AI-Object classification of recyclable and non-recyclable wastes

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Abstract

According to the **World Bank[1]**, our global waste production from September 2018, is predicted to rise by 70 percent by 2050 unless we take urgent action. We human beings currently produce two billion tonnes of waste per year between 7.6 billion people. Population increase may be part of the problem, but it's levels of consumption within developed countries, and their gross mismanagement of waste, that let to the environmental catastrophe.

What's worse, until now, the most popular approach of managing the waste is still incineration. The bad part of this "efficient method" is that **if the garbage is not well classified, it produces large amount of toxic gases around the incineration area, which potentially cause death to infants and other diseases to residents.**

So, in order to protect the health of those who live near the garbage station, and to protect the environment, we came up with our **waste classification app** that can help us to restrict the emission of toxic gases by improving our garbage classification process.

[1] Retrieved from http://sensoneo.com/sensoneo-global-waste-index-2019/

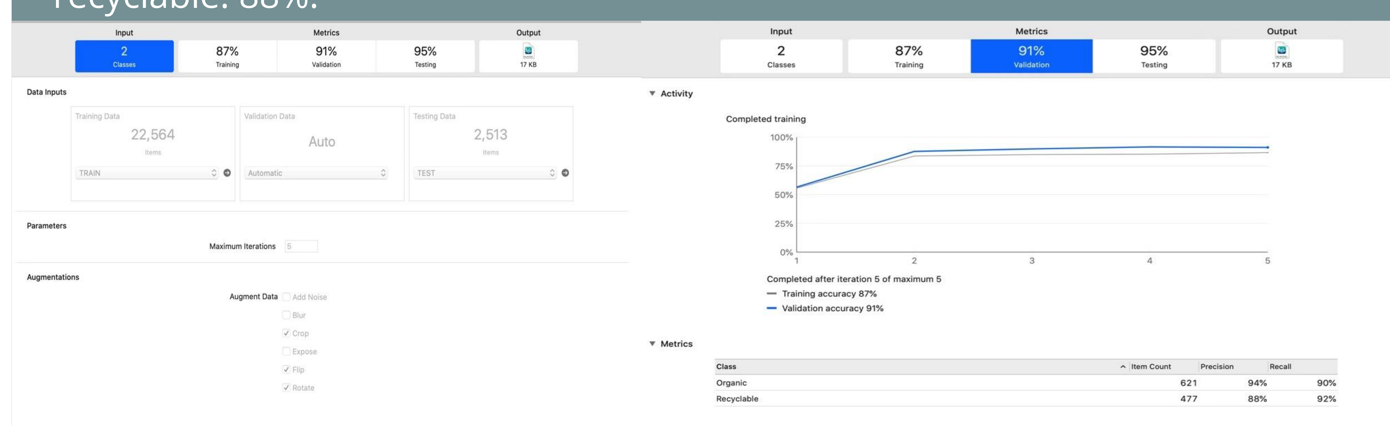
Introduction

Our app is called **Waste Classifier**, which is consist of two main parts with two **human-AI interaction** aspects, the **Explainable AI** and the **AI feedback system**.

- The first function of our app, also the main ability of our app is recognizing the object in a **real-time frame**, to see if the object is recyclable or organic. In this function, we introduced the **Explainable AI** concept. Users are allowed to look into each layer of the decision-making process, each of which contains a **short description** of why our **model predict the result in certain manner**. This idea helps the users to understand and to learn new knowledge of how to classify the disposal.
- Another capability of our app is that it takes back the **incorrect data**, that the users report when they find out that the prediction of our model is clearly wrong. This **feedback system** allows us producers to look into where we did wrong, to consistently **renew our database** online, and to **improve our AI model** in order to provide more accurate predictions.

Methodology

This project uses create ml to analyze and train the data set containing about 22500 images, and get the .mlmodel file accurate enough, compared with validation data, the accuracy of data is very high, which are organic: 94%, recyclable: 88%.

