Project Report Format

1. INTRODUCTION

1.1 Project Overview

This project combines a VGG16 model with a Flask web app, allowing users to upload waste images and get instant classification results through a user-friendly UI.

1.2 Purpose

The goal is to automate waste segregation, aiding smart city waste management and reducing environmental harm through proper classification.

2. IDEATION PHASE

2.1 Problem Statement

Manual waste segregation is time-consuming, error-prone, and inefficient. There's a need for an automated, accurate, and real-time classification solution.

2.2 Empathy Map Canvas

Initially, no predefined workflows existed. The system was built from scratch, identifying pain points in manual classification to derive a structured approach.

2.3 Brainstorming

Ideas centered around using image recognition models and web apps to make waste classification accessible, efficient, and adaptable for everyday use.

3. REQUIREMENT ANALYSIS

3.1 Customer Journey map

Users upload an image via the web app → Image is analyzed by the model → Category prediction is shown → Informs user on disposal method.

3.2 Solution Requirement

Requires an accurate model (VGG16), Flask backend, HTML/CSS frontend, a reliable dataset, and integration mechanisms between UI and ML model.

3.3 Data Flow Diagram

User → UI (HTML) → Flask Server → VGG16 Model → Prediction Result → Display to User (UI).

3.4 Technology Stack

- **Front end**: HTML and CSS used to build user interface pages like index.html and result.html.

- **Back end**: Python with Flask handles model serving, routing, and HTTP requests for user inputs and predictions.

- **Model**: Pre-trained VGG16 CNN model used for image classification, fine-tuned on waste images from Kaggle.

- **Storage**: Model saved as vgg16.h5; image data handled during runtime with temporary storage through Flask.

- **Tools**: Anaconda, Jupyter Notebook, TensorFlow, Flask, NumPy, Pandas, Matplotlib, Seaborn, OpenCV.

4. PROJECT DESIGN

4.1 Problem Solution Fit

Problem of inefficient waste segregation is solved by automating classification using AI, offering speed and consistency**.**

4.2 Proposed Solution

Build a transfer learning-based model (VGG16) deployed via Flask to predict waste categories in real-time through a web interface**.**

4.3 Solution Architecture

UI (HTML) ↔ Flask Backend ↔ VGG16 Model ↔ Result Display; a simple client-server architecture integrated with deep learning**.**

5. PROJECT PLANNING & SCHEDULING

5.1 Project Planning

Steps include data collection, preprocessing, model building, training, testing, and app deployment, completed in defined milestones**.**

6. FUNCTIONAL AND PERFORMANCE TESTING

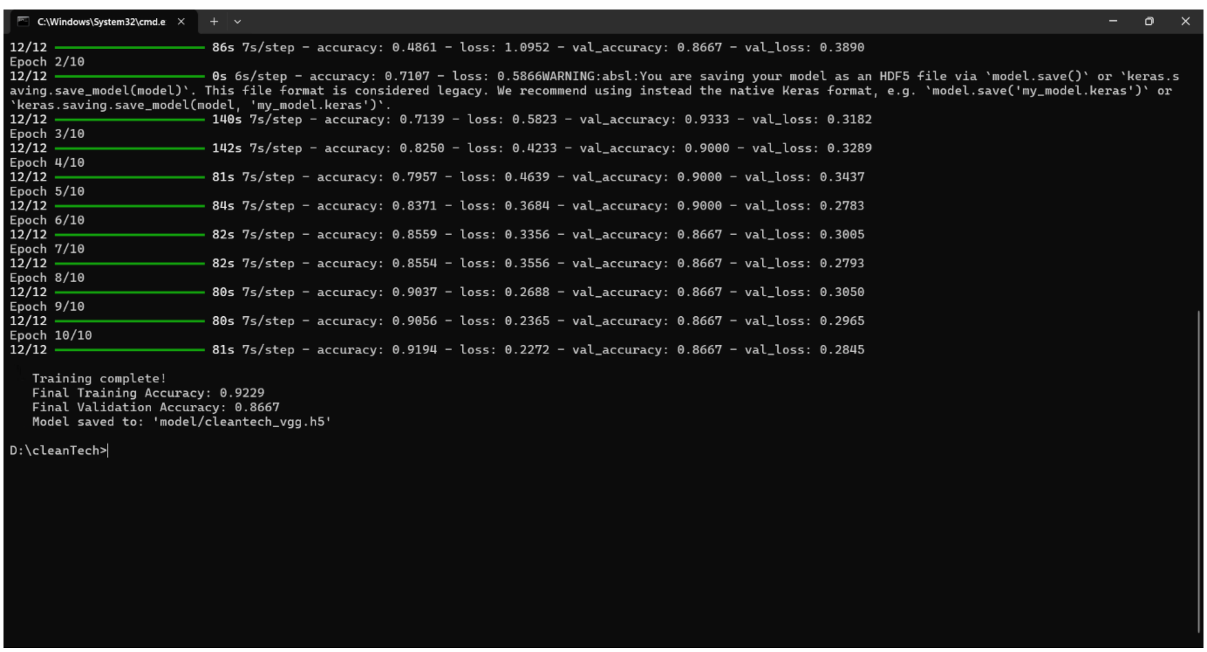
6.1 Performance Testing

Model performance evaluated using accuracy, loss curves, and test data; prediction speed and model response also tested**.**

7. RESULTS

The model successfully classified waste images with high accuracy, proving transfer learning's effectiveness on small datasets.

7.1 Output Screenshots



8. ADVANTAGES & DISADVANTAGES

Advantages:

- Fast and automated waste classification
- High prediction accuracy
- Easy web-based access

Disadvantages:

- Limited to 3 waste categories
- Performance may vary on poor-quality or ambiguous images

9. CONCLUSION

Clean Tech provides an efficient AI-based solution for automatic waste classification using transfer learning. It enhances accuracy and simplifies waste segregation.

10. FUTURE SCOPE

Future improvements include adding more waste categories and integrating the system with smart bins and mobile applications for broader usability**.**

11. APPENDIX

Source Code(if any)

Dataset Link

GitHub & Project Demo Link

https://github.com/RachamaduguNarasimhaRao/ccc/blob/main/Project/templates/index.html

https://github.com/RachamaduguNarasimhaRao/ccc/tree/main/Project/dataset/train/Biodegradable%20Images

https://github.com/RachamaduguNarasimhaRao/ccc

https://drive.google.com/file/d/1MfLTwax2BsGROR7QzAbILZLDgL7YS1Ub/view?usp=sharing