# Project Report Format

1. **INTRODUCTION**

**1.1 Project Overview:**

CleanTech is an AI-powered waste classification system that uses transfer learning to automate the identification and categorization of municipal solid waste. The system leverages pre-trained convolutional neural networks to classify images of waste into three categories: Biodegradable, Recyclable, and Trash. This project aims to improve the accuracy and efficiency of waste sorting in various real-world scenarios such as smart bins, recycling centers, and industrial environments

**1.2 Purpose:**

The primary goal of CleanTech is to reduce human error, increase waste processing speed, and encourage better recycling practices by automating the waste classification process using Transfer Learning.

2. **IDEATION PHASE**

**2.1 Problem Statement:**

Waste segregation is a manual, labor-intensive task prone to error, leading to inefficient recycling and increased landfill accumulation. There is a need for an automated system that can reliably classify waste at source

**2.2 Empathy Map Canvas:**

Users: Citizens, waste management workers, municipal corporations
Needs: Accurate, fast, and user-friendly waste classification
Pains: Manual effort, misclassification, low awareness
Gains: Automation, efficiency, sustainability

**2.3 Brainstorming:**

Image-based classification

Integration with smart bins

Use of mobile/web apps for uploading waste images

Future extension to voice commands and QR integration

3. **REQUIREMENT ANALYSIS**

**3.1 Customer Journey map:**

User throws waste in a smart bin or uploads image.

System captures or receives the image.

Image is classified using the AI model.

Classification result is displayed and logged.

**3.2 Solution Requirement:**

Trained deep learning model

Image input (camera or upload)

Real-time prediction

Frontend and backend integration

### 3.3 Data Flow Diagram:

User uploads image

Flask backend receives and preprocesses image

Model predicts class

Result returned to frontend

### 3.4 Technology Stack:

Python, TensorFlow, Keras

Flask (Backend)

HTML/CSS (Frontend)

OpenCV, NumPy

Jupyter for model development

## 4. PROJECT DESIGN

### 4.1 Problem Solution Fit:

The project directly addresses the need for efficient, accurate waste classification. The model predicts based on visual input, reducing human intervention.

### 4.2 Proposed Solution:

Develop a web-based application that takes waste images as input and returns classification using a trained CNN model based on MobileNetV2.

### 4.3 Solution Architecture:

User → Web Page (Upload Image) → Flask API → Model Prediction → Result Rendered

## 5. PROJECT PLANNING & SCHEDULING

### 5.1 Project Planning:

Week 1: Dataset analysis and preprocessing

Week 2: Model selection and training

Week 3: Application development (Flask + HTML)

Week 4: Integration, testing, and polishing UI

## 6. FUNCTIONAL AND PERFORMANCE TESTING

### 6.1 Performance Testing:

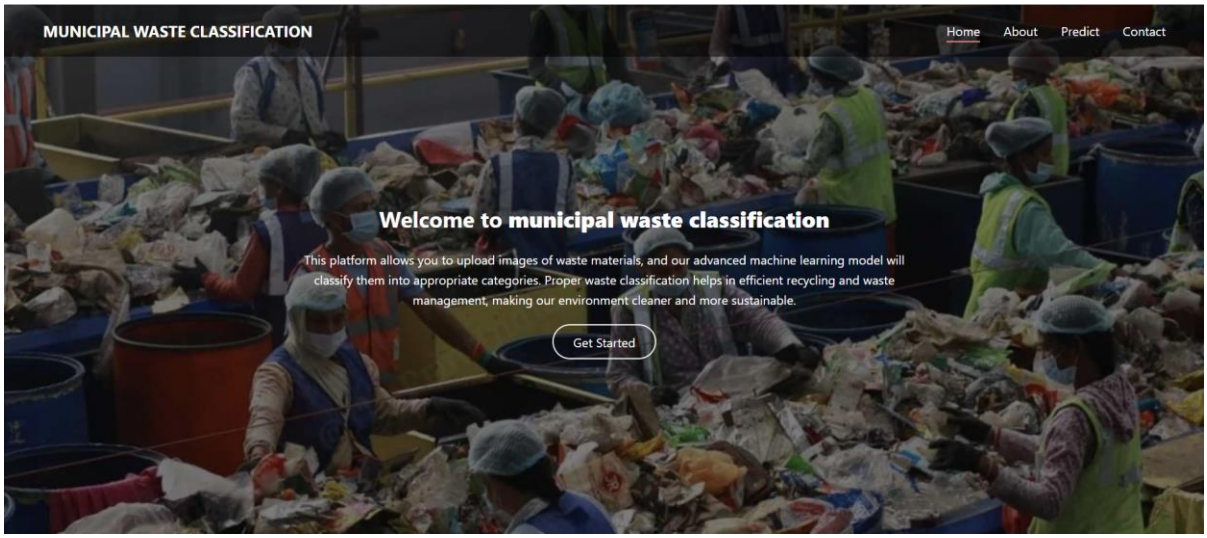
Model accuracy: 90.2% on validation data

