Smart Garbage Separation Robot with Image Processing Technique

Rani Rokade[1], Avdhesh Maurya[2], Vaishnavi Khade[3], SwetaTandel[4], Prof. Jyoti Mali[5]
Department of Electronics &Telecommunication Engineering,
Atharva College of Engineering,
Mumbai, India

***Abstract*—Rising garbage of the world poses serious threats to human being because escalating amount of waste generated each minute by an individual. Approximate 0.2 million tones' garbage generated per day only in India. Maximum garbage cannot be fixed to proper solution because separation mechanism is not present widely in India. Only rage picker do separation of garbage in some cities but it cannot complete the whole separation. As only 30-40% garbage is separated daily. Some garbage cannot be separated by hand as they are hazardous like chemical waste, medical waste, floating waste etc. so the separation of the garbage is needed which is safe, lenient and automatic. Therefore aim of the paper is to present a smart robot which is capable of separating degradable and non- degradable waste using image processing techniques. The proposed robot is in random motion whenever it senses any object it stops and camera takes image of the object, after processing and segmentation is done, it separates waste into degradable and non-degradable waste.**

Keywords- Robot, garbage, segmentation, processing, automatic, webcam, microcontroller, dc motor.

I. INTRODUCTION

Waste segregation and recycling are effective ways of reducing dumped trash.. People have been negligent when it comes to proper waste disposal, ignoring labels and throwing recyclables that can still be reused. Most are unaware or choose to ignore the fact the waste segregation and recycling can reduce cost, reduce drain in our resources, and lessen the waste being produced. Typical composition of garbage people throw in are 5.8% metals, 3.5% glass, 1.6% plastic, 12.9% papers, 1.8% textiles and 53.7% biodegradables which means only the remaining 20.7% of the wastes should really be going to our landfills. In our country, recycling centers do manual process of sorting wastes leading to a high risk of acquiring sickness. This study aims to automate waste segregation and implement a waste delivery system that would minimize human interference in the waste collecting and segregation process. Garbage such degradable and non-degradable are the wastes that need to be segregated in this project.

II. METHDOLOGY

It is PIC microcontroller based garbage separation robot block diagram is shown in fig1.

A simple PIC microcontroller is root of the system. It controls the working and time period of all the subSection. So as to separate the garbage into degradable and non-degradable there is some primary categories.

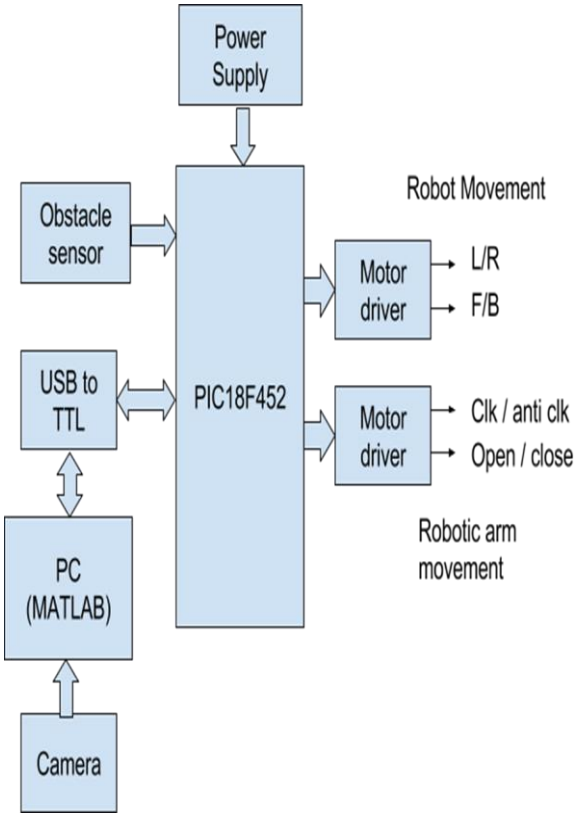

Fig.PIC microcontroller based garbage separation model

III. FLOW OF PROJECT

In this project one robot with robotic arm is used to segregate the garbage automatically.

Robot is made with PIC controller and DC motors, robot can move left, right, forward and backward and robotic arm can do movement as clockwise, anticlockwise, open and close.

There are two modes to operate the project, manual and auto.

A. Manual Mode

In manual mode, user will give command manually from PC GUI and through USB to TTL command will received from PC, be given to PIC controller. And according to command robot will act.

B. Auto Mode

In this mode, waste will be segregated using image processing; camera is attached in front of robot. Which will capture the image of waste and will give it to MATLAB for image processing. PC will give command to robot to start move forward and till any obstacle is detected using obstacle sensor it will continue to move forward. After detecting any obstacle robot will stop and camera will on to take garbage image.MATLAB will process it and according to garage detected, robotic arm will dump it in respective bin.

