Automatic Garbage Separation Robot Using Image Processing Technique

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Abstract— Solid waste management is a big challenge in urban areas for most of the countries throughout the world. An efficient waste management is a pre requisition for maintain a safe and green environment as there are increasing all kinds of waste disposal. Many technologies are used for waste collection as well as for well managed recycling. The Information gathering is cumbersome. The robot capable of detecting the object in the random movement after detecting the object the robot senses by webcam and followed by image processing, after the segmentation process the robot classifies the waste into de gradable and non-degradable waste. The robot run with 60 rpm motor and the arm movement of the robot run with 10 rpm motor and the process is interface with serial port by interfacing device. By Image processing technique, modifications in the robotic arm, navigation, image, and interfacing modules the encountered various problems in garbage collection.

Keywords: Automatic, Garbage, Image Processing, Separation, Micro-Controller, Mobile Robot.

1 INTRODUCTION

To make our environment sustainable handling of solid waste in household and industrial cleaning and ocean conservancy is a complicated task [1]. To reduce the human work in cleaning and sweeping, to develop artificial intelligent robots in industries, to decrease the human effort and manpower in the cleaning, and there by separating the garbage into degradable and non-degradable wastes. The whole purpose of assigning robots to do a man's work is to reduce our work load and most importantly, do the job for us in environment that is too hostile for us. we are trying to design a robot that is capable of automatic cleaning with the help of its arms that can be able to reduce the man power for the cleaning purpose mainly in industries , and there by separating the waste into degradable and non-degradable to avoid polluting environment. The concurrent effects of a fast national growth rate, of a large and dense residential area and a pressing demand for urban environmental protection create a challenging framework for waste management [2]. The complexity of context and procedures is indeed a primary concern of local municipal authorities due to problems related to the collection, transportation and processing of residential solid waste today the garbage collection is manual which takes a lot of efforts and is time consuming [3].

2. EXISTING SYSTEM

The robot capable of collecting the garbage within the line by the Arduino controller (cop toplayan robot) and the robot can able to collect the garbage within the line and after the collection of certain quantity of garbage the robot search for the trash bin and dispose wastes to the collected.

3. PROPOSED SYSTEM

proposed system, the robot detect the object by the ultrasonic sensor can collect the garbage automatically by sensing using web camera by the image processing technique using mat lab, the robot can be able to separate the garbage into degradable and non-degradable waste. Embedded c programming used for the arm and gripper movement by the PIC micro-controller and the separation of garbage is done by the image processing technique of size[4], color and texture as shown in fig 1.1.

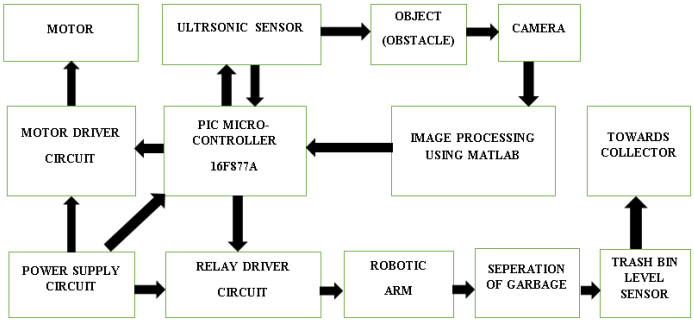

Fig 1.1 Flow Chart

A. REQUIREMENT SYSTEM ANALYSIS:

The automatic garbage separation robot used in the category of mobile robot to follow the wall and the waste garbage.
The requirement is obtained as follows:

- Robot is programmed with embedded c programming with pic-controller of PIC-16f877A.Which consist of 40 pins and 5 ports.
- The vehicle movement is carried out by the two gear motor of 60 rpm at 12 v DC motor gearbox of 125 gm weight and followed by the castor wheel.
- Arm used for picking the object, which consist of two motors, one motor is for forward and backward moment and another is for left and right moment. (10 rpm).
- The gripper is fixed at the end of the arm.
- And the motor driver circuit [5] of L293D which is used to drive the gear motors [6] consist of 4 inputs and outputs.

- The relay driver circuit is placed in order to work as a Electromagnetic switch for on and off.
- The power supply circuit is placed in order to supply the power according to each power input capacity.
- Webcam which is connected and is interfaced with RS 232 (Recommended Standard 232) with serial ports.

B. DESIGNING HARDWARE AND SOFTWARE:

- The PIC16F877A Micro-controller [7] has major advantage of 40 pins and 5 ports with brown out circuitry detection and the watch dog timer.
- The vehicle, arm and the gripper moment is controlled by embedded C programming.[8]
- Processing of the image is done with Mat-lab image processing as shown in fig 1.2 and by the Euclidian classification it classifies the waste into degradable and non-degradable and interfaced with RS232 [9].

