PRECISION FIELD MARKER ROBOT USING VIRTUAL PATH NAVIGATION

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ABSTRACT

Robotic technologies offer a very comfortable environment in the current world and even more sophisticated in the near future. The proposed model provides the ease of sports ground field line marking with high precision, of error not more than 5 centimeters. A consistent mathematical approach is given to extract the feature of the drawn field line pattern in the developed graphical user interface (GUI) with higher degree of approximation. The extracted features are fed into the robot, so that it lays the specific line marking on the field automatically without any human guidance or control. This model replaces the traditional way of human laying the field line markings that might lead to various human errors. This system provides the flexibility to draw any patterns and not only restricted to any particular type of sports field. Robot can even draw the road safety surface markings once it is programmed with that feature. By developing a user friendly interface this sketch based navigation of robots can be deployed for various applications.

Keyword: - *Field marker, GUI sketch robot, Sketching robot, Automated field robot, Virtual navigation, Sports robot.*

1. INTRODUCTION

In recent times Indoor robotics and automated robots are in a significant progress in almost every field. Automation provides the precision and also the ease of doing any work to any complicated level. While the use of personal computing devices has become common, we create a system to control the robots through our PC. Any sports playground field can be scaled and drawn in the computing interface and thereby program the field marker robot to draw the field on the ground. The main idea of the project concept is to "Sketch and Run" [1], through which we make the job as an easy to use module with the technology.

The conventional method of drawing the field using a white powder by moving a dropper or dispenser machine manually is replaced by the latest technology. The main objective is to develop a field marker robot that could automatically draw the field patterns once the field is sketched in the computing device. Here different sketch feature extracting algorithms are used that capture the mathematical feature of the sketch drawn in the Graphical user Interface (GUI). Once the sketch is drawn in the processing GUI, it is programmed to extract the significant features like the angle of movement of sketch, direction of movement of sketch, home point or the start pint of the sketch, end point of the sketch and when to drop the paint up and down. Depending on these features extracted from

the drawn sketch the precision is guaranteed by the hardware to replicate the field lines in the real time sports ground or the safety markers on the road.

The developed model has an easy-to-use graphical user interface to sketch any type of field patterns or road safety patterns and the precision of this field marker robot can be made better, so that the error is much reduced to be not more than 5 cm. The developed model is more flexible to draw any kind of sports field with much accuracy in real time. Once the exact field size to be laid is known then design is done in the graphical user interface (GUI) and then the sketch feature is extracted and that knowledge is transferred to the robotic field marker robot and then the robot is ready to mark the field lines any number of times with greater precision.

Fig -1: Traditional manual field marking

2. PROPOSED APPROACH

2.1 Design

The prototype that was designed was simple consisting of:

- Arduino UNO board
- 3 X Servo Motors
- 4 X wheels
- Robotic Chassis
- 12 V Battery

The robotic system [6] has an easy to use Graphical user interface in order to sketch the sports field layout and any type of field patterns or road safety patterns [2]. The robot is more flexible to draw any type of field patterns with all are and size specifications. This robot is designed to be very accurate to the precision of about +/- 5 centimetres. This robot provides the ease of drawing the field marking with accuracy replacing the traditional method of drawing the field using a painting machine by moving it manually where it might end with error.