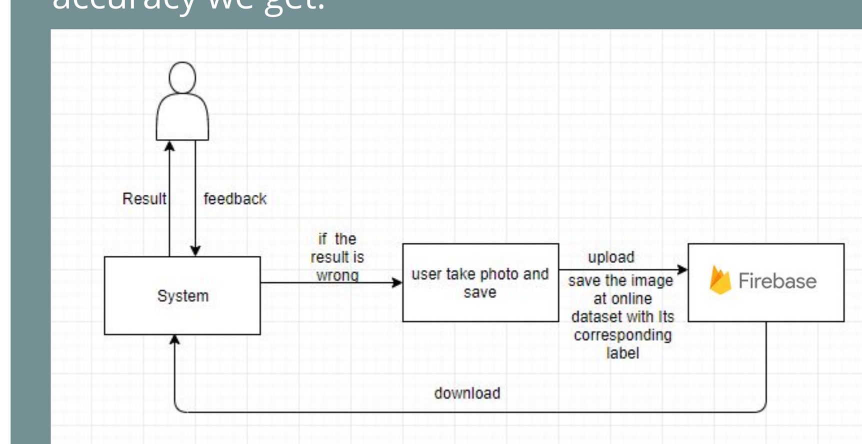


Human-AI Interaction

- Feedback

AI of this project will keep learning and updating its data set according to user interaction and feedback.

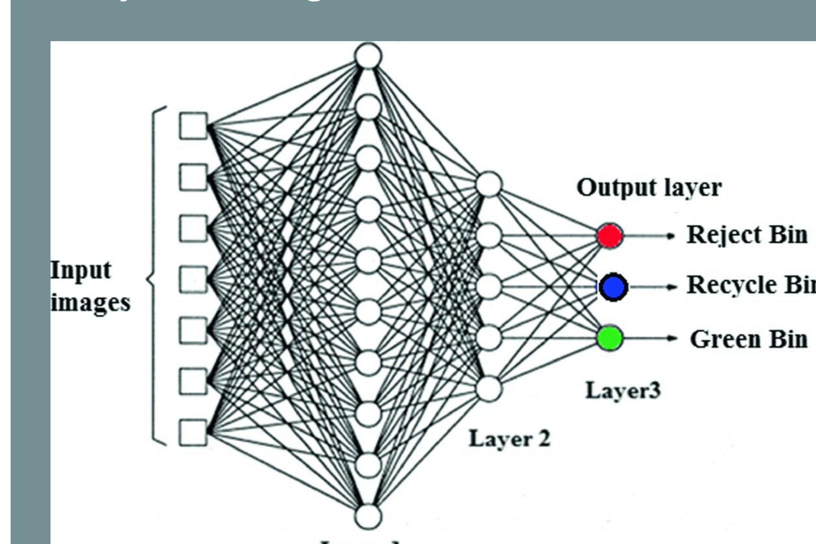
We use Firebase Baas as our own background service to continuously collect the uploaded data of users, update our data set, and we will use the newly collected data to automatically train our model every three days, so that when our AI identifies different garbage categories, the more users we use, the more accuracy we get.