IV. COMPONENT DETAILS

A. 1.PIC 18F452 microcontroller

PIC microcontrollers (Programmable Interface Controllers), are electronic circuits that can be programmed to carry out a vast range of tasks. They can be programmed to be timers or to control a production line and much more. They are found in most electronic devices such as alarm systems, computer control systems, phones, in fact almost any electronic device.

B. 2.Motor driver L293D

Since motors require more current then the microcontroller pin can typically generate, you need some type of a switch (Transistors, MOSFET, Relay etc.,) which can accept a small current, amplify it and generate a larger current, which further drives a motor. This entire process is done by what is known as a motor driver.

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC, Dual H-bridge Motor Driver integrated circuit (IC). The l293d can drive small and quiet big motors as well.

C. 3.DC motor -30rpm, 12v

The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion.

Every DC motor has six basic parts axle, rotor (a.k.a., armature), stator, commutator, field magnet, and brushes. In most common DC motors (and all that Beamers will see), the external magnetic field is produced by high-strength permanent magnets.

The stator is the stationary part of the motor this includes the motor casing, as well as two or more permanent magnet pole pieces. The rotor (together with the axle and attached commutator) rotates with respect to the stator. The rotor consists of windings (generally on a core), the windings being electrically connected to the commutator. The above diagram shows a common motor layout with the rotor inside the stator (field) magnets.

Interfacing a DC motor with a microcontroller. Usually H-bridge is preferred way of interfacing a DC motor. These days many IC manufacturers have H-bridge motor drivers available in the market like L293D is most used H-Bridge driver IC. H-bridge can also be made with the help of transistors and MOSFETs etc. rather of being cheap, they only increase the size of the design board, which is sometimes not required so using a small 16 pin IC is preferred for this purpose.

D. Obstacle sensor

It consists of three major components. The first is an Infra-Red (IR) transmitter (usually an IR LED), the second is a TSOP (an Infra-Red receiver) and third IC 555.

The main difference between LED and IR LED is that IR LED emits Infrared Radiations, which we cannot see by our naked eyes. TSOP requires the incoming data to be modulated at a particular frequency and would ignore any other signals. It is also immune to ambient IR light. They are available for different carrier frequencies from 32 kHz to 42 kHz.The transmitter part of the sensor project is an Infrared (IR) Led which transmits continuous IR rays to be received by an IR receiver. The output of the receiver varies depending upon its reception of IR rays. Since this variation cannot be analyzed as such, therefore this output can be fed to a comparator. Here operational amplifier (op-amp) of LM339 is used as comparator.

When the IR receiver does not receive signal the potential at the inverting input goes higher than that that at non-inverting input of the comparator (LM 339).

Thus the output of the comparator goes low and the LED does not glow .When the IR receiver receives signal the potential at the inverting input goes low. Thus the output of the comparator (LM 339) goes high and the LED starts glowing. Resistor R1 (100), R2 (10k) and R3 (330) are used to ensure that minimum 10mA current passes through the IR LED, photodiode and normal LED, respectively. Resistor VR2 (preset=5k) is used to adjust the output. Resistor VR1 (preset=10k) is used to set the sensitivity of the circuit.

Truth table:

- High (1): Obstacle not sensed
- Low (0): Obstacle sensed

E. USB to TTL

The cable is easiest way ever to connect to your microcontroller/Raspberry Pi/Wi-Fi router serial console port. Inside the big USB plug is a USB<->Serial conversion chip and at the end of the 36" cable are four wire - red power, black ground, white RX into USB port, and green TX out of the USB port. The power pin provides the 5V @ 500mA direct from the USB port and the RX/TX pins are 3.3V level for interfacing with the most common 3.3V logic level chipsets.

F. Web camera

Webcams are known for their low manufacturing costs and flexibility, making them the lowest cost form of video telephony. They have also become the source of security and privacy issues, as some built-in webcams can be remotely activated via spyware. Webcams typically include a lens, an image sensor, and some support electronics. Various lensess are available, the most common in consumer-grade webcams being a

plastic lens that can be screwed in and out to set the camera's focus. Fixed focus lenses, which have no provision for adjustment, are also available. As a camera system's depth of field is greater for small imager formats and is greater for lenses with a large f-number (small aperture), the systems used in webcams have sufficiently large depth of field that the use of a fixed focus lens does not impact image sharpness much. Image sensors can be CMOS or CCD, the former being dominant for low-cost cameras, but CCD cameras do not necessarily outperform CMOS-based cameras in the low cost price range. Most consumer webcams are capable of providing VGA-resolution video at a frame rate of 30 frames per second. Many newer devices can produce video in multi-megapixel resolutions, and a few can run at high frame rates such as the PlayStation Eye, which can produce 320×240 video at 120 frames per second. Support electronics are present to read the image from the sensor and transmit it to the host computer. The camera pictured to the right, for example, uses a Sonic SN9C101 to transmit its image over USB. Some cameras, such as mobile phone cameras, use a CMOS sensor with supporting electronics "on die", i.e. the sensor and the support electronics are built on a single silicon chip to save space and manufacturing costs.

