Research Experiences for Teachers and Young Scholars in Advanced Self-Powered Systems of Integrated Sensors and Technologies (ASSIST)

Advising Methods of Plastic Waste Disposal with Object Recognition

Isabelle Fetzer[1], Chonghan Lee[2], Faysal Khan[2], Justin Bush[3], John Sampson[2], and Vijaykrishnan Narayanan[2]

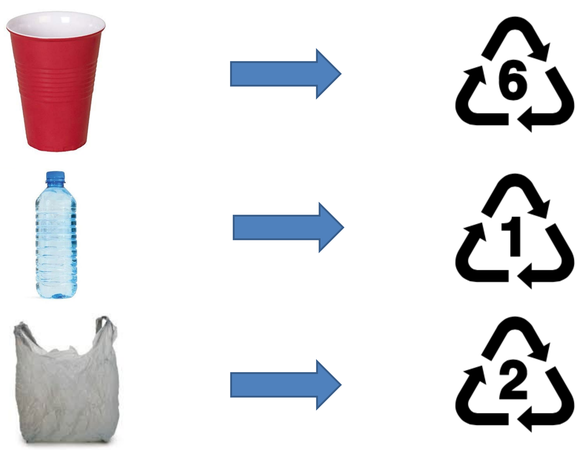
[1]The Grier School, [2]PSU Department of Computer Science and Engineering, [3]Philipsburg Osceola High School

Introduction:

Plastics have revolutionized our world with their versatility, durability, and low cost, but the effects of plastic waste are undeniably damaging to the environment, with pollution endangering wildlife worldwide. And with 300 million tons of plastic being produced annually, the issue is becoming overwhelming. The goal of this project is to keep waste out of the environment and conserve energy and resources by encouraging recycling and proper waste disposal.

Purpose:

The purpose of this project is to develop an app that can simplify the process of plastic waste disposal and recycling. We can use object recognition technology to identify different types of plastic from images and provide relevant information on their proper disposal as well as energy and resources conserved by recycling them. This simplification and the knowledge that one is conserving energy and resources should serve as an incentive for people to use the app and make an impact on the environment.



Plastic products are categorized into seven different groups which are used in sorting plastics during recycling and can help people determine how to dispose of their plastic waste.

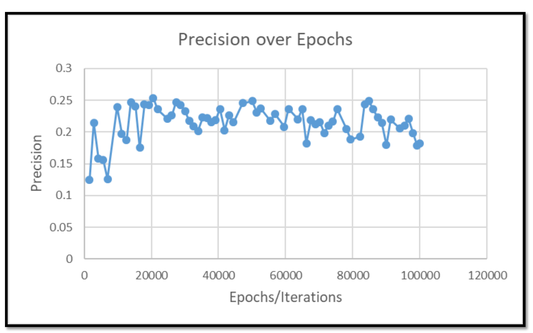
Method:

- Collect 1500 images of plastic cups, bags, and bottles to form training data set.
- Use the LabelImg annotation tool to draw bounding boxes around plastic objects in the images and label them as “plastic”.

- Train a convolutional neural network (CNN) model with collected training data.
- Test CNN by inputting new images containing plastic objects.

Results:

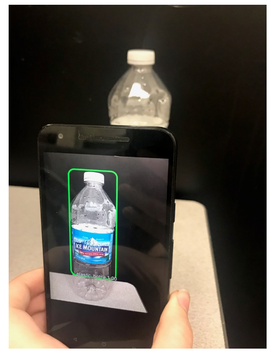
- Divided training data into 3 groups (cups, bags, and bottles) to improve model’s detection of different plastic objects.



- Precision did not improve drastically, but the model could accurately detect plastic bags and cups.
- Difficulty detecting bottles in images with noisy backgrounds

Implications:

- The difficulties around using a single label were attributed to the major visual differences between cups, bags, and bottles.
- Using 3 different labels within training data helped the model identify objects more easily.
- Errors in labelling and bottle detection attributed to errors in collecting and labeling training data.



Future Work:

- Perfect current model by collecting new training data, adjusting labels, and retraining.
- Train the model to recognize plastic by category to sort objects for recycling at home or at recycling facilities.

- Determine amount of energy saved by recycling instead of producing a new product.
- Track each user’s impact concerning energy and resource conservation to provide incentive to use the app.

Acknowledgements:

Special thanks to ASSIST, Dr. Vijay Narayanan, Dr. Matthew Johnson, Dr. John Sampson, Justin Bush, Chonghan Lee, Faysal Khan, Nagadastagiri Reddy Challapalle, and Sahithi Rampalli for their contributions to this project.

The ASSIST RET and Young Scholar programs are funded by NSF Nanosystems Engineering Research Center Grant EEC 1160483.