Garbage Segregation System using Support Vector Machine

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Abstract. The garbage bins are full, half full or empty. These bins include various types of garbage ranging from metals, plastics to glasses. The collection of these dump waste are not segregated and so when the eliminating method is proposed the method is not efficient. The bio waste also gets dumped into landfills. To make the system efficient this paper proposes method to segregate system at its early stage. The system uses a Machine Learning Algorithm called Support Vector Machine (SVM) which performs image comparison in the vector form. Also, capacitive proximity sensors is used for next level of segregation which identifies type of waste either wet or dry with dielectric effect. Thus, this system collaboratively separates the waste using Machine learning and capacitance effect. The separated bio waste is converted to bio fuel for economic purposes. The plastic wastes can be given to scrap industries.

Keywords: Garbage segregation system, Machine learning, SVM, capacitance effect, Waste segregation system.

1 Introduction

Due to the over growing population in the country, the enormous amount of waste produced should be eliminated in the right manner. There are different types of wastes that are put into the bin. These wastes when unsorted become very unhygienic to the environment as they are ultimately burned or simply dumped in landfill sites. This does not allow recycling or reusing the waste. To make efficient use of biodegradable and non bio degradable wastes, a machine learning and capacitance based solution is developed in this project where it automatically segregates waste into wet and dry waste. While the dry wastes are recycled, the wet wastes are used to create bio-fuel and natural fertilizers. The wastes are separated using SVM machine learning algorithm. Further the raspberry pi processes the information and the motor is instructed by it, hence leading into the proper segregation of wastes and moving forward towards a greener and cleaner world.

2 Related Works

This study proposes the separation of waste into various categories. Their main focus is to separate the urban trashes. The paper uses CNN algorithm which captures images in various angles. The former uses the method called Alex Net that increases the resolution of images to produce better results. The unique feature of article is the use of MLP which refer to multilayer perceptrons system. The term means identifying and processing the hidden layers of the image captured. It is a supervised learning and do not disturb the machine trainings of CNN. [1]

It is known that the waste which is thrown away can be used in many different ways. This paper deals with the solid waste management methods and practices in India. The solid waste management consists of various types of wastes like industrial, agricultural, transport; municipal etc. [2] Datasets have a large number of images in the form of array. A main process of training dataset in deep learning algorithm is Model preparation. [3]

In this paper, plastic separation method is implemented with SVM. The paper mainly focuses on the chemical structure of the plastic. As chemical arrangements of the polymers vary it is identified with NIR spectra. Thus, with obtained chemical forms the changes are noted with SVM. [4] In this paper the system of input data is processed with CNN. Process of identification of waste material is based on the shape and size of the objects and uses no sensors. The waste will be categorised and dumped in separate containers with the help of raspberry pi. [5]

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This paper proposes a new method called as Automation of material segregation method called as AMS. The main of the project is to separate the conducting and non conducting materials like plastics and glasses. The separation of particles is done by the use of two sensors inductive and capacitance. The metals can be identified with former whereas the latter classifies the types of waste. The inductive sensor is an efficient way but generating electricity and producing magnetic fields are complex products. The system also uses capacitive sensors which classifies between type of garbage as wet or dry. This is achieved through the capacitance effect. [6]

The machine learning induction algorithm is able to adapt to changing situations through integrating new conditions and findings with those it has already seen. [7] In this paper, they use the Raspberry Pi 3 which is more efficient that Raspberry Pi 1. It has ARM Cortex (A53) quad core processor. The code in MATLAB is changed to SIMULINK architecture and it is installed into Raspberry Pi. [8]

Bio ethanol is one of the most important alternative renewable energy sources that substitute the fossil fuels. Sugarcane bagasse has a content of cellulose and hemicelluloses, which make it suitable as fermentation substrate when hydrolyzed. The objective of work is ethanol production from sugarcane bagasse (SCB) by the fermentation process. [9]

