Project Report CleanTech: Transforming Waste Management with Transfer Learning

1. INTRODUCTION

1.1 Project Overview:

CleanTech is a smart waste classification system that uses transfer learning with VGG16 to categorize waste images into biodegradable, recyclable, or trash. It is implemented as a web-based platform.

1.2 Purpose:

The purpose is to simplify and automate municipal waste segregation using AI, enabling eco-friendly disposal, reducing landfill, and improving recycling practices.

2. IDEATION PHASE

2.1 Problem Statement:

Improper waste segregation leads to inefficient recycling and pollution. Manual sorting is error-prone and not scalable.

2.2 Empathy Map Canvas:

- User: Municipal workers, citizens
- Need: Simple tool for waste classification
- Pain: Confusion about waste categories, no awareness
- Gain: Easy, instant, image-based classification

2.3 Brainstorming:

We explored mobile apps, barcode scanning, and finally chose an AI-based visual classification system due to its efficiency and simplicity.

3. REQUIREMENT ANALYSIS

3.1 Customer Journey Map:

User visits website Uploads waste image Sees classification Uses info for disposal

3.2 Solution Requirement:

- Frontend: HTML, Bootstrap
- Backend: Flask, Python

- Model: VGG16 (Keras)
- Hosting: Local/Cloud
- Accuracy > 90%

3.3 Data Flow Diagram:

[User Upload Flask App Model Prediction Display Result]

3.4 Technology Stack:

- Frontend: HTML, CSS, JS, Bootstrap
- Backend: Python, Flask
- Model: TensorFlow + Keras (VGG16)
- Tools: Anaconda, Jupyter, VS Code

4. PROJECT DESIGN

4.1 Problem Solution Fit:

A real need exists for quick waste identification. Our solution fits perfectly as it uses only an image and gives fast results.

4.2 Proposed Solution:

A user-friendly platform that uses a CNN model to identify waste category and guide the user in proper disposal.

4.3 Solution Architecture:

Frontend uploads image Backend receives and predicts using model Returns prediction UI displays it

5. PROJECT PLANNING & SCHEDULING

5.1 Project Planning:

- Week 1: Dataset preparation
- Week 2: Model training
- Week 3: Web app integration
- Week 4: Testing and documentation

6. FUNCTIONAL AND PERFORMANCE TESTING

6.1 Performance Testing:

Tested with 50+ images. Average response time is under 2 seconds. Accuracy above 90% with proper lighting and image clarity.

7. RESULTS

7.1 Output Screenshots:

[Attach screenshots showing predictions for biodegradable, recyclable, and trash]

8. ADVANTAGES & DISADVANTAGES

Advantages:

- Accurate prediction
- Easy-to-use interface
- Environmentally beneficial

Disadvantages:

- Needs good image quality
- Model limited to trained classes

9. CONCLUSION

CleanTech bridges technology and sustainability, offering a practical AI solution for everyday waste problems. It empowers users and municipalities alike.

10. FUTURE SCOPE

- Mobile app version with TensorFlow Lite
- Smart bin integration
- Cloud hosting
- User feedback integration

11. APPENDIX

Source Code: Available upon request

Dataset Link: https://www.kaggle.com/datasets accessed for public waste images

GitHub & Project Demo Link: https://github.com/Ayaan48/CleanTech-Transforming-Waste-Management-with-Transfer-Learning

Demo link :- https://drive.google.com/file/d/1VDSvotAL6u6IlAEWXIXyBgMyMTLJ0YvT/view?usp=drive_link