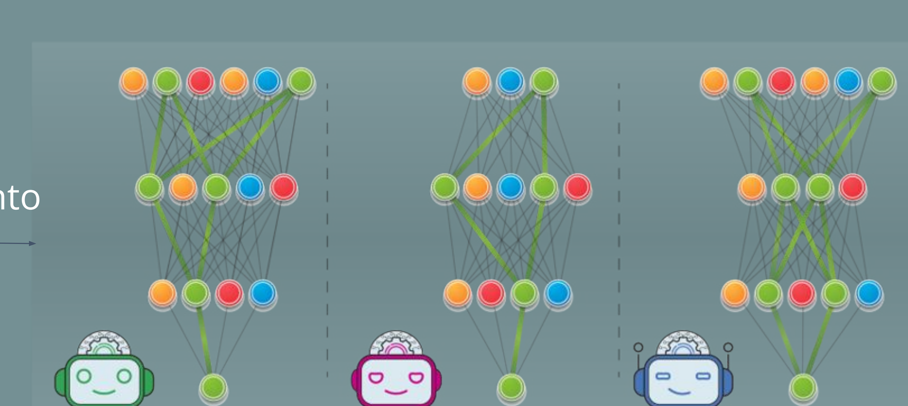
- Explainable AI

In order to let users know how our program makes decisions for garbage classification, we not only use recyclable / organic model alone, but also decompose the CNN into several layers, layer material, layer object and layer color. From these features, users can directly see how the AI judges that the garbage is recyclable / organic.