3 System Architecture

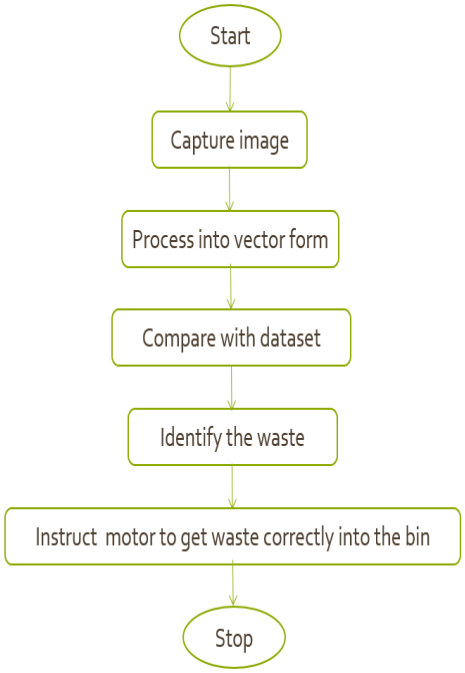

Fig. 1. Workflow of the Segregation process

4 Components

The following hardware components and materials are used.

4.1 Google data set

The Google offers data set that contains the images of various wastes that had been captured as images. These images form different perspectives of the object. The Google data set approximately consist of 5000 images including the images of crushed papers and bottles. The image also tries to identify differences between photos and real objects.

4.2 Camera

The high resolution camera is used to capture images. The general 5mp raspberry pi camera can be used to combine with various models of raspberry pi like model A, model B, B+. It supports static images of resolution around 2500 x 1900. And it weighs less than 5g. The camera setup is as shown below in Figure 2.

Fig. 2. Camera rev1.3

4.3 Raspberry Pi

Raspberry Pi is a computer like device that is developed in European countries for the purpose of student mission. The raspberry pi does not provide options for any additional components. The system has the processor speed with maximum of around 1.5 GHz for the model B+. The programs in the model are stored in the Micro SD card. The same amount of memory is shared for operating systems also. As typical it provides 1 GB RAM and 256 MB of data.

Raspberry Pi has four portals each one for separate functions. There is a thin sleeve used as jack for the audio output (3.5mm std). The other ports are for video, High definition, combined videos. It uses 802.11 architecture of Wi-Fi. The parts of Raspberry pi is labelled in Figure 3. The other features include it instructs motor in this system acting as an interface. The component also stores the data inputs, their outputs and with camera it captures the input waste and also monitors if anything is incoming.

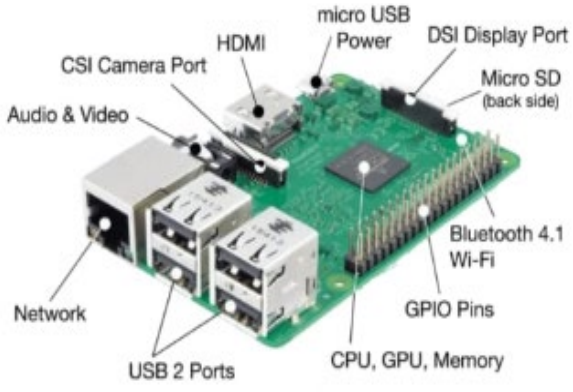

Fig. 3. Raspberry pi

4.4 Capacitive proximity sensors

The capacitive proximity sensor is a sensor that can sense both metallic and non metallic materials. It consists of a metallic plate inside the capacitor. Another element which is placed outside varies or not varies from conducting. The internal element varies from the outside object with in between air present in it. Thus outside object acts as dielectric material. They can detect any material that has a dielectric constant greater than air. The presence of an object changes the capacitance value and note's the value. The range for the capacitive proximity sensors is from 5 millimeters up to 40 millimetres approximately. Figure 4 shows proximity sensor.

Fig. 4. Proximity Sensor

4.5 Motor

A **servo motor** is one type of motor that can either rotate or push with good accuracy. They are operated automatically via electrical power and are used when we need to rotate something to certain distance or angles. The mechanism used here is known as the servo mechanism. Servo motor ranges from 0-180 degree or 210 degree max according to the make. The motor is shown in Figure 5.

Fig. 5. Motor

4.6 Bio Fuel

Bio fuel is fossil fuel which is renewable but is replaced in places of non-renewable fuel. Converting trash into bio fuel will be very useful. It also reduces the amount of trash buried in landfills. In the first step, the non-combustible materials such as metals are removed. The waste is treated using physical means to convert it in to fuel pellets or refuse-derived fuel called as RDF. Mostly only segregated biodegradable solid waste is present in the pellets. Volume of the waste is reduced up to 60%. The combustion of fuel pellets is efficient and hygienic. Due to the continuous pressure, around after 6 to 8 hours the system produces bio fuel.

