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AUTOMATED DOMESTIC WASTE SEGREGATOR USING IMAGE PROCESSING

J Sanjai[1], V Balaji[2], K k Pranav[3] B. Aravindan[4]

[1]J Sanjai, Panimalar Engineering College ,Chennai
[2]V Balaji, Panimalar Engineering College ,Chennai
[3]K K Pranav, Panimalar Engineering College ,Chennai
[4]B Aravindan, Assistant Professor Panimalar Engineering College ,Chennai

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Abstract - *Our project titled "Automated Domestic Waste Segregator using Image processing" proposes a smart waste sorting system for domestic level which consists of hardware and a software system based on image processing. The ultimate goal is to design a real time thrash can which can be used for domestic purposes. It aims at efficiently separating domestic wastes so that it would be easy for the municipality people to segregate them on a large scale basis. The wastes are classified primarily into two levels as biodegradable and non-biodegradable. These two main classes are further classified into two categories depending on their reusability. The hardware system is a trash bin framework based on the core module Raspberry Pi and the software is an image classification algorithm based on machine learning process. The ultimate aim of the project is to segregate the wastes into four main categories – paper, food wastes, plastics and metals. This would help in easy recovery of useful and recyclable items.*

1. INTRODUCTION

This project proposes a smart waste sorting system for domestic level which consists of hardware and a software system based on image processing. Hence this project aims developing a domestic garbage separation system for household needs which can also be used in public places like schools, colleges, railway stations and airports etc. Generally domestic waste is classified into two types a) Biodegradable wastes b) Non – Biodegradable wastes. These two main classes are further classified into two categories depending on their reusability.

India is one of the places in the world where most garbage is disposed. Around 62 million tons of waste is produced each day by 377 million people living in urban India of which 45 million of waste is left untreated and disposed unhygienically causing severe health issues and environmental degradation. The common method of disposal of the waste is by unplanned and uncontrolled open dumping at the landfill sites. The segregation, handling, transport, and disposal of waste needs to be properly managed to minimize the risk to the health and safety of patients, the public, and the environment.

It is found that the waste segregation systems are mostly developed only for large scale level and not for domestic level. Majority of the dumping grounds in India use human labor. Waste Separation machines are used only in few Municipalities in India and not implemented at domestic level. Provided all these systems depend mostly on the use of sensors. Hence this paper aims developing a public garbage separation system for public places like schools, colleges, railway stations and airports etc. which can also be used in household needs.

Municipal Solid Waste includes commercial and residential wastes generated in municipal or notified areas, in either solid or semi-solid form excluding industrial hazardous wastes, but including treated bio-medical wastes. The quality and quantity of MSW generated by a particular community will vary according to their socio-economic status, cultural habits, urban structure, population and commercial activities. Asian countries are facing MSWM problems due to the rapid growth in MSW generation rate. The total quantity of waste generated by 23 metro cities in India was 30,000 tpd in 1999, which has increased considerably to about 52,000 tpd.

Government Bodies at all levels (central, state and municipal) are taking proactive steps to improve the municipal solid waste scene in India. The Government of India issued new rules that regulate the MSWM at the local level. The mandatory requirements of the rule are,

- Source segregation and storage at source
- Door to door collection
- Abolition of open storage
- Daily sweeping of the street
- Transportation of waste in covered vehicles
- Waste processing by composting or energy recovery
- Disposal of inerts by sanitary landfilling

2. WORKING METHADOLOGY

First datasets of the different waste materials are created. Then using MATLAB, the features are detected from the datasets using Feature Extraction algorithms. The detected features are stored in a bag of Variable. The variable is trained using SVM in matlab. Once the training is completed, the output variable is stored for prediction. Start the webcam run live waste detection and get the image. Predict waste

using extracted features by comparing with the stored output variable and plot the results.

