# Apply Image Recognition to Classify Plastic Bottles and Aluminum Cans

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## Abstract

*In this project, we use the Convolution Neural Network (CNN) to distinguish plastic bottles from aluminum cans, and classify plastic bottles into different categories based on their sizes. The model will be trained and tested on ESPRIT dataset, which contains 1075 images of cans and bottles in different sizes. We aim to improve the model's ability of generalization to expand the algorithm to other recycled objects classification, such as glass bottles, paper/plastic boxes, and distorted recycled objects.*

## 1. Introduction

The new era of consumer convenience has produced a massive amount of wastes. Most of these wastes are made from non-renewable material, such as oil. It also takes a longtime to decompose these landfills. In fact, plastic items, such as bottles, toys, and plastic bags that we use everyday can take anywhere from 10 to 1,000 years to decompose, and PET bottles need at least 450 years to decompose [1]. An efficient method to classify wastes into different categories can help speed up the recycling process, and hopefully can save our planet.

We aim to build a model which can classify bottles/can based on their sizes and materials with the highest accuracy on the test set.

In this paper, Section 2 discusses related work that tackle similar subjects. Section 3 gives a detailed discussion to the dataset. Section 4 presents a basic knowledge of the networks being used in our project. Section 5 describes the metrics for experiments. We discuss our result in the last section.

## 2. Related work

Classifying waste, in general, and using Image recognition to classify plastic bottles and aluminum cans, in particular, has been a subject of various machine learning researches.

Hohlfeld et al. [4] applied Convolution Neural Network (CNN), Deep Residual Network (ResNet), Faster-R-CNN, and Support Vector Machine (SVM) to classify beer bottles images with different brand labels and colors. They achieve 99.86% accuracy.

Iandola et al. [3] experiment on logo classification using CNN and R-CNN on "GoogLeNet-GP" onFlickrLogos-32-test dataset. Their final model provides 89.6 % accuracy.

## 3. Dataset

The dataset consists of 1075 images, 72x72 pixels. These images are grouped into 8 classes:

- 6 classes of plastic bottles – images of bottles of different sizes 25cl, 33cl, 50cl, 100cl, 150cl, and 200cl
- Can class – images of aluminum cans
- Reject class – images of objects that should have been rejected. An example of this class is an image of an empty tray.

The data was collected at ESPRIT for a school project, the Reverse Vending Machine Project. Images are saved in JPEG format. Each image contains a single item on a white tray. Images were intentionally taken in different sizes, background, and lighting to enhance the machine learning algorithm's generalization ability.

The dataset was obtained from `https://www.kaggle.com/moezabid/bottles-and-cans`

## 4. Potential solution

We aim to solve this problem by using transfer learning. Transfer learning is a technique used to extract knowledge learned from related domains to enhance the model's generalization in another domain of interest.[2]

*Convolutional Neural Network*

CNN is chosen for this project because of its shared-weight architecture and its ability to automatically and adaptively learn spatial hierarchies of features. There is no need to provide features of objects in advance. CNNs will learn which features are relevant during the training process [4]. An input will be processed in convolution, pooling, and fully connected layers. Filters used in convolution layers will extract features needed for the model [5][6].

## 5. Metrics for experiments

The dataset will be split into training and testing datasets to be used in trained networks.

We will use a Deep Learning model on the datasets to train the network. Number of epochs, learning rate, etc. will be adjusted to achieve higher validation accuracy.

## 6. References


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