2.2 Methadology

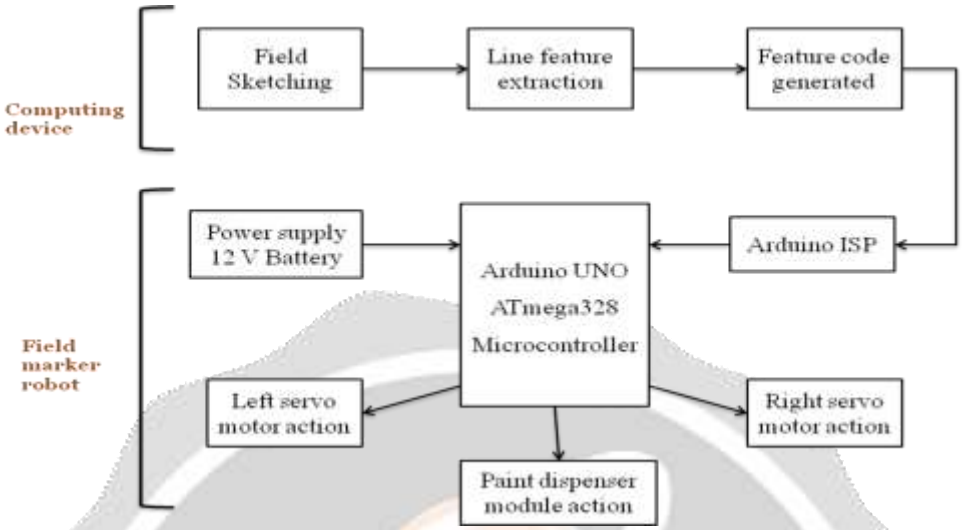

Fig -2 Block diagram of Precision Field Marker Robort

The project is based on robotics automation [7] where the human knowledge is given to the robot so that the work is done by the robot with much precision. The main objective of the project is to develop a field marker robot that could automatically draw the field patterns once the field is sketched in the computing device. The block diagram of the proposed model is grouped into two divisions one is the computing device section where the user sketches the field layout in the GUI developed using processing p3 software, then the drawn field line layout features are extracted through mathematical algorithm used. According to the feature extracted the hardware understandable coding is generated with respect to the field sketch drawn in the GUI. The other section is the hardware section that is the field marker robot which is controlled by the Arduino UNO ATmega328 microcontroller. Arduino UNO ATmega328 microcontroller is the brain of the robotic system and it is used to control various devices and motors attached. It is powered using a 12 volt battery power supply.

The feature code generated is programmed into the Arduino ATmega328 microcontroller by means of Arduino ISP (In-System Programmer). After the code is programmed, the microcontroller does the processing and accordingly the left and right servo motors are rotated by giving a torque action. Also the paint module [3] or the marker controlling servo motor is rotated. Thus the robot is used in the application of marking various sports field [4] or the road safety markers.

Fig -3: Day light image of Jawaharlal Nehru stadium, Tamilnadu, Chennai

2.3 Functional Methods

Scaling: The required field pattern and its specific The GUI is developed with the help of processing p3 open source software which consist of a sketching work area to draw the field layout and various parameters. The designed processing interface will easily turn drawings into code for the robot to follow. The user interface requires 4 pieces of information before you can start drawing: the time it takes your robot to do a complete 360 degree turn, the speed of your robot (cm/s), the window height, and the window width. These are all crucial to have an accurate drawing with good precision. In the interface just buttons are clicked to change the values. A left click increases the values and a right click decreases a values. Once the setup is completed the "Done" Button is clicked. A small scale version of your sports ground window will appear.

Measurements are scaled in order to sketch the field layout.
Parameter adjustment: various parameters are defined such as window length and breadth, robot speed, home point.
Sketching: field layout is drawn in the graphical user interface.
Programming: Arduino ISP is used programming the Arduino UNO microcontroller.
Action: controlling the left and right servo motor and the paint dispenser module or marker pen.

2.4 Design and working in GUI

Table -1: Ideal parameters considered for prototype

Parameter	Values
Robot 360 cycle time	8 seconds
Robot speed	8 cm/second
Field window height	100 cm
Field window width	100 cm

Before sketching the field the "Homepoint" button has to be clicked and drag it onto the mock window. Wherever you release it a small red circle will appear, this is the place that robot [5] must be placed in real time to start the drawing, and it will return to that spot at the end of the drawing. Now to start drawing the mouse is clicked and dragged in the scaled version of the window. Where the first click of the mouse will be the start point of the line and where it is released will be the end point of the line. There is also an "Undo" button in case of mistakes. Wherever a white line is seen it indicates that the robot will lower the pen and draw, between those lines it lifts the pen and moves to the start of the next drawn line. Once the drawing is done "Generate Code" button is clicked. In the bottom of the original processing sketch, a bunch of arduino commands will appear. These commands are copied which will be used in the arduino programming.

3. RESULT AND ANALYSIS

Thus, the field layout in drawn in the interface and the feature is extracted by means of processing p3 software.

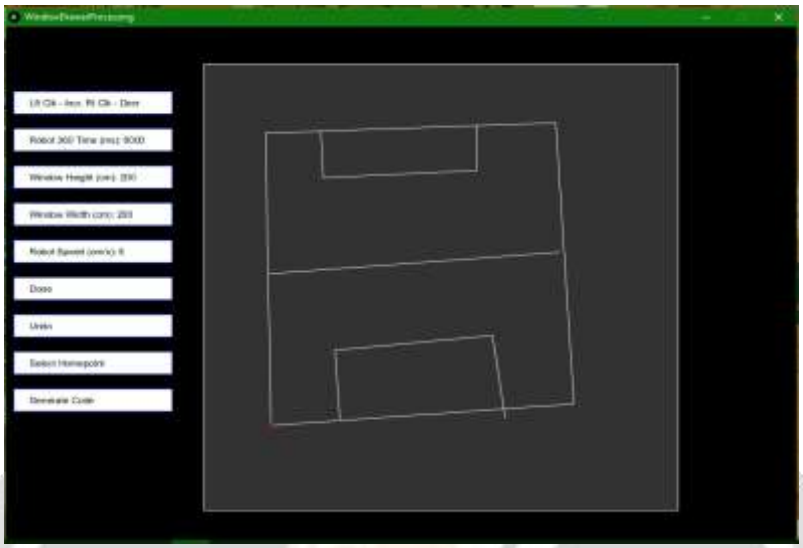

Fig -4: Field Sketching in the GUI

The code generated with respect to the sketched field is given to the hardware and the robot is made to navigate along the sketched virtual path. The prototype was developed with the marker pen installed instead of paint module; the robot was checked for performance and was navigating as expected according to the pattern drawn in the interface with good precision.

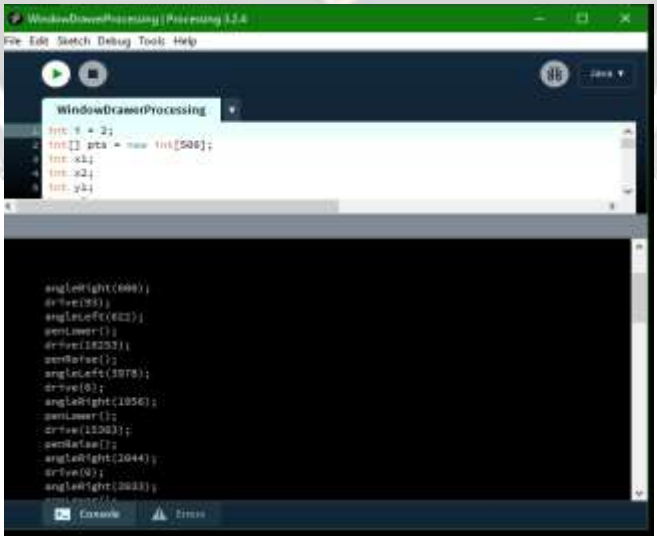

Fig -5: Generated code in Processing P3 software

4. CONCLUSION

Automated robots are a very essential future technology. The Field marker robot provides the ease of marking the sport field lines. The proposed work is done only for extracting straight line sketch features. Further this model can be enhanced by including the algorithm to extract the contour or curved paths, so that it is possible to draw any shapes of the field. This system provides the users to easily design and deploy the field pattern by offering higher efficiency. Besides this robot is more flexible to draw any pattern and thus can be deployed to automatically paint the road safety sign markings on the road, therefore highway road markings for several kilometers can be painted easily with less time and much accuracy. In the future work, Global positioning system and Internet of Things will be included in the system to provide the location awareness knowledge and to operate the robot using internet protocols. Besides, proposed design may also be optimized by providing sensor's feedback to the Controller.

5. REFERENCES

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