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Enabling People
Education for Future Generations

AI Course

Team Project Final Report

For students (instructor review required)

Samsung Innovation Campus

Let’s Recycle!

< Date (01/05/23) >

Planeteers

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Content

1. Introduction

1.1. Background Information

The objective of our project is to correctly classify waste material to facilitate and encourage the average consumer to recycle properly.
We expect the model to be able to classify different types of waste.
The benefit would be that it could help consumers easily determine whether their waste is recyclable, thus encouraging recycling.

1.2 Motivation and Objective

We will take image data to determine whether something is recyclable. We will solve multiclass Image classification using a convolutional neural network (CNN). We will use TensorFlow to perform this classification.

1.3 Members and Role Assignments

Michelle F- Prepare data
Lydia W- Train model
Katerina V- Train model
Nabeela R- Summarize results
Kavya G- Summarize results
Melissa J- Prepare data

2. Project Execution

2.1 Data Acquisition

We found the dataset on Kaggle, then used opendatasets to load the dataset. We then used os to create either 2 or 4 categories and standardized the number of images in each category to be used in the model.

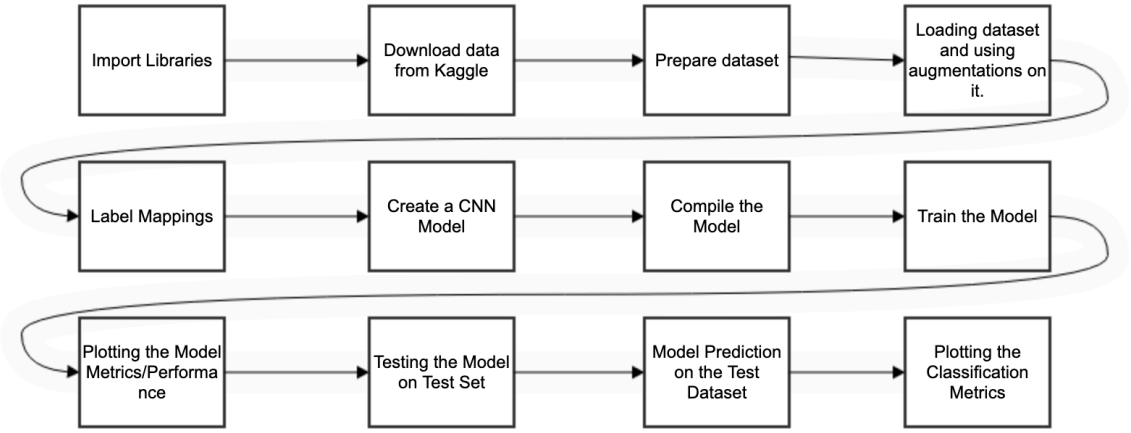
2.2 Training Methodology

Import data directly from Kaggle. Visualize a small sample of random images from the train set. We will create the model, define configuration options, perform some image augmentation for improved model generalizability, and train it. Evaluate the model on the test set using different classification metrics. Visualize the images from the training and test set.

2.3 Workflow

Load Image Datasets and Apply Augmentations.Training a CNN Model. Testing the model on the validation dataset. Check model performance, and plot the Classification Metrics.

2.4 System Diagram



3. Results

3.1. Data Preprocessing

We made a uniform number of images for each category and divided images into 2 or 4 categories depending on the model. Then we standardized the size of the images to 150 widths and 150 heights for the model.

3.2 Exploratory Data Analysis (EDA)

Data Collection: We found a dataset with a large collection of pictures of various waste from Kaggle and uploaded them into appropriate categories.

Data Cleaning: We removed surpluses in certain categories to have a standardized number of images in each category and resized the images to a uniform size.

3.3 Modeling

For our project, we used Convolutional Neural Networks, which consist of three Convolution and Activation('relu') layers followed by pooling and bath normalization layers. Flatten layer is used as a connection between the Convolution and the Dense layers—followed by two Dense layers, separated by the Drop layer.

