
Trash Marshall

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An automated trash sorting machine that uses machine learning to classify trash and carries it to a designated bin.

Abstract- We aim to use computer vision to take an image of an object destined for the landfill, and use our model to classify it into four distinct classes like paper, plastics, metal and organic. The project will utilize an Convolutional Neural Network (CNN) as it is widely regarded as an adequate method of handling image classification problems. Once the trash has been classified a conveyor belt or actuators will carry it to it's designated bin.

Keywords- Computer vision, classification problem, convolutional neural network

Introduction

Bangladesh being the ninth most populous country in the world naturally produces an enormous amount of waste which, if recycled can be a source of revenue for city corporation workers. Through our sorting machine we hope to accelerate the recycling process, as a sorted pile of trash is immensely more convenient. We envision our project to be implement in two possible ways. One would be as an educational mobile phone app that raises awareness among city corporation workers as to what the classification of trash achieves. The second implementation would include the conveyor belt that carries a stream of trash, one piece at a time, underneath a camera that takes an image of the object and using a CNN classify it right away. If a reasonable pace of classification, and accuracy can be achieved it can be used at recycling facilities to accelerate the process.

Background and Motivations

1. An estimated to be about 22.4 million tonnes per year. The rate of waste production in our country is increasing rapidly and the space in landfills diminishing as a result. The effects of the general public and the administration overlooking the importance of recycling has led to the death of numerous rivers around the capital and spreads illnesses.
2. Many countries such as Germany, Sweden, and Brazil to name a few have extensive recycling programs that reduce unnecessary production of non-degradable materials which negatively impact the environment. Consequently recycling reduces pollution, risk of spreading illnesses borne by medical waste and increases conservation of natural resources and economic security in the country.

Literature Review

Inspired by the research of Mindy Yang's team[1], and Oluwasanya Awe's[2] team from Stanford University, we have decided to pick up where their study has left off. Both studies look into multiple methods of trash classification with an aim to increase accuracy in testing scenarios. Although the first team had very poor results from training their CNN, Awe's team had reused a pre-trained CNN and found it to be adequately accurate. A few studies have looked into the detection of trash but our project focuses more on. The aforementioned papers had selected more than 4 classes and that had led to complications and lower accuracy. For applications in Bangladesh we have decided 4 classes(organic, paper, plastic, metal) will suffice as creating training examples for our neural net will be simpler. The choice for using a CNN instead of support vector machines(SVM) has been further bolstered by the research of Jozef Marko[3] from Masaryk University who had also taken on the task of classifying trash into 4 classes. The models used in the study showed the CNN fared the best accuracy(80%) when using only 3 classes. All of the studies have mentioned how difficult it is to create data sets for training even when there is an overwhelming amount of trash available in the streets. Trash objects are never in perfect, pristine conditions and so also collecting photographs of singular object can be the most time consuming part of the project. Therefore creating a data set that is large enough to train a CNN model will require the most effort as we have highlighted in the timeline for the project.

The proposed Solution

We want to build a machine that can detect and classify items from the trash that are destined to be recycled. We aim to use machine learning to create a model that will be built on top of the TensorFlow framework. More specifically, we will use the Inception V3 model that has been trained for ImageNets and has shown an accuracy of 78.1%. Any rating above 80% would be considered a success for us. Another stretch goal of the product, if we can manage a reasonable pace of classification, we could implement a sorting machine that passes trash along a conveyor belt that carries the trash to designated bins, one for each class of recyclable. The motivation for the project has come from the lack of research into classifying trash for automated recycling machines that can run on relatively low power.

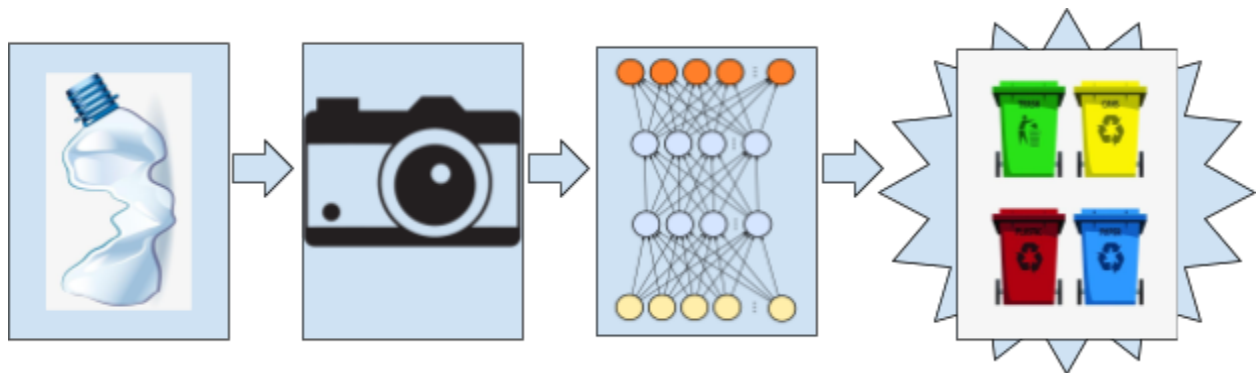


Figure: Box diagram showing the 4 steps of classification and sorting of Trash

1. Isolate trash
2. Take an image
3. Classify using Neural Net
4. Dispose into designated bin

Timeline

As mentioned before, the collection of trash images and creating a data set of a suitable size for training is expected to take the most time, estimated at about 3 weeks. We will be looking at the possibility of implementing multiple algorithms therefore the training timeline should be lengthier than expected, about 2 weeks. The most efficient method of carrying trash will have to be evaluated before trying to implement the proposed conveyor belt.

Impact and Sustainability

There is a company in Europe called Zenrobotics that aim to make autonomous robots that can collect, sort and recycle trash but has been unsuccessful largely due to the fact that their methods are not cost effective. Recycling is a very cost sensitive subject as producers always want to use materials that they have to pay the least for. In a country like Bangladesh where labour is relatively cheap and abundant it will be a challenge for us to minimize the cost to implement the system. If it can be used to educate people on the importance of recycling via a software application it can potentially raise awareness in our country's youth. It a very common sight to see children collecting trash such as discarded plastic bottles and selling them to local collectors for a miniscule amount of money. Our project is not aimed at diminishing their livelihoods but as a tool that can be used to accelerate the process of recycling. Bangladesh has already started to crack down on users of polyethene bags and started to enforce the laws that ban their use in markets in favor of jute bags that are biodegradable.

References

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Project proposal

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