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Design Of Low Cost Autonomous Environment Cleaning Vehicle

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Abstract— cleaning public places is a field where more human power is required. This leads to wastage of human resources. The solution to this problem would be autonomous robots. The proposed project is Autonomous environment cleaning vehicle. This vehicle cleans its surrounding without any human intervention. The work done by the robot includes several common tasks such as navigation, object detection and discrimination, obstacle avoidance, and task sequencing. The robot has a dustbin on its rear. Whenever the robot senses an obstacle with its camera, the image from the camera is processed to identify the waste from non-waste materials. If it is a waste material then the mechanical arm attached to the robot will lift the object and drop it in the dustbin. If the object is made up of metal, it is sensed in the mechanical arm and dropped in non-recyclable part of the dustbin. Hence in addition to waste collection, waste segregation is also done. All these processes are powered by a rechargeable battery. Hence this project will help to achieve a clean and hygiene environment.

I. INTRODUCTION

Robotics is an emerging field in the world which is bringing drastic changes in human life. Robots are designed in human interactive way and they are becoming part of lives. Human power is being saved by replacing it by robots in various fields. Cleaning public places is one such field where more human power is required. Autonomous trash collecting robots have been considered as benchmark for mobile robot design problem. These include several common tasks such as navigation, path planning, object detection and discrimination, obstacle avoidance, task sequencing and often multi-agent coordination. The major public problem faced by many developing countries, especially in India, is lack of uncollected trash littering the streets, roads, sidewalks, shopping malls, railway and bus stations and many other public places. An autonomous robot is a robot which performs behaviours or tasks individually with highest degree of autonomy. These are mainly desirable in fields such as household maintenance cleaning, wastewater treatment spaceflight, deliveringgoods and other services. Some of the modern factory robots are

allowed to be autonomous within the strict boundaries of their environment. Every degree of freedom may not exist in their surrounding environment, but the factory robot's workplace is challenging, can contain unpredicted variables and can be often chaotic. An autonomous robot can obtain information about its surrounding environment, work for more time without human intervention, move either all or part of itself throughout its operating environment without human assistance, avoid situations that are harmful to humans, public property, or itself unless those are specified in design specifications. They can also adapt to changing surroundings. Like other machines, these robots need regular monitoring and maintenance for proper performance.

Main objective of the proposed work is to develop completely automated garbage collector using ultrasonic sensor for providing self-driving which cleans interior spaces like factories and auditoriums.Also, the waste is segregated into metal waste and non-metal waste with the help of metal sensors for recycling purpose. The filling of dustbin is monitored and sent to the mobile application using blynk server with a help of wifi module.

Garbage collectors in this modern age were semi-autonomous that is, when the garbage gets filled it is collected by the humans using a truck or some vehicle. In the existing method of driverless vehicle GPS and (LIDAR) sensor are used for navigation and predicting directions. LIDAR uses light in the form of pulsed laser which gets affected by smog, heavy rain and causes refraction. Large data set of sensors are difficult to interpret, and it results in high cost.

The advancement of a proposed system is a mobile robot to collect waste and it is autonomous. The mechanical hand attached to robot is used to pick up the objects and dump it into the dustbin. The dustbin placed at top of robot will have metal proximity sensor to segregate metals from non-metals. This is done to identify the recyclable objects. The robot stops whenever it encounters a waste object in its path. The hand moves toward the waste and picks it up to throw in the dustbin. Arduino gets analog inputs from its surrounding and automates all the processes.

II. LITERATURE SURVEY

A. DEVELOPMENT OF AUTONOMOUS GARBAGE COLLECTOR ROBOT

In order to help in garbage collection and revolutionaries the whole process, the idea of an autonomous garbage collector came into existence which aims to provide cleaner surroundings and footpaths. This robot can sense obstacles through the two types of sensors attached to it. The Arduino is then programmed to move according to the set of

instructions along a predefined path. After the refuse bin is full, the sensors attached to it send the signal through the WiFi module to a web page. Hence this project even incorporates the principle of Internet of Things. The robot moves then to empty the trash bin in a designated place.

In this paper, the design of the autonomous garbage collecting bot uses engineering method. First, the needs of Municipal authorities are analysed, and then the basic operations which would be performed by the bot are decided. After that, the circuitry, the input and output devices are decided upon, then a basic framework is built. The basic points to focus upon are illustrated in the figure below. The functioning of the bot can be classified into four main categories. They are motion control of the bot, obstacle detection, garbage collection and disposal of garbage.

The primary aim is to introduce a way in which garbage could be collected and disposed efficiently; To analyse the problem of garbage disposal at a school, restaurant, office, hotel, production plant or any other suitable location; To design and develop a system for solving the problem; To test and maintain the implemented system. Theproject is divided into two main parts. The system is designed such a way that the garbage is collected automatically through line. For which there is a designed arena so that the machine will follow the specific path and also manually by using Arduino and Bluetooth module. The machine can be controlled by software which will give command to the robotic jaw to collect the stationary waste. It also has the characteristic to get controlled by voice command which makes the robot to collect the garbage according to the given command. The authors have designed a semi-autonomous garbage collector robot which can do multiple functions. This robot has one robotic arm in which it can pick the garbage and dispenseit in main basket attached to the robot. The camera placed on robot helpsthe administrator to remotely monitor the robot while collecting garbage. Theprototype has an electronic mechanism by which the robot can dispense itcollected garbage to the dispensing point. This robot has installed batteries inwhich there is no fuel or electricity required to complete the operation.

