Municipal Solid Waste Classification Using Transfer Learning

Team Mates

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INTRODUCTION:

Waste management is a critical issue in urban development. Efficient waste classification plays a vital role in reducing environmental pollution and promoting recycling. Manual classification is time-consuming and error-prone. This project leverages transfer learning with deep learning techniques to automate the classification of municipal solid waste into three categories: Biodegradable, Recyclable, and Trash.

OBJECTIVE

The primary objective of this project is to build an intelligent waste classification system using a pre-trained convolutional neural network (CNN), specifically the VGG16 model. This system can classify images of waste into predefined categories with high accuracy, making waste disposal and recycling more efficient.

TECHNOLOGIES USED

- Python

- TensorFlow / Keras
- VGG16 (Pre-trained CNN Model)
- Flask (for web application)
- HTML, CSS (for frontend design)
- Jupyter Notebook (for model training and testing)

DATASET DESCRIPTION

The dataset used in this project is the "Municipal Solid Waste Dataset" sourced from Kaggle. It contains images of waste labeled into three categories:

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- Biodegradable
- Recyclable
- Trash

The dataset was split into training, validation, and test sets. Data augmentation techniques such as rotation, flipping, and zooming were applied to increase the diversity of training samples.

METHODOLOGY

1. Data Preprocessing:

- Images were resized to match the input shape required by VGG16.
- Applied normalization and augmentation.

2. Transfer Learning with VGG16:

- The top layer of VGG16 was removed.
- Custom layers were added for our specific classification task.
- The model was trained using the augmented dataset.

3. Model Evaluation:

- Evaluated using accuracy, precision, recall, and F1-score.
- Early stopping and validation monitoring were used to prevent overfitting.

4. Model Deployment:

- The trained model was saved as internship1.h5.
- A Flask-based web app was developed for real-time predictions.

WEB APPLICATION WORKFLOW

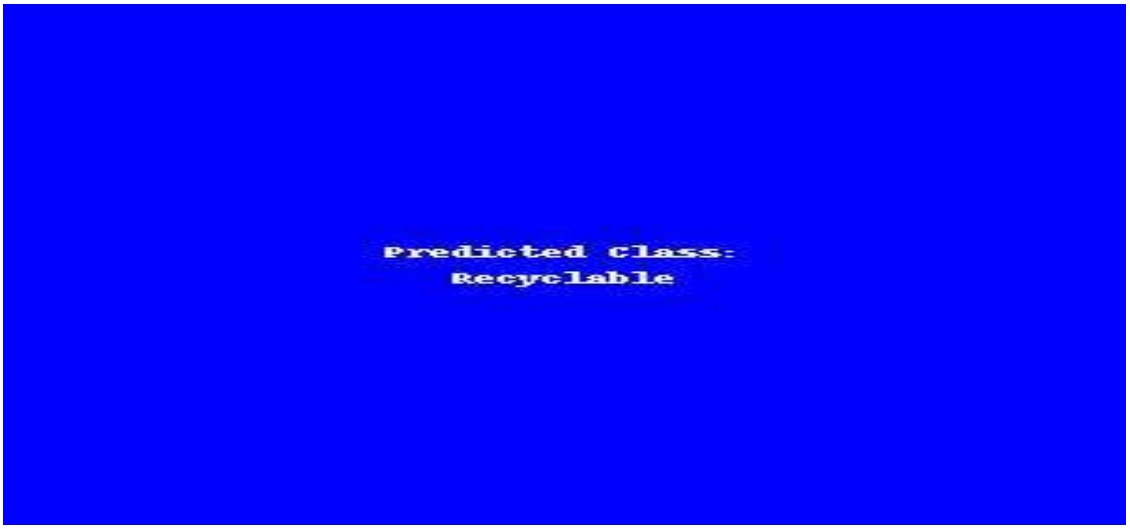
- The user uploads a waste image.

- The app processes the image and passes it to the trained model.
- The model predicts the class (Biodegradable/Recyclable/Trash).
- The result is displayed on the web page.

RESULTS AND DISCUSSION

The model achieved high accuracy on the test set, proving that transfer learning with VGG16 is effective for image-based waste classification. The web app enables users to classify waste images in real-time, promoting sustainable waste management practices**.**

OUTPUT 1:



OUTPUT 2:

ADVANTAGES

- Reduces the need for manual waste segregation.

- Fast and accurate classification.
- Scalable for smart city waste management systems.

LIMITATIONS

- Model performance is limited by the dataset quality.

- May not generalize well to waste images from different environments without retraining.

FUTURE SCOPE

- Include more waste categories.

- Integrate with IoT devices for smart bins.
- Improve model performance with more advanced architectures like ResNet or EfficientNet.

CONCLUSION

This project demonstrates the practical application of transfer learning for solving real-world problems like waste management. The system effectively classifies municipal waste using a pre-trained deep learning model and provides a user-friendly web interface for end-users.

-----THANK YOU-----