Automatic Object Sensing and Spray Painting

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Abstract: Today industrial automation of spray painting is limited to high part volumes and robot trajectories that are programmed by off-line programming and manual teach-in. This paper presents an approach that uses range image data to obtain the geometry of an unknown part and to automatically generate the robot spray painting trajectories. Laser strip range sensors are installed in front of the paint booth to acquire a range image of the part. Utilizing process knowledge (a geometric library containing constraints specific for the painting application) geometric primitives are detected in the range data. From the geometric primitives a normal vector field is generated that enables to extract main faces. The main faces are located in 3D space and the process knowledge related to each geometric primitive is utilized to obtain the trajectory for the paint gun.

***IndexTerms* - Spray paint, Object sensing, Microcontroller, Arduino.**

I. INTRODUCTION

The objective of the European RTD project Flex Paint is to automate robot programming for painting applications of small lot sizes with a very high number of part variants. The project goal is to provide economic possibilities for usage of robots for industrial painting tasks. As a matter of fact, economic realization hinder the application of the currently used conventional automation technology (off-line programming and / or manual teach in) used for high volume production. In this paper an inverse approach is presented to automatically obtain robotic paint paths from range sensor data and to automatically generate a feasible, complete and executable robot program. The approach must cope with a large spectrum of parts as depicted. For each industrial customer the part families are known. The goal is to be able to paint any order of parts coming along the conveyor. The technical challenge is to detect the geometry of the part on the conveyor, to automatically infer from the geometry the robotic painting trajectory and to automatically generate a collision free robot program.

II. RELEATED WORK

2.1 B.Kayalvizhi , V.Seetha, B.Lavanya, P.ParuthiIlamvazhuthi :

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 indicated to 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 Morphological gradient is an edge-strength extraction operator that gives symmetric edges between foreground and background regions. The resulting image is then threshold to obtain a binary edge image.

2.2 Dhaval Thakar, Chetan P. Vora:

Painting is the practice of applying paint, pigment, color or other medium to a surface (support base). The medium is commonly applied to the base with a brush but other objects can be used. In art, the term painting describes both the act and the result of the action. However, painting is also used outside of art as a common trade among craftsmen and builders. Paintings may have for their support such surface as walls, paper, canvas, wood, glass, lacquer, clay, leaf, copper or concrete, and may incorporate multiple other materials including sand, clay, paper, gold leaf as well as objects. For small and medium scale industries manufacturing components have to coat of paint to prevent from rusting so the spray application.

2.3 Tapas Raj Ashirvad Jena:

Detection of desired color and its automated generation can be very useful. Each color has specific wavelength in visible spectrum ranging from 400nm-700nm. Based on its wavelength and other properties a machine could be developed that could utilize the principle of robotics to automatically mix the primary colors viz. red, blue and green (RGB) in required proportions to obtain the similar color as required. The automated system can be further developed to spray-paint a given area with the help of robotic arm. This fully automated system will definitely have the following benefits. Improved quality: with an automated robotic spray painting arm, we can expect to create a more reliable, high quality end product. The robotic spray gun always remains at the proper distance away from target object hence provide accessibility in hard to reach areas with ease. Conserve paint: it can cut down the material cost as it is precise and does not overspray. Play-it-safe: avoid exposure to harmful toxins. Save energy: Robotic spray allow for more compact and precise painting which requires less physical effort.

III. PROBLEM STATEMENT AND PROPOSED DESIGN

In Today's small scale industries painting of different thickness and different dim of parts is done by manually. Its causes and error because of manually operation, for solving this problem Development of automatic painting machine to the different material bodies using Sensor and Automation.

3.1 Scope

Scope of this project is to develop an automated painting system. Overall scopes of this project are stated below:
1) Designing of an automated painting system.
2) Fabrication of the automated system.
3) Testing of the painting System.

3.2 Objective:

With the increasing advancements in automation and consistency in painting for manufacturing industry, it is also important to develop a low cost system to meet the needs of the industry. As in case of this project the material for painting will be Different dimensions and Different thickness which is extensively used in manufacturing industry.