G. MATLAB Image processing algorithm

The program should recognize the objects like circles, rectangles, and squares from the input image. This is a shape classifier based on the properties of each shape, like roundness, ratio of dimensions, centroid etc. In this classifier we will recognize only shapes like circles, rectangles, and squares from the input image. So, we will concentrate on the steps we will follow to recognize from any input image. We have seven steps:

1. Read the RGB (colored) image in from user.
2. Convert image from (RGB) colored to gray image.
3. Threshold the image (convert gray image to binary image).
4. Invert the binary image (in order to speed up the time of processing).
5. Find the boundaries concentrate.
6. Determine shapes properties (ratio of dimensions, roundness).
7. Classify shapes according to its properties.

- Input : RGB image have the shapes to recognize.
- Output: The RGB image with shapes recognized and labeled.

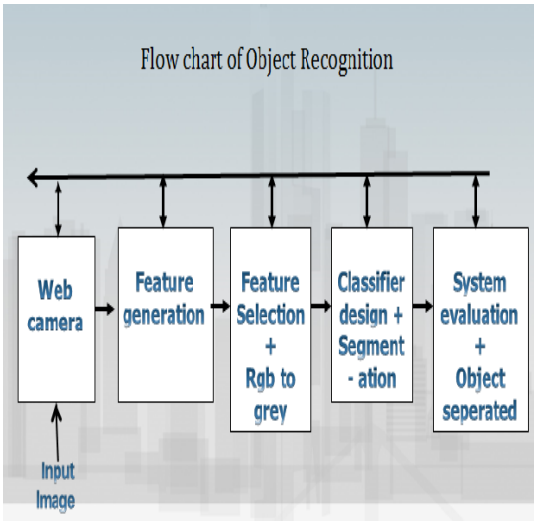

Fig2.flow chart of image recognition

V. CONCLUSION

The smart garbage separator robot was able to sort out the two types of waste, degradable and non-degradable. When the obstacle sensor is triggered the camera is actuated and through image processing waste is detected, and according to this robot is instructed to dump the waste in respective bin. The robot was able to receive and react to the signals sent via remotely controlled PC. The trash bin is mounted on the robot and with the use of an arm wastes are dumped to the space designated for the waste in the robot.

VI. ACKNOWLEDGEMENT

Authors please to acknowledge Atharva College of Engineering, Mumbai for every support to write this paper. Authors also acknowledge other contributors for their contribution in preparing such paper

VII. REFERENCES

[1] RECYCLING FACTS (Online). GrowNYC. URL:http://www.grownyc.org/recycling/facts.
[2] About 70 percent of trash can be recycled (Online). Montgomery Advertiser, Ala. URL:http://www.redorbit.com/news/science/341544/about_70_percent_of_trash_can_be_recycled/.
[3] Davidson, E. (2008). The design of an autonomous recycling robot. Grace Allen Scholars Theses. Paper 2. http://scholarcommons.usf.edu/honors_gast/2.
[4] Huang, J., Pretz, T., &Zhengfu, B. (2010). Intelligent solid waste proc. using optical sensor based sorting technology. 3rd International Congress on Image and Signal Proc. (CISP), Vol. 4, pp. 1657–1661, doi: 10.1109/CISP.2010.5647729
[5] Gonzalez, R. & Woods, R. (2009). Digital Image Processing using MatLab. 2nd edition, McGraw-Hill.
[6] N. Kelly, “A Guide to Ultrasonic Sensor Set Up and Testing Instructions,” Limitations, and Sample Applications.[Online].
[7] Gareth J.Monkman, Stefan Hesse, Ralf Steinmann, Henrik chunk “Robot Grippers” ISBN: 978-3-527-40619-7, pp 463 November 2006
[8] Understanding Mat lab, “A Textbook for Beginners Paperback”30 August 2013 by S.N Alam (Author).
[9] Electrical machines, drives and power system sixth edition by theedorewildi and Pearson.
[10] G.K. Dubey “Fundamental Electrical Drives” second edition 2002, Narosa Publications, Second edition, 2002.
[11] B.P. Singh, Microprocessors and Microcontrollers, Galcotia Publications (P) Ltd, First edition, New Delhi, 1997.
[12] Embedded Controller Hand book, Intel Corporation, USA.

[13] Terry Baltelt, Industrial electronics, devices, systems and applicationsDelmar publishers- 1997.S.
[14] Available:http://www.oceanconservancy.org/who-we are/newsroom/2013/ocean-conservancys-internationalcoastal cleanupannounced-for-september-21.html. (1-2014)
[15] Available:http://www.egr.msu.edu/classes/ece480/capstone/fall09/group05/doc s/ece480_dt5_application_note_nkelly.pdf.