5 Implementation

The input of garbage is accepted by the camera. As a pre-requisite the system is trained with Google data set. This machine uses SVM algorithm which compares images in vector form. Based on the color used the angle varies in the vector form of the image. This vector model is compared with the images already captured. If the image captured and the image in the data set matches then the raspberry pi marks its category.

The second level of segregation is done using capacitance system. The capacitive proximity sensors placed has internal oscillators that oscillate based on the dielectric property of the object. This classifies the metals, papers, plastic and wood as each of its dielectric values varies.

When the waste type of the object is identified the instruction is sent to the Raspberry pi module which in turn instructs the motor to place it in the respective bins. The motor rotates based on the instruction and the plates do open as said by raspberry pi. The segregated organic wastes are collected which under pressure is converted to bio fuel.

5.1 SVM Algorithm

The general SVM algorithm processes by separating the image into two hyper planes and giving space equally for both planes. The optimized technique to find hyper plane equation is **Kernel Trick.**
The formula to find Kernel Trick equation is as follows:

$$i \cdot j = x_i \cdot x_j + y_i \cdot y_j + z_i \cdot z_j . \quad (1)$$

$$i \cdot j = x_i \cdot x_j + y_i \cdot y_j + (x_i^2 + y_i^2) \cdot (x_j^2 + y_j^2) . \quad (2)$$

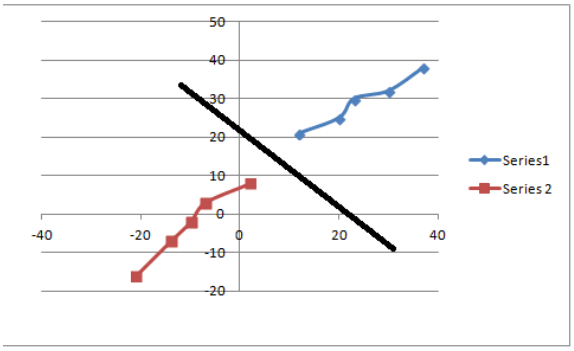

Fig. 6. Hyper plane of curves

The black line in Figure 6 is the hyper plane equation for the curves, series1 and series 2.

5.2 Capacitance effect

The segregation of waste with capacitors occurs with the effect of difference in dielectric of objects. The different dielectric values of the objects are:

Table 1. Dielectric constants of different materials

Object	Value
Air	1.00059
Wood	3.3
Glass	4.9-7.5
PVC	4.0
Paper	3.7

5.3 Bio fuel

The spoilage of bio waste is done by the bacteria. These bacteria destroy the bio particles to biodegradable one. When this happens in the absence of air, it is anaerobic respiration. To initiate and fasten the process, cow dung is used. When this mixture is inputted to the can and locked under high pressure the bio waste solids are removed and the methane gas is formed. Thus, bio fuel is created.

6 Results and Discussions

The system is successful for segregation of solid wastes. The wastes are separated into 3 categories: biodegradable non-biodegradable and plastics. The biodegradable wastes are treated with pressure and is converted into bio fuel. It is very efficient. It is helpful to the environment as segregation is done at the most basic level- the moment we drop trash into trash can. If the system is deployed at all the houses, there will be drastic reduction in the need for manual waste segregation or segregation of large quantities of waste together. It the long run, it will also aid in fuel production that can be used as an alternative source of energy.

7 Conclusion and Future Works

Thus, the proposed project works properly to segregating the trash accordingly as when it is dumped into the trash can. The entire system is coordinated with the machine learning algorithm to get the desired output. The system is very economical and environment friendly hence can also be used from small scale to large scale uses. The separation of trash helps in reusing and recycling of wastes which lead to a greener and cleaner world. The future work is to employ our proposed system on a large scale where the waste can be separated after the dumping of general wastes. The current project can also be combined with the IOT based smart trash can that lets the whole city know the level of the garbage before dumping them through a cloud website which not just saves labor time and traffic jam but also the overflowing of garbage and its aftereffects.

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