The various layers:

1. The convolutional Layer(Conv2D) was the first layer to extract the various features from the input images. The output is a Feature map that gives us information about the image, such as the corners and edges. The Conv2D layer passes the result to the corrected linear activation function (ReLU) that will output the input directly if it is positive. Otherwise, it will output zero.
2. The Pooling Layer decreases the size of the convolved feature map to reduce computational costs. The Max pooling operation calculates the largest or maximum value in every patch and the feature map. It summarizes the features generated by a convolution layer.
3. The Batch normalization layer standardizes inputs for each mini-batch, stabilizing the learning process and reducing the training epochs required.
4. The Dense layers are used for the output layers. Separated by a dropout layer of 0.5, 50% of the nodes are dropped out randomly from the neural network to improve the performance of a machine learning model as it prevents overfitting by making the network more straightforward. It drops neurons from the neural networks during training.
5. The final layer will be a softmax output layer with 2 or 4 possible classes which gives a probability for each class, and they sum up to 1. The model will predict based on the class with the highest probability.

3.4 User Interface (Interface).

We created a user interface using Gradio where you can drag or upload an image and get our model's category prediction. It takes an image input and returns a text prediction output.

3.5. Testing and Improvements.

Adding extra layers, we improved accuracy from 80% to 98% for the first model. Also, we added shuffling, which gave a more uniform distribution to the datasets. We improved accuracy from 25% to 83% for the second model by changing the approach.

4. Projected Impact

4.1. Accomplishments and Benefits

On our project, we achieved 98% accuracy on our 2 class model and have a user interface that allows a user to put an image to be categorized into trash or recycling. We also created a model with 4 classes with an accuracy of 83%.

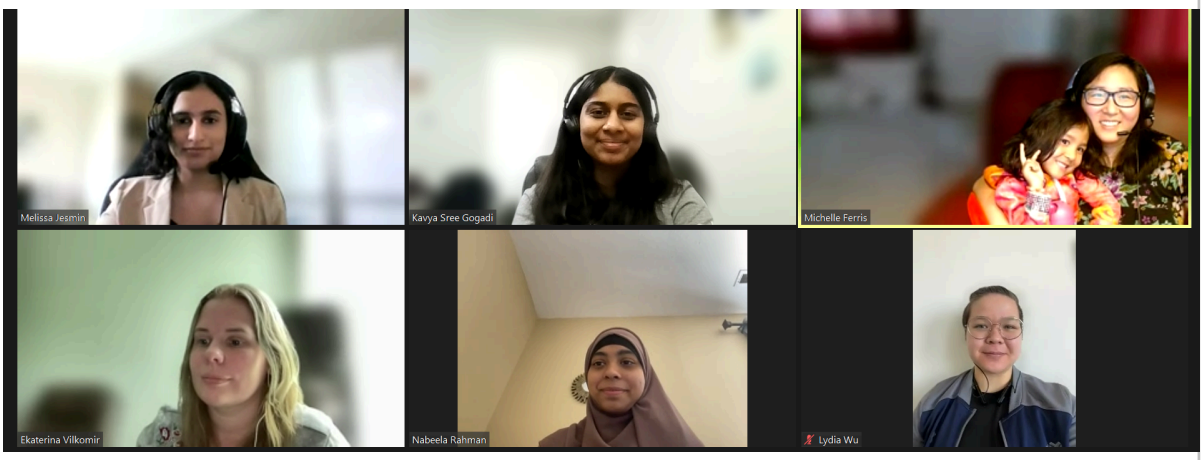
The benefits are that users can get help categorizing their waste to help sort recyclables.

4.2 Future Improvements

Future improvements are to break down further the categories that the model can predict for recyclables. An example would be to categorize papers, plastics, metal, glass, etc.

Also more training/testing data and layers can be added to further improve the accuracy of the model.

5. Team Member Review and Comment



NAME	REVIEW and COMMENT
Michelle F	Prepared data and added Gradio UI
Lydia W	Train model
Katerina V	Train model
Nabeela R	Summarize results
Kavya G	Summarize results
Melissa J	Prepared data

6. Instructor Review and Comment

CATEGORY	SCORE	REVIEW and COMMENT
IDEA	__/20	
CODING	__/20	
PROJECT MANAGEMENT	__/30	

PRESENTATION & REPORT	__/30	
TOTAL	__/100	