B. WASTE MANAGEMENT BY A ROBOT- A SMART AND AUTONOMOUS TECHNIQUE

The automatic traffic sign detection and recognition (TSDR) system is very important research in the development of advanced driver assistance systems (ADAS). Investigations on vision-based TSDR have received substantial interest in the research community, which is mainly motivated by three factors, which are detection, tracking and classification. During the last decade, a substantial number of techniques have been reported for TSDR.

This paper provides a comprehensive survey on traffic sign detection, tracking and classification. The details of algorithms, methods and their specifications on detection,

tracking and classification are investigated and summarized in the tables along with the corresponding key references. A comparative study on each section has been provided to evaluate the TSDR data, performance metrics and their availability. Current issues and challenges of the existing technologies are illustrated with brief suggestions and a discussion on the progress of driver assistance system research in the future. This review will hopefully lead to increasing efforts towards the development of future vision based TSDR system.

C. AUTONOMOUS CLEAN GARBAGE COLLECTOR

This paper presents an overview of the road and traffic sign detection and recognition. It describes the characteristics of the road signs, the requirements and difficulties behind road signs detection and recognition, how to deal with outdoor images, and the different techniques used in the image segmentation based on the colour analysis, shape analysis.

It shows also the techniques used for the recognition and classification of the road signs. Although image processing plays a central role in the road signs recognition, especially in colour analysis, but the paper points to many problems regarding the stability of the received information of colours, variations of these colours with respect to the daylight conditions, and absence of a colour model that can led to a good solution.

This means that there is a lot of work to be done in the field, and a lot of improvement can be achieved. Neural networks were widely used in the detection and the recognition of the road signs. The majority of the authors used neural networks as a recognizer, and as classifier. Some other techniques such as template matching or classical classifiers were also used. New techniques should be involved to increase the robustness, and to get faster systems for real-time applications.

III. METHODOLOGY

The robot is operated using an Arduino mega in autonomous mode.The trash is picked up using robotic arm made using 3servos.The collected trash is transferred to a trash bin attached to the robot platform. The trash bin has separate partitions for metallic and non-metallic trashes. Another Servo motor attached to the trash bin will rotate the bin so that the collected waste will fall into the corresponding partition of the bin.

In autonomous mode the robot locomotion and waste pickup is done without human intervention. The robot is placed at the centre of the workspace. Then it follows a coverage path planning algorithm/random path planning algorithm. The trash detection is made possible using 4 ultrasonic sensors placed in 2 rows (2 in one row). The sensing range is limited to about 30cm to avoid crosstalk.

Using this ultrasonic sensor configuration, the robot will be able to distinguish between big objects (walls) and objects that it may be able to pick. Big objects are considered as obstacles by the robot and are avoided. Other objects are considered as trash and are picked up by the robotic arm.

Metal detectors placed in the arm check the trash picked to be metallic or non-metallic and are dumped its corresponding partition in the trash bin.

Ultrasonic sensor placed in the trashbinmonitor the level of the waste in the bin. If the bin is full it is notified to the operator.

A. HARDWARE COMPONENTS

- At Mega 2560
- Servo.motors:
  Ultra Torque Dual Shaft Metal Gear 35kgcm Coreless Servo
- MG995 Metal Gear Servo 180 Degree Rotation
- LI-ION 11.1V 10000MAH (2C) With Inbuilt Charger-Protection
- ESP8266 Wifi Module
- Step Down Dc-Dc Adjustable Voltage Regulator
- LM1117 3.3V Output breakout board breadboard power supply
- USB to TTL module
- Metal detector
- Ultrasonic sensor

IV.BLOCK DIAGRAM

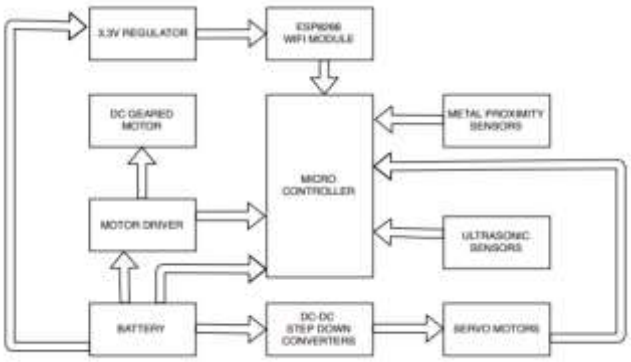

Fig 1 .Block diagram

V.RESULTS

The prototype of the Autonomous garbage cleaning vehicleis shown in below Fig.4.1. This prototype consists of ultrasonic sensor which makes the vehicle stop when an object is detected, and the robotic arm is moved from top to bottom.

Fig. 2.Autonomous garbage cleaning vehicle

Figure 3 and 4, after sensing the object the robotic arm picks up the object and throw it into respective trash can (metal/nonmetal) with the help of metal detector attached to it.

VI. CONCLUSION

The proposed work is used to clean the cities, industries, factories, hospitals and reduced pollution and keep disease free country. Its helps in minimizing human errors that in turns into major accident-causing devastating loss to public property. Inspection on this project completely paves path for 100 percent automated logistic transportation system which in turn helps in utilizing human labour in more efficient manner

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