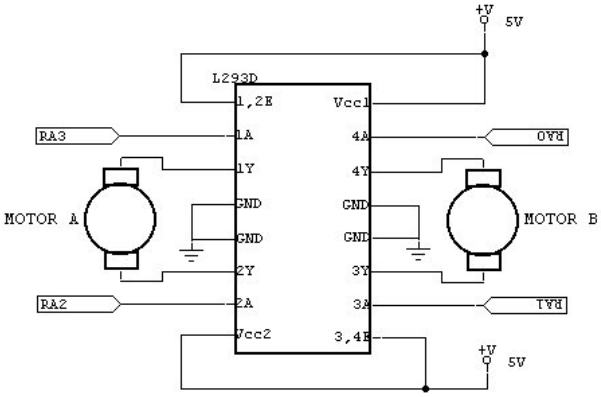

Fig 2: Interfacing L293D with Microcontroller

3.*IoT MODULE:*

Once the painting process is started the user can view all the details and condition of the wall, as the paint used, total areas painted, the condition of the wall, etc., The painting process can also be instantly viewed with the help of the Camera module placed on the paint bot.

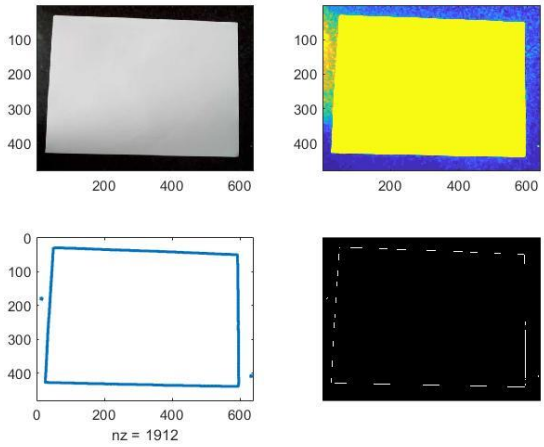

Fig 3 : Simulated Wall Image

All these three modules are interfaced together using the Raspberry Pi microcontroller and for the simulated result view, Matlab is used. The main arm is made up of a lead screw mechanism for the fast movement of the shaft. This is similar to the pulley system used in [2]. First, the wall to be painted scanned using the camera placed on the paint bot. the scanned image is processed and then given to the processor. The image is eroded and dilated using the edge detection algorithm and the binary image of the input image is obtained. From the resultant image, the painting process is taken over. The horizontal axis is used for the left-right movement and the vertical arm for top and bottom movement. The speed and direction of the motor are controlled using the motor driver. The user can able to view the present condition of the wall while the painting process is been carried out. This is done using an external video feeding app called ipwebcam. This is an IP address based webcam connected with the raspberry pi using the IP address. Up to 20 users can able to access from a single IP address.

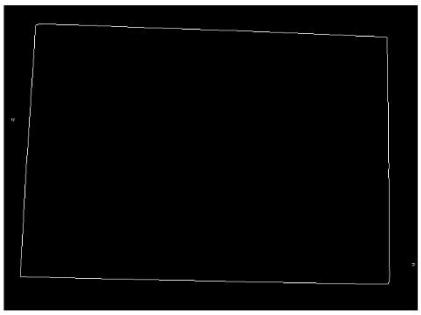

Fig 4: Output Binary Image

CONCLUSION

The project aims at providing a finely painted wall for the scanned areas with the exact amount of paint requirement. The wastage of paint can be reduced. Using our project we can reduce the labor work and also do paint the wall time efficiently.

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