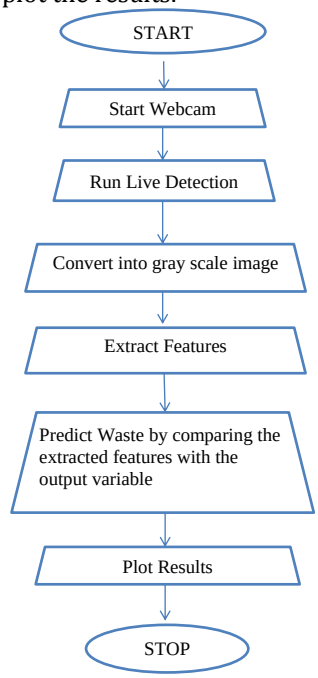

Fig -1: Flow Chart

The design is aim to classify the waste into two types they are

- Biodegradable waste
- Non-biodegradable waste

The bio degradable waste is classified into

- Paper waste
- Vegetable waste

The Non-Bio degradable waste classified into

- Plastic waste
- Metallic waste

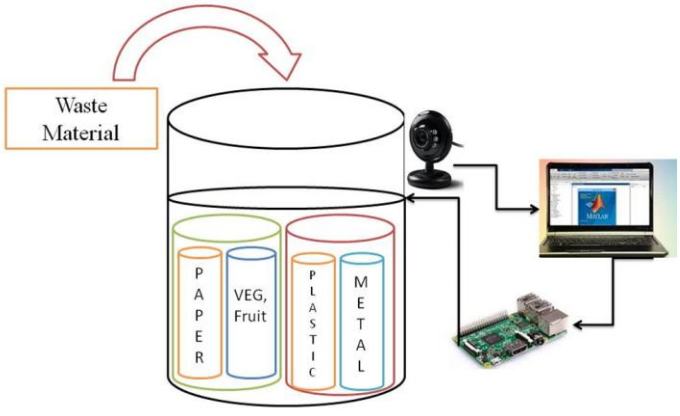

Fig -2: Block Diagram

Initially, the waste is put into the input section and waste image is captured by the camera fixed inside the bin. The image is processed through MATLAB software in the computer. The Raspberry Pi is used to control the motor which is fixed inside the bin. Initially the waste to be segregated is put inside the trash can. The Infrared sensor detects the entry of waste materials and sends command to the Pi so that the camera gets turned on. Using the captured image, MATLAB compares with the trained images and based on the feature value it sends a command to the motor through Raspberry Pi.

3. HARDWARE COMPONENTS

3.1. Web Cam

A webcam is a video camera that feeds or streams its image in real time to or through a computer to a computer network. When "captured" by the computer, the video stream may be saved, viewed or sent on to other networks traveling through systems such as the internet, and e-mailed as an attachment. When sent to a remote location, the video stream may be saved, viewed or on sent there. Unlike an IP camera, a webcam is generally connected by a USB cable, or similar cable, or built into computer hardware, such as laptops.

3.2 DC Motors

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic; to periodically change the direction of current flow in part of the motor.

3.3 Inductive Sensor

An inductive sensor is a device that uses the principle of electromagnetic induction to detect or measure objects. An inductor develops a magnetic field when a current flows through it; alternatively, a current will flow through a circuit containing an inductor when the magnetic field through it changes. This effect can be used to detect metallic objects that interact with a magnetic field. Non-metallic substances such as liquids or some kinds of dirt do not interact with the magnetic field.

3.4 IR Sensor

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called a passive IR

sensor. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes that can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and these output voltages, change in proportion to the magnitude of the IR light received.

3.5 l293d 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.

Concept - It works on the concept of H-bridge. H-bridge is a circuit which allows the voltage to be flown in either direction. As you know voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction, hence H-bridge IC are ideal for driving a DC motor.

In a single L293D chip there are two h-Bridge circuit inside the IC which can rotate two dc motor independently. Due its size it is very much used in robotic application for controlling DC motors. It's like a switch.

Working of L293D - There is 4 input pins for l293d, pin 2, 7 on the left and pin 15, 10 on the right as shown on the pin diagram. Left input pins will regulate the rotation of motor connected across left side and right input for motor on the right hand side. The motors are rotated on the basis of the inputs provided across the input pins as LOGIC 0 or LOGIC 1.