3.3 Methodology:

The various steps involved in the making of the product are as follows:

1. Detection of color and deciding its RGB proportion using a color sensor.
2. Positioning and selection of colors.
3. Insertion of various mechanisms for the working of model.
4. Assembly of the parts used in the prototype.

Block Diagrams:

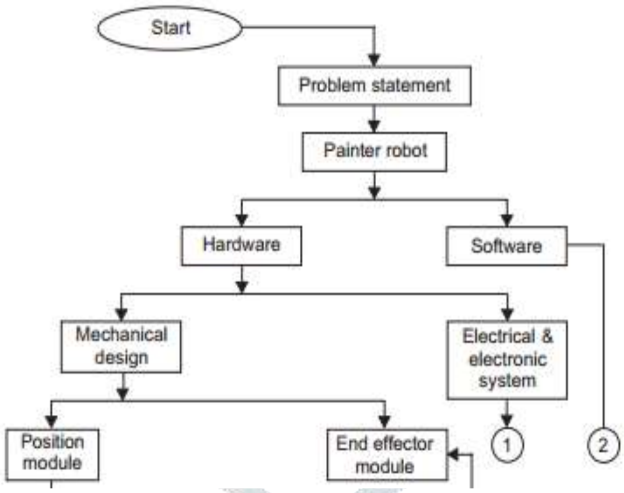


Fig 1: Block diagram

The block diagram gives a brief idea about various important parts of the wall painting robot. Here the important parts are controller, motor, battery, sprayer, micro controller, IR sensors, and key pad. Micro controller is brain of the system which will control the entire system in response to the instructions from the keypad and sensor controller through receiver. Battery is the power supply for the system which is chooses based on the sprayer timing and the system's average current. Four motors are used to motion of automatic wall painting robot. The spraying part is arranged with a sprayer gun, geared motor.

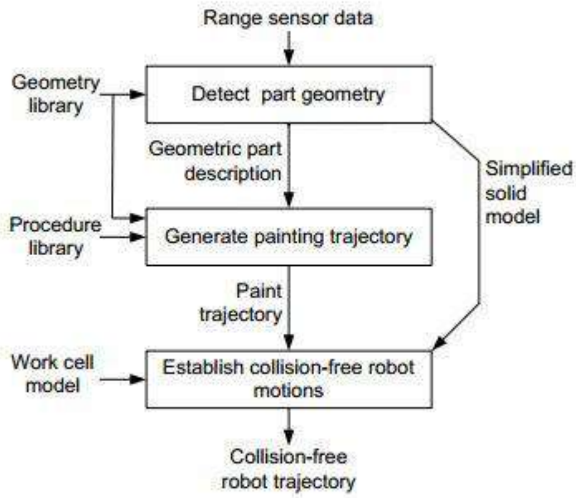
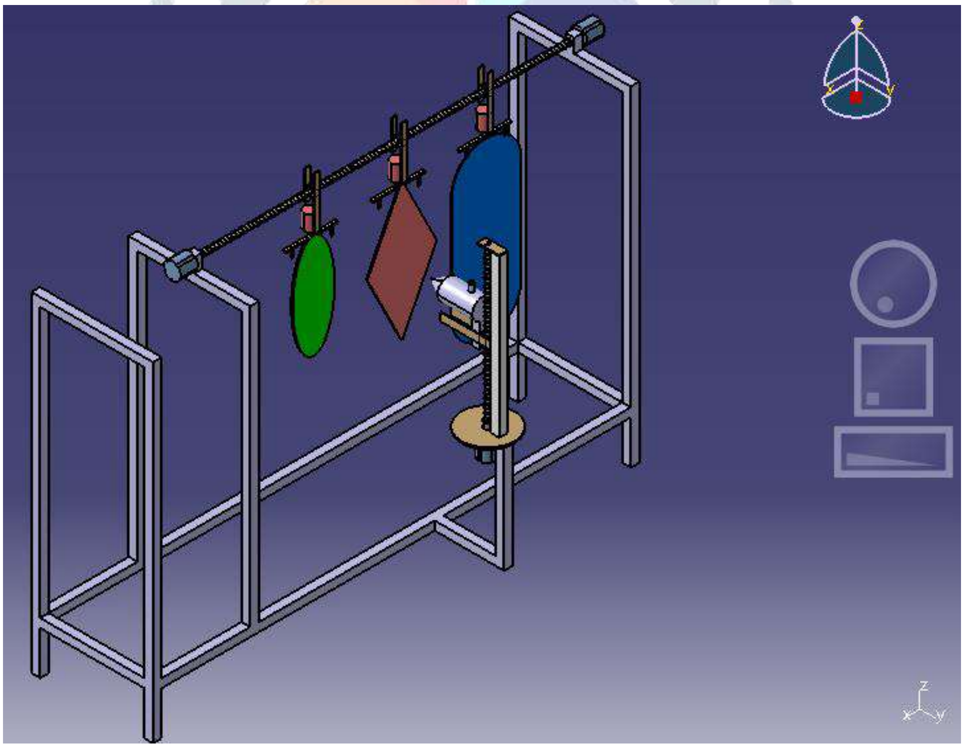


