Multi-Class Waste Identifier for Visual Feedback in “Smart” Trash Bins

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Introduction

This document presents the project on which we, Rene Lamb, Nishanth Rao and Jean Haberer, will be working on for the CS 584 class during the fall semester of 2021. We wanted to find an application project that could both be useful to society and challenging in machine learning.

After some research we decided to work on the recycling issue to provide a system that could help citizens recycle their garbage. This application could not only educate people but also ensure the quality of the sorting process to guarantee a great recycling rate.

Project Description

Waste management has been a global challenge for several years, and it will continue to be so unless we recycle the waste efficiently. Many of the inefficiencies within waste management is due to the mixing of various waste types that should be separated. This is often a result of ignorance or confusion regarding how to separate waste.

In this project, we strive to create a feedback mechanism that identifies waste and guides individuals to dispose of that waste in its appropriate container in a multi-bin trash can. To implement this plan, we need to group similar types of garbage for efficient processing. We aim to build an application that utilizes machine learning algorithms to classify garbage such as **plastic, glass, metal, paper, cardboard, organic waste, E-waste, and chemical waste.**

We will train the model using a database containing images of garbage using neural networks, and later test the model on other pictures taken from a camera consisting of different types of garbage. In addition, our application will provide visual feedback such that when a live camera identifies waste in an individual's hand, it will communicate as to which bin to dispose of the trash.

Related Work

There are some similar applications for using computer vision to classify garbage, however, the classification methods and how the models in these previous applications are utilized ultimately will differ from our approach.

In Yang and Thung's research paper [1], garbage is classified into glass, paper, metal, plastic, cardboard, and trash. We plan to expand these classifications to include "organic", "E-waste" and "Chemical Waste" categories as well. Additionally, the training images are pieces of trash that are overlaid on a white background. The goal of our application is to utilize a machine learning algorithm to provide visual feedback to a person throwing an individual piece of trash away. This requires our approach to be more robust such that the garbage is identified as the closest piece of garbage to a camera with a background that may potentially contain multiple other objects.

In Wang and Zang's research paper [2], collected garbage in large quantities is identified in images with various backgrounds. Unlike their application, our application will be concerned with only identifying a single piece of garbage at a time. Additionally, our application will be able to specify the category of garbage for that individual piece.

In Baras, Ziouzios, Dasygenis, and Tsanaktisidis' research paper [3], they outline a "smart recycling bin" prototype that identifies and classifies waste. However, in their application, the waste enters a single bin and is not identified until it is already inserted into the bin.

The goal of our application is to provide a person immediate feedback as to what type of waste they are holding so that they can put the waste in the bin that matches the classification of the waste.

Preliminary Schedule

See attached "MP_ML_Project_Schedule" for project milestones

References

[1] M. Yang and G. Thung, "Classification of trash for recyclability status," CS229 Project Report 2016, 2016.

[2] Y.Wang and X.Zhang "Autonomous garbage detection for intelligent urban management" Shanghai University, 2018

[3] N. Baras, D. Ziouzios, M. Dasygenis, C. Tsanaktsidis "A cloud based smart recycling bin for waste classification" University of Western Macedonia, 2020