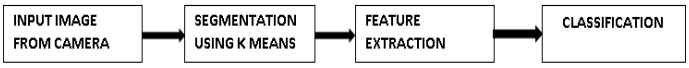

Fig 1.2 Mat lab Image Processing

K-means Algorithm for Segmentation:

The K-means algorithm is used to segment the paper and vegetable separately.
1) Randomly select '*c*' cluster centers.
2) Calculate the distance between each data point and cluster centers.
3) Assign the data point to the cluster center whose distance from the cluster center is minimum of all the cluster centers.
4) Recalculate the new cluster center using:

$$V_i = (1/c_i) \sum_{j=1}^{c_i} x_i$$

where, 'c_i' represents the number of data points in i^{th} cluster.
5) Recalculate the distance between each data point and new image is obtained from cluster centers.
6) If no data point was reassigned then stop, otherwise repeat from step 3.

FEATURE EXTRACTION:

1. Color feature extraction
2. Size feature extraction
3. Texture feature extraction

1. COLOR FEATURE EXTRACTION:

In color image features in R, G, B color projection values are extracted and stored in database using specified programming methods.
Step 1:- All ten thousand images are taken in to working directory of MATLAB.
Step 2:- Using MATLAB programming all image features in R, G, B color projection values are extracted and stored in database using specified programming methods.
Step 3:-Threshold calculation is taken for categorizing the images into a similar feature groups. In this step, threshold value is computed based on the histogram calculation. If the image is a color image it will convert into gray color image.
Step 4:-In usual methods, image color values are storing in matrix form. Using Image matrix, all R, G, B components in image are extracted and separated into three different array forms.
Step 5:- Using the feature vectors, each image color wise means are computed. In this method row and overall image mean are computed and stored into the database. Based on all this features different computing methods are formulated.

2. SIZE FEATURE EXTRACTION:

Size feature extraction is used to find the size of the vegetable fruit and shape. It is depend upon the size parameter of the Mat lab command.

3. TEXTURE FEATURE EXTRACTION:

These filters are based on multichannel filtering, which emulates some characteristics of the human visual system. The human visual system decomposes an image formed in the retina into several filtered images, each of them having variations in intensity within a limited range of frequencies and orientation.

CLASSIFICATION:

Euclidian distance classifier:

Let assume 'n' as to seek and estimate the density function P(x) from a dataset of examples n P(x) can be approximated by the expression n The volume V is determined by the D-dim distance RkD(x) between x and its k nearest neighbor Where cD is the volume of the unit sphere in D dimensions.

The unconditional density is, again, estimated with n And the priors can be estimated by n The posterior probability then becomes n Yielding Discriminant functions g This is known as the k Nearest Neighbor classifier is given by N V k P(x |) i i i = N N P( ) i i = k k NV k N N N V k P(x) P(x |)P( ) P(| x) i.

4. WORKING PRINCIPLE

The robot works under the random movement of the vehicle and if any scrap is detected by the ultrasonic sensor the vehicle stops and the object is sensed using camera by the image processing technique of size, color and texture. After the processing of the image the robot can able to analyse whether the object is degradable or non-degradable waste, which is done by programming in the Matlab and then it is collected by means of Gripper and there by separating the waste into two bins of one is for degradable waste and another one is non-degradable waste which is kept at the back end of the

vehicle.LCD (Liquid Crystal Display) is used in a project to visualize the output of the application. We have used 16x2 LCD. So we can write 16 characters in each line. Total 32 characters we can display on 16x2 LCD.LCD can also use in a project to check the output of different modules interfaced with the microcontroller. Thus LCD plays a vital role in a project to see the output and to debug the system module as shown fig 1.3 .

5. CONCLUSION

Although the final AGSR (Automatic Garbage Separation Robot) was a relative success, the team has created an outline for future improvement in terms of research and theory, implementation, and program management. On a high level, more research should have been done regarding the interfacing between modules so that a specific implementation plan could have been created. This would have allowed the team to avoid on-the-fly creation of code with limited functionality and debugging. In addition, more time should have been spent researching mechanical design of the robotic arm, whose problems led to a limited functionality of the robot.

Fig 1.3 Automatic Garbage Separation Robot

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REFERENCES

[1]Available:http://www.oceanconservancy.org/who-we are/newsroom/2013/ocean-conservancys-internationalcoastal cleanup-announced-for-september-21.html. (1-2014)

[2] N. Kelly, "A Guide to Ultrasonic Sensor Set Up and Testing Instructions," Limitations, and Sample Applications. [Online]. Available: http://www.egr.msu.edu/classes/ece480/capstone/fall09/group05/docs/ece480_dt5_application_note_nkelly.pdf.

[3]. Gareth J.Monkman, Stefan Hesse, Ralf Steinmann, Henrikschunk "Robot Grippers" ISBN:978-3-527-40619-7,pp 463 November 2006

[4] Understanding Matlab, "A Textbook For Beginners Paperback"30 August 2013 by S.N Alam(Author).

[5]. Electrical machines, drives and power system sixth edition by theedore wildi and pearson.

[6]. G.K. Dubey "Fundamental Electrical Drives" second edition 2002, Narosa Publications, Second edition, 2002.

[7]. B.P. Singh, Microprocessors and Microcontrollers, Galcotia Publications (P) Ltd, First edition, New Delhi, 1997.

[8]. Embedded Controller Hand book, Intel Corporation, USA.

[9]. Terry Baltelt, Industrial electronics, devices, systems and applications-Delmar publishers- 1997.S.