4. BACKGROUND AND RELATED WORK

4.1 Machine learning

Machine learning teaches computers to do what comes naturally to humans and animals learn from experience. Machine learning algorithms use computational methods to "learn" information directly from data without relying on a predetermined equation as a model. The algorithms adaptively improve their performance as the number of samples for learning increases.

There are two types of machine learning techniques to train a model. They are:

➢ Supervised Machine Learning

➢ Unsupervised Machine Learning

Here we have used unsupervised machine learning technique.

4.2 Raspberry pi – matlab

Raspberry Pi 3 Model B was released in February 2016 with a 1.2 GHz 64-bit quad core processor, on-board Wi-Fi, Bluetooth and USB boot capabilities. The Raspberry Pi 3, with a quad core ARM Cortex-A53 processor, is described as having ten times the performance of a Raspberry Pi 1.
The MATLAB code is first converted into a SIMULINK model and then the code is deployed to the hardware i.e. Raspberry Pi. The hardware can run standalone once the code is deployed as a Simulink model provided an external power supply has to be given to power up the pi board. Through these steps the waste segregation takes place in the dust bin without any external connection to a pc. It is noted that a webcam is connected to the raspberry for capturing the images of the waste.

4.3 Raspberry pi

The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote teaching of basic computer science in schools and in developing countries. It does not include peripherals (such as keyboards and mice) and cases. Processor speed ranges from 700 MHz to 1.4 GHz for the Pi 3 Model B+; on-board memory ranges from 256 MB to 1 GB RAM. Secure Digital (SD) cards in Micro SDHC form factor (SDHC on early models) are used to store the operating system and program memory.

The boards have one to four USB port. For video output, HDMI and composite video are supported, with a standard 3.5 mm tip-ring-sleeve jack for audio output. Lower-level output is provided by a number of GPIO pins, which support common protocols like I^2C. The B-models have an 8P8C Ethernet port and the Pi 3 and Pi Zero W have on-board Wi-Fi 802.11n and Bluetooth.

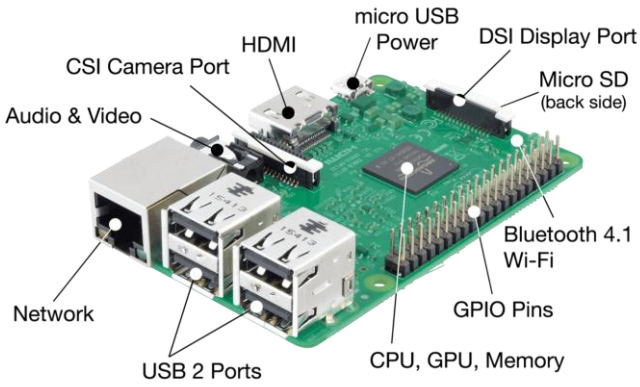

Fig -3: Raspberry pi 3 Board

The Broadcom BCM2835 SoC used in the first generation Raspberry Pi includes a 700 MHz ARM11 76JZF-S processor, Video Core IV graphics processing unit (GPU), and RAM. It has a level 1 (L1) cache of 16 KB and a level 2 (L2)

cache of 128 KB. The level 2 cache is used primarily by the GPU. The SoC is stacked underneath the RAM chip, so only its edge is visible. The 1176JZ(F)-S is the same CPU used in the original iPhone although at a higher clock rate, and mated with a much faster GPU.

The earlier V1.1 model of the Raspberry Pi 2 used a Broadcom BCM2836 SoC with a 900 MHz 32-bit; quad-core ARM Cortex-A7 processor, with 256 KB shared L2 cache. The Raspberry Pi 2 V1.2 was upgraded to a Broadcom BCM2837 SoC with a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor, the same SoC which is used on the Raspberry Pi 3, but under clocked (by default) to the same 900 MHz CPU clock speed as the V1.1. The BCM2836 SoC is no longer in production as of late 2016.

The Raspberry Pi 3+ uses a Broadcom BCM2837B0 SoC with a 1.4 GHz 64-bit quad-core ARM Cortex-A53 processor, with 512 KB shared L2 cache.