Recycleable/organic classifier CNN



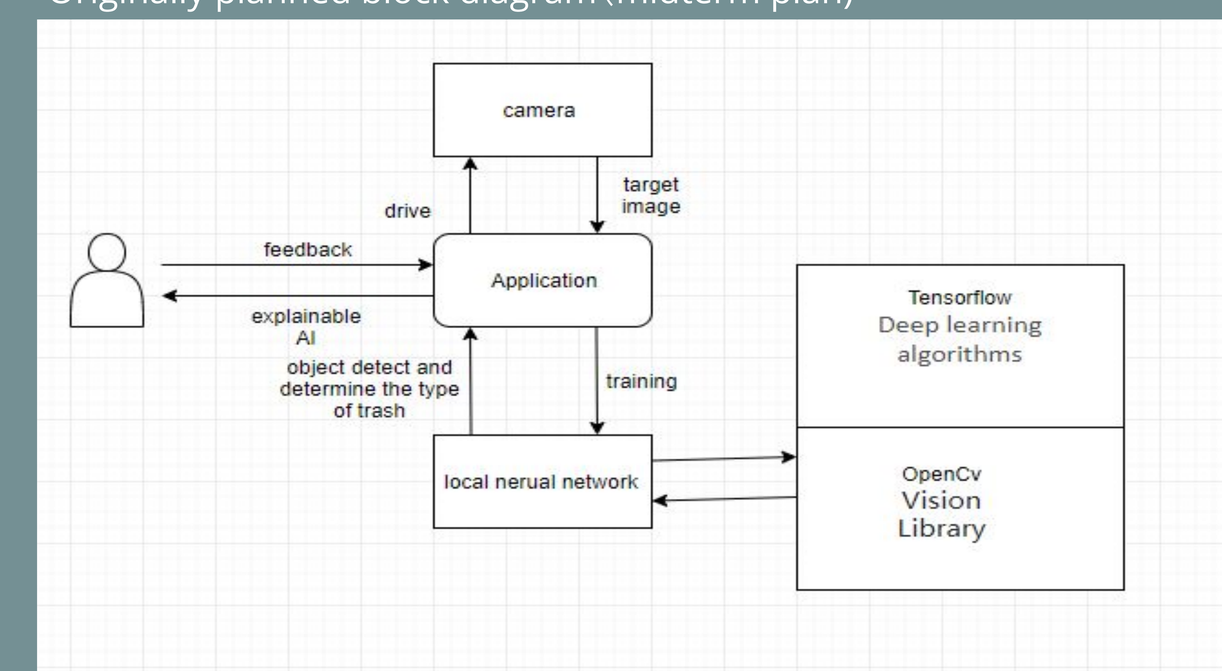
divided into



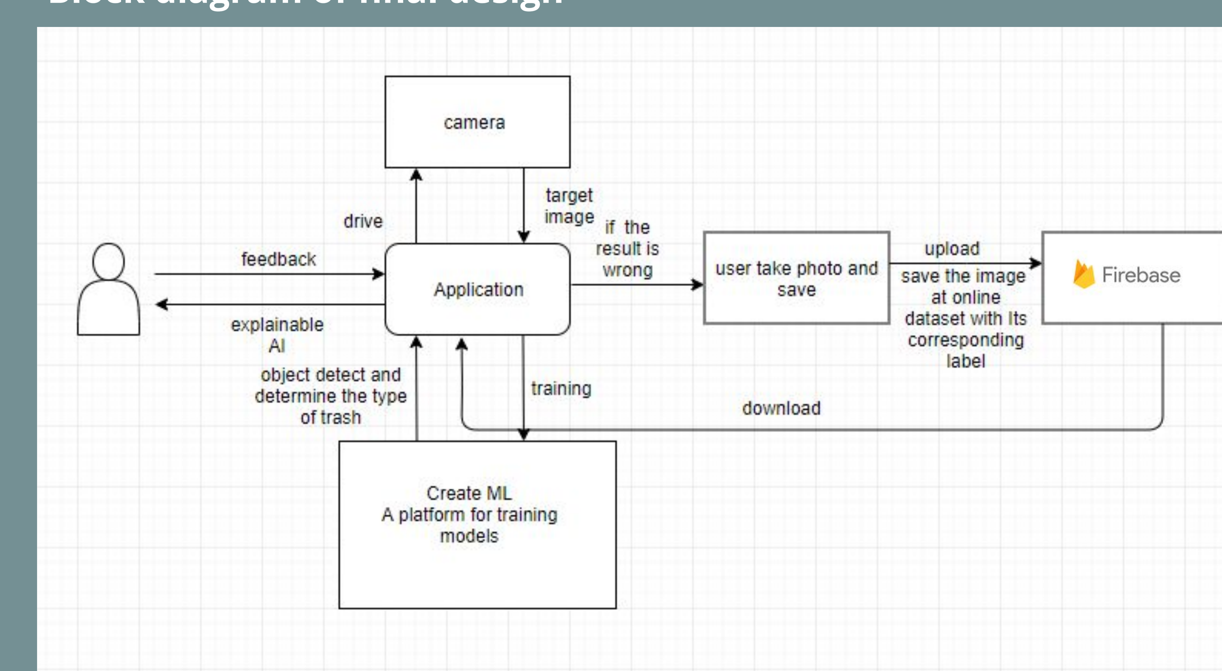
layer material layer object layer color

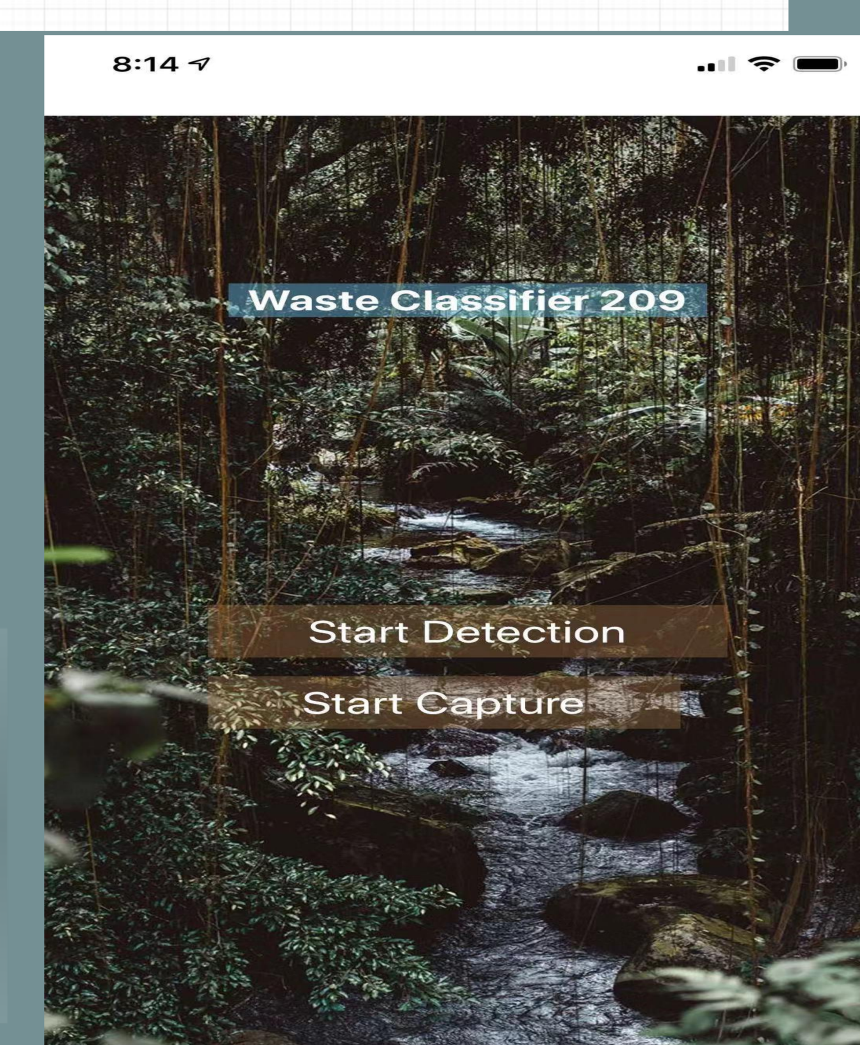
Block Diagram

Originally planned block diagram (midterm plan)



Block diagram of final design

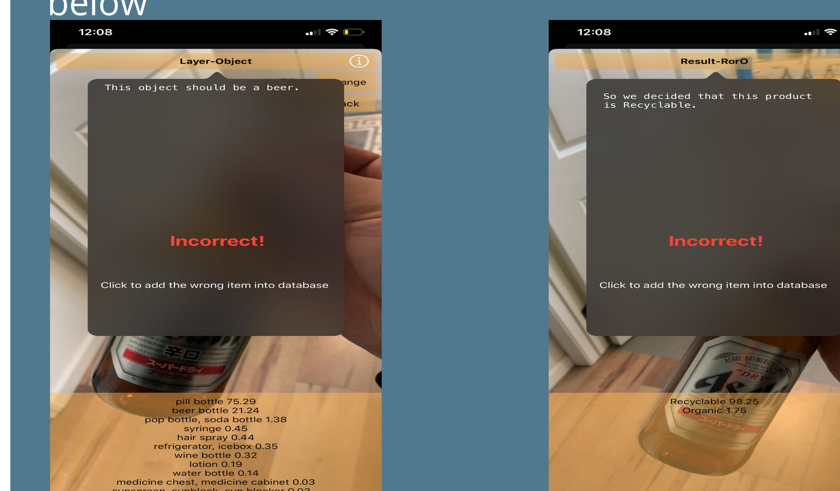




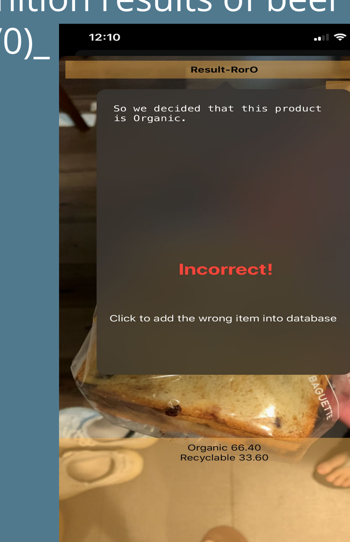
Actual interaction interface

Results

The final identification results are shown in the figure below



Recognition results of beer bottle (Object and R/O)_



Recognition results of bread (R/O mode)

Conclusion

As we can see from the results, our app can function pretty well. Users can experience the convenience of having AI to help them do the classification. We do have some downsides in our product. The model that we are using to predict the object is not accurate enough. But this can be improved by our feedback system.

Overall, we achieved our original goal pretty decently, and we hope in the future, we get chances to refine our app, making it a more user-friendly creation.

Reference

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Waste Classification Data, by Sashaank Sekar. Retrieved from http://www.kaggle.com/techsash/waste-classification-data.

Save UIImage to Custom Folder in Swift 5, by Rebeloper. Retrieved from http://youtube.com/watch?v=LgeBLeQmFUA.