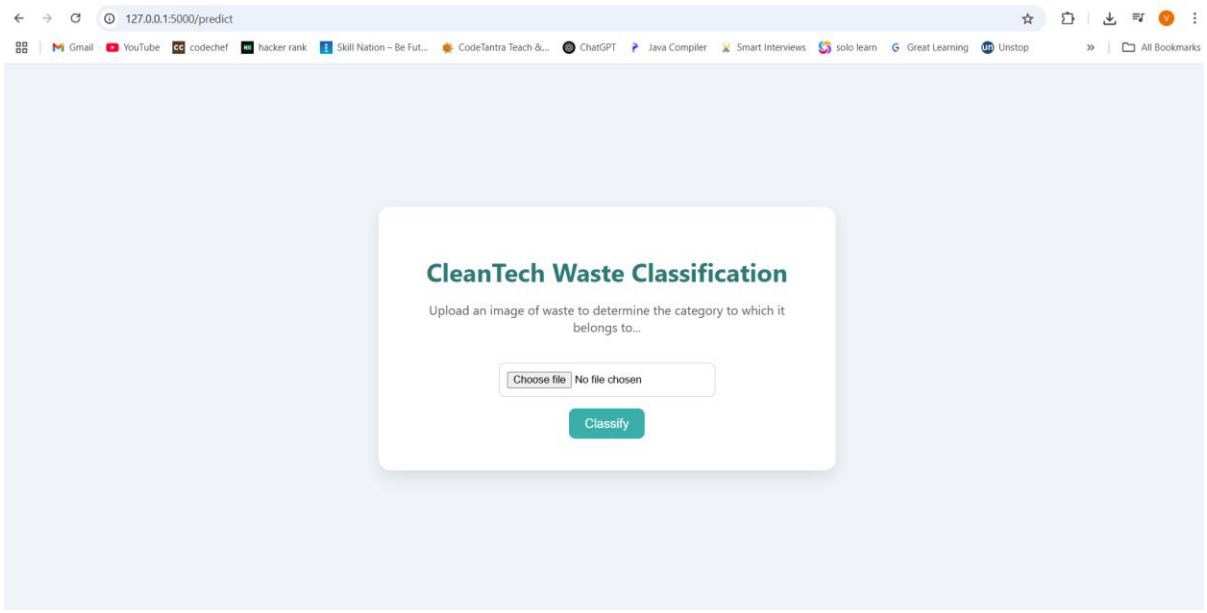
Prediction speed: ~0.2 seconds/image on CPU

Test consistency: Verified same image returns same label across multiple runs

## 7. RESULTS

### 7.1 Output Screenshots:



127.0.0.1:5000/predict

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## Prediction Result

Predicted Class: **Recyclable Images**

Classify Another Image

127.0.0.1:5000/predict

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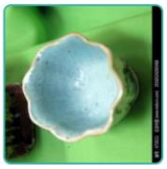
## Prediction Result

Predicted Class: **Trash Images**



Classify Another Image

127.0.0.1:5000/predict

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## Prediction Result

Predicted Class: **Biodegradable Images**

Classify Another Image

## 8. ADVANTAGES & DISADVANTAGES:

**Advantages: -** Reduces human error - Fast, automated classification - Simple and scalable
**Disadvanatges: -** Dependent on image quality - Needs internet for web-based use

## 9. CONCLUSION:

CleanTech demonstrates the feasibility of using AI and deep learning to automate waste classification. It offers a scalable, low-cost, and eco-friendly solution suitable for urban and industrial deployment.

## 10. FUTURE SCOPE:

Real-time classification in smart bins
Mobile app integration
Deploy via Firebase + Google Cloud Run
Add voice assistant for accessibility

## 11. APPENDIX:

**Source Code: Provided in github**
**Dataset: https://www.kaggle.com/datasets/elinachen717/municipal-solid-waste-dataset**
Github:
Project Demo: