CONCEPT OF AUTONOMOUS ROAD MEDIAN BLOCK PAINTING MACHINE

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Abstract: The autonomous mobile robots used for development of road marks painting. This document deal with Concept of Autonomous Road Median Painting Machine with the help of Arduino in order to avoid fatal accidents and large man power involvement. The important purpose of the system is to accomplish its tasks using the autonomous navigation device for road detection and painting. The advantage of this system is to minimize the blocking of the roads during painting and repainting of the faded marks.

Keywords: Autonomous mobile robots, road median painting, repainting, road detection, navigation.

I. INTRODUCTION

The Painting of the Road Median Blocks ensures more safety for the road users and to prevent fatal accidents, nowadays the paint get faded easily, and the painting process could not accomplish properly due to the lack of manpower assistance and making obstacle to the road users, during low lights, road covered by fog drivers find difficult to identify the road median, if it is not painted properly this leads to accidents to avoid this we employed an autonomous machine to done this work periodically. Road mark paintings are used on the paved roadways to provide guidance and information to the drivers and pedestrians. A number of the markings on the roads can be classified into five categories [1], i.e., longitudinal, lateral, merging diverging, symbols & letters and special situations.

II. MEDIAN BLOCK PAINTING

CONSTRUCTION

Create the body according to the Road median or it may be adjustable to fix in the block without any misalignments will move on the guide properly, at the top of the body place a two separate tanks to store the paint of different colors (Black, yellow, white) to be coated on the surface, the space near to that place controllers and power units, on the either sides placing Ultrasonic sensors to avoid obstacles, inside the machine we place a two separate painting roller brushes, for painting actions two stepper motors are connected with the roller brush and controlled by an Arduino, on the ground the servo motors were placed for the movement which was also controlled by Arduino.
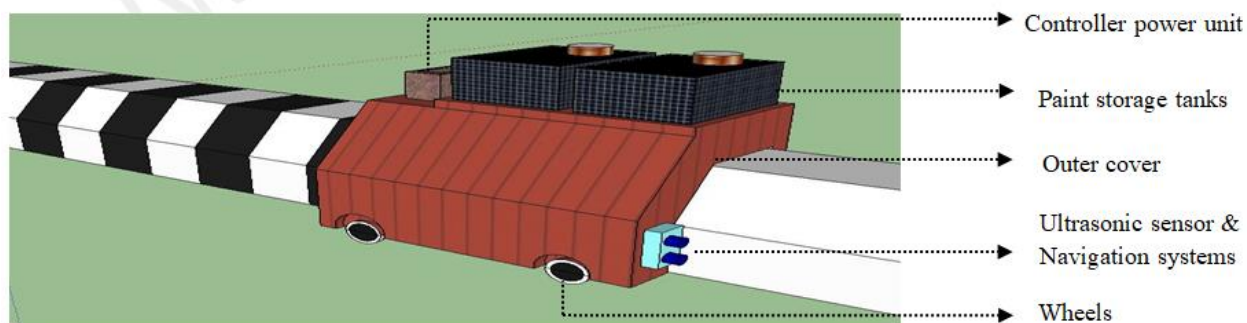

FIG 1: CONCEPT MODEL

Components involved

1. ARDUINO

Arduino is an open-source project that created microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices. Arduino is an open source hardware and software project, created with a simple aim in mind, to be as simple as possible.

-Microcontroller ATmega328P

-Operating Voltage: 5V

-Digital I/O Pins 14 (of which 6 provide PWM output)

-PWM Digital I/O Pins 6 Analog Input Pins 6

-Flash Memory 32 KB (ATmega328P) of which 0.5 KB used by Bootloader.

Program must be coded to actuate the servo and stepper motors

2. STEPPER MOTOR

Stepper motors are DC motors that move in discrete steps. They have multiple coils that are organized in groups called "phases". By energizing each phase in sequence, the motor will rotate one step at a time. With a computer controlled stepping you can achieve very precise positioning and/or speed control. For this reason, stepper motors are the motor of choice for many precision motion control applications.

3. SERVO MOTOR

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

4. ULTRASONIC SENSOR

Ultrasonic sensors "are based on the measurement of the properties of acoustic waves with frequencies above the human audible range," often at roughly 40 kHz. They typically operate by generating a high-frequency pulse of sound, and then receiving and evaluating the properties of the echo pulse. Using for obstacle detection in our concept.

5. WIRELESS SENSOR

Wireless sensor network used to monitor and record the conditions of the environment. It measures environmental conditions like temperature, sound, pollution levels, humidity, and wind etc., it used for human existence detection in case of disasters. It performs simultaneous localization and mapping and communicates over wireless sensor.

6. NAVIGATION

It is used to focus on the process of monitoring and controlling the movement of robots from one place to another. Autonomous Navigation System (ANS) was an on-board, integrated suite of sensors & technology that enabled autonomous navigation, perception, path planning, a vehicle-following capabilities for unmanned ground vehicles, allowing them to move on the battlefield with minimal human oversight. It performs obstacle detection and avoidance and follower capabilities in both day and night conditions [2].

7. PATH PLANNING

Path planning is an important process for autonomous mobile robots which used to find the shortest path between two points. Algorithms are used to find shortest path in robotics. It also requires map of the environment for the robot to get aware of the locations.

PATH PLANNING ALGORITHM

DIJKSTRA'S ALGORITHM:

This algorithm use to mark all direct neighbours of the initial vertex with cost where the path should start. Depending on the vertex low cost it marks all the remaining neighbours and checked it. Once the algorithm reaches its destination vertex, then robots can follow the edges towards the lowest edge cost.

A* ALGORITHM:

Much faster than Dijkstra's algorithm. It is the process of plotting an efficiently directed path between multiple points called nodes. An extension of A* addresses the problem of re-planning when obstacles detected in the path of the robot is known as D*.D* starts from destination vertex & has the ability to change the cost of parts of the path. This allows D* to re-plan around the obstacles.

8. GPS

Global positioning system (GPS) is a satellite based radio navigation system. It doesn't require the user to transmit any data. It receiver monitors multiple satellites and to determine the position of the receiver and deviation from its true time.

9. BEACONS

It helps to guide navigators to their destinations. It includes radar reflectors, radio beacons, sonic and visual signals. The visual beacons range from small, single-pile structure to large lighthouse or light station & it is located in land or on water. Vehicular beacons are rotating or flashing lights affixed to the top of vehicle to attract the attention of surrounding vehicles. Especially used in emergency vehicles.

10. ANTENNA

It is an electro-magnetic signal which used to transmit & receive signal from & to the air. It works at GPS frequencies.

11. PARTICLE SWARM OPTIMIZATION

It's really a very simple algorithm. Over a number of iterations, a group of variables have their values adjusted closer to the member whose value is closest to the target at any given moment.

The algorithm keeps track of three global variables:

   a) Target value or condition

   b) Global best (g-best) value indicating which particles data is currently closest to the target.

   c) Stopping value indicating when the algorithm should stop if the target isn't found

Each particle consists of:

   a) Data representing a possible solution

   b) A velocity value indicating how much the data can be changed

   c) A personal best (p-best) value indicating the closest the particles data has ever come to the target. [3]

III.   WHY IT MUST BE PAINTED

A. FOG AND LOW LIGHT

During this condition if the road median is not visible then it led to be an accident.

B. AUTO LANE ASSISTANCE

In recent cars having the feature of lane assistance without this marking it will not able to adjust the vehicle according to the lane.
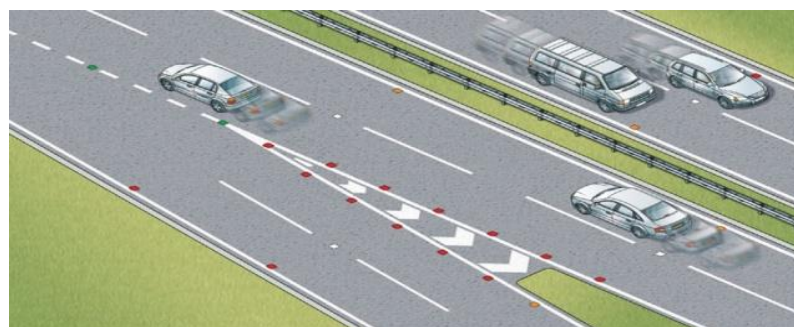

FIG 2: AUTO LANE ASSISTANCE

IV.   CONCLUSION

WHY AUTONOMOUS

- Reducing man power and human fatigues.

- Human interrupts free road ensures fast and safe ride.

- Reduce wastage and proper painting by means of autonomous system.

- Easy access for guided vehicles.

- Avoid fatal accidents.

FIG 3: HUMAN INTERRUPTS

.This system needs a little amount of power which can be charged in storage battery and operated for a while.

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