Fig 2: Block diagram of the Flex Paint system.

The Flex Paint approach is based on the observation that the parts comprise a large number of elementary geometries with typical characteristics for an entire product family. . These surfaces are smooth free form surfaces, which are very difficult to represent by use of simple geometric attributes such as cylinders, spheres and boxes. Hence, the goal is to specify these elementary geometries in such a way that generic methods for detecting and for path planning can be developed and that the variety of geometries seen in the applications is encompassed. The specification of elementary geometry types is based on the constraints of the painting process.

Proposed Design:



IV. EXPERIMENTAL RESULTS:

The system is already implemented as a prototype and has been tested in ABB's technical centre in Eichen, Germany. The purpose of these experiments was to prove the basic system concept. It was realized that process quality has to be optimized by establishing validated painting procedures for the individual geometric primitives. The painting procedures used were not established by preceding experiments. Since the surface was scanned only from one side of the part it was only possible to perform automatic spray painting of the scanned surface. However, it was observed that a relatively good painting quality was achieved on these parts of the surfaces, which were scanned. The prototype installation demonstrated to be capable of realizing production constraints: (1) any series of parts of the industrial parts can be scanned. And, (2) the motion of the conveyor requires an overall processing time of about 60 seconds. Range image processing requires about 30 seconds on a standard PC and path planning can also be executed in 30 seconds on a high end PC.

V. CONCLUSION:

A method has been developed for automatic spray painting of unknown parts. Experiments at ABB flexible automation, Friedberg have shown that the system concept is feasible. The input for the system does not include any pre-established CAD models or other information about the parts. The parts are entirely specified by geometry models,

Provided by a laser scanning system and customized feature extraction methods. Up to now the parts were scanned by one laser scanner only. The parts of the surfaces that were visible to the scanner were modeled in a 3D geometry model, which was used to automatically generate the motions of the spray gun. Collisions between the spray gun and the part and conveyor system were automatically avoided by a collision avoidance module from AMROSE Ltd. Robot programs were automatically generated using the Robot Studio off-line programming system from ABB. The robot programs were executed and the robot painted the scanned part of the surfaces. It was observed that the quality of the painted surfaces was good, although the Procedure Library is not yet sufficiently developed. Even though the project is primarily aimed towards robotic spray-painting, the "inverse approach" proposed can be applied for obtaining process motions for a large range of processes in the field of surface treatment. Examples of processes in which the approach can be applied are: powder painting, washing and cleaning with liquid (including high-pressure cleaning), washing and cleaning with physical contact between tool and part, de-greasing, sandblasting, polishing, sealing (e.g. for corrosion protection), inspection systems, polishing, grinding, debarring and gluing.

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