# Enhanced Waste Management: An AI-Driven Approach to Biodegradable and Non-Biodegradable Waste Classification

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**Data Loading and Preprocessing**

Code Summary:

- The data set which is extracted from the Kaggle which is stored in the biodegradable and non-biodegradable is in the zip file.
- The well organizes images into the two categories with a biodegradable and non-biodegradable.
- In the data preprocessing to training the data I have splits into the data training 80% and validation 20%

Interpretation:

- The are classifications into the setup with simplified materials like plastics cardboards glass metal and trash into the two broad categories.
- In this data we have successfully loaded 2,022 images belonging to 2 classes, to the training set and 505 images belonging to 2 classes in the validation set.

**Model Architecture - MobileNetV2 (Best Performing Model)**

Code Summary:

- The mobile net V2 model is actually commonly used in the convolution neural network for the pre-trained on the image classification to get the better clear vision of the image efficient, high accuracy, fast interference, good generalization.

Interpretation:

- The interpretation mobile net v2 model is pre-trained the features of the images to improve accuracy.
- The more efficient and the generalized which is compared to an custom with the Convolutional neural network models.
- The training accuracy of a 85.06% is correctly classified the images during the training phase of your mobilenetV2 model. The model learned from the training data.
- The validation accuracy 82.05% the model performance on a unseen data validation this is best performed among the test models.
- The demonstrations, which is the good generalization meaning the model is not actually over fitting its significantly and is capable of making accurate predictions on new data.

**Model Compilation & Training**

Code Summary:

- Which uses the binary cross -entropy loss its actually suitable for the binary classification for the training.
- The images are used to train the images are transformed, for an example the images are rotated, flipped, zoomed adjusted in brightness. The epoch is one complete passing the entire dataset through the model. 10 epochs improve and updating the weight each time to improve learning.
- This class weights are actually help's balancing the dataset to handle the imbalanced data so that way it should be balanced and prevents bias towards the majority class.

Interpretation:

- The binary cross-entropy is a have the two-class problems where they have two-class 0 and 1 which is true or false. When categorical cross entropy it would be a better choice because of the it will consider as more than two class.it works better for multi-class classification.
- The class weighting which helps to balance the dataset if I have fewer images in the paper more in the cardboard so it will take the minor images paper helps to improve its predictions for that class. Fine-tuning the weights is important to avoid overfitting and underfitting to ensure the best model performance.
- The model is stable learning because the model is learning in controlled and the steady manner this will lead to better generalization on a new unseen data. This makes predictions without drastic changes.

**Model Performance Analysis**

Code Summary:

- The confusion matrix what it is means is based on evaluating the performance of a classifications model to predictions by comparing the predicted labels with actual labels. In the classifications report we can calculate the metrics like precision recall and F1 score.
- The validation accuracy refers to the performance of the model on the validation dataset its based on calculated after the epoch and gives the how the model is generalizing unseen data compared to just fitting to training data.
- This validation accuracy and loss trends helps to understand if the model is improving by overfitting or underfitting.

Interpretation:

- The validation of the accuracy is 82.05% which is not only the generalization ability to just memorize the training data, but its generalizing learning also to make accurate predictions on new unseen data.
- In the confusion matrix observations, which is actually I got the result plastic precision is 84% and recall 98% the model successfully detects almost all plastic samples.
- The trash class in the confusion matrix which is actually I got the result precisions 93% and recall 100% the model never misses the any trash item. Overall accuracy is strong.
- The cardboard glass metal paper is highly accurate and also reliable for these categories.
- Transfer learning is leveraging pre-trained models on a large dataset because of transfer learning so we do not need to build from scratch in the convolution neural network.

**Model Predictions & Deployment**

Code Summary:

- The dataset consists of biodegradable and non-biodegradable images based on the loads that are trained in the mobilenetV2 model once training is completed, I got the result saved it as a waste_classifier_model.h5.

Interpretation:

- The model predicts a biodegradable unseen image. I am taken the sample image from the google new unseen image the unseen image predicts and gave the score 99% with high confidence.

- The model predicts a non-biodegradable unseen image. I am taken the sample image from the google new unseen image the unseen image predicts and gave the score 99% with strong classification.
- The mobile net V2 model is best suitable for deployment due to its balance of the accuracy and efficiency in the classification