4.4 Pin Description

The Raspberry Pi is a credit card sized single-board computer with an open-source platform that has a thriving community of its own. There are a few versions of the Raspberry Pi, but the latest version, has improved upon its predecessor in terms of both form and functionality. The Raspberry Pi Model B features are:

- More GPIO
- More USB
- Micro SD
- Lower power consumption
- Better audio
- Neater form factor

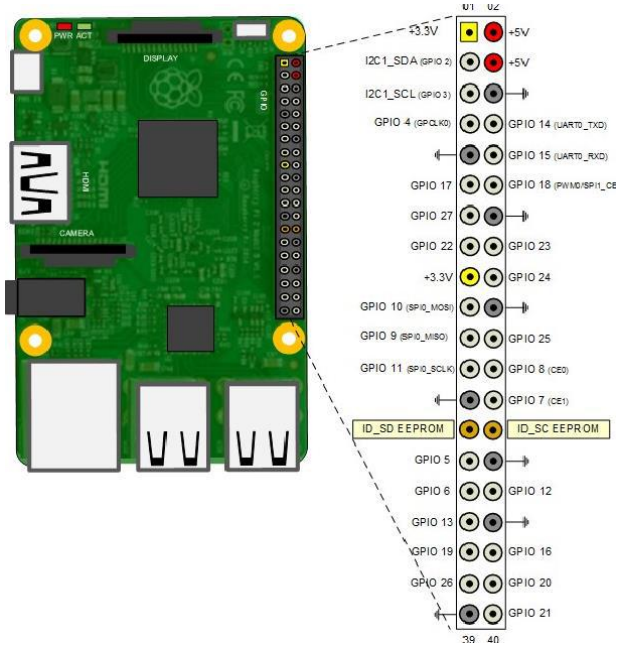

Fig -4: Pin Diagram

This higher-spec variant increases the Raspberry pi GPIO pin count from 26 to 40 pins. There are now four USB 2.0 ports compared to two on the Model B. The SD card slot has been replaced with a more modern push-push type micro SD slot. It consumes slightly less power, provides better audio quality and has a cleaner form factor.

To get started you need a Raspberry Pi 3 Model B, a 5V USB power supply of at least 2 amps with a micro USB cable, any standard USB keyboard and mouse, an HDMI cable and monitor/TV for display, and a micro SD.

5. COCLUSION

Thus the bin designed was able to easily segregate domestic wastes which were thrown individually. The bin was tested with various waste materials and is found to be effective in the segregation process. It can be used for domestic purposes and recyclable materials can be easily recovered through this project. Metallic wastes are also segregated. Besides domestic purposes, it can also be used in certain public places. Thus through this project, we are using machine learning and image processing as a tool to classify the wastes.

6. REFERENCES

[1] https://bestonsortingmachine.com/automatic-waste-segregation-machine
[2] Sharanya.A, U.Harika, N.Sriya, Sreeja Kochuvila (2017), “Automatic Waste Segregator”, IEEE Journal.
[3] Uppugunduru Anil Kumar, B.Renuka , G.Kiranmai , G.Sowjanya (17th &18th March 2017), “Automatic Waste Segregator using Raspberry pi”, International conference on Emerging Trends in Engineering, Science and Management.
[4] Saravana kannan G, Sasi kumar S, Ragavan R, Balakrishnan M (2013), “Automatic Garbage Separation Robot Using Image Processing Technique”, International Journal of Scientific and Research Publications, Volume 6.
[5] Yijian Liu1, King-Chi Fung, Wenqian Ding1, Hongfei Guo1, Ting Qu1 and Cong Xiao (June 2, 2018), “Novel Smart Waste Sorting System based on Image Processing Algorithms: SURF-BOW and Multi-class SVM”, Computer and Information Science, Vol. 11, Published by Canadian Center of Science and Education..
[6] Amrutha Chandramohan, Joyal Mendonca, Nikhil Ravi Shankar, Nikhil U Baheti (2016), “Automated Waste Segregator”, IEEE journal.
[7] https://in.mathworks.com/help/stats/support-vector-machines-for-binary-classification.html.