Smart Waste Classification Using Computer Vision

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Project Objectives

- Problem Statement
- Project Overview – Introduction
- End Users
- Wow Factor in Project
- Modelling/Block Diagram/Flow of Project
- Result/outcomes
- Conclusion
- Future Perspective

Problem Statement

Developed an AI-powered system to automatically classify waste images, reducing human effort, improving recycling efficiency, and ensuring safe waste disposal practices.

➢ Objectives

- Automated waste classification
- Easy image upload & prediction
- Reliable results with confidence
- Promote responsible disposal

➢ Goals

- High accuracy with deep learning
- Efficient segregation at source
- Scalable for apps & smart bins
- Support recycling & sustainability

Fig 1. Overflowing Garbage Bin (Waste Pollution)

Project Overview – Introduction

- Waste generation has increased significantly due to urbanization and industrialization.
- Effective waste management is crucial to reduce pollution, conserve resources, and promote sustainability.
- Manual segregation is common but labor-intensive, unsafe, and inefficient.
- AI and Computer Vision can automate classification into categories for faster, more accurate segregation.
- Contributes to cleaner and more sustainable environments.

End Users

1. **Households / Individuals** - Use via mobile apps or smart bins.
2. **Municipal Corporations / Local Authorities** - Integrate into smart bins and collection systems.
3. **Recycling Companies / Waste Management Industries** - Classify and sort waste more accurately.
4. **Hospitals and Institutions** - Classify biomedical, plastic, paper, or general waste quickly.

Wow Factors in Project

1. Real-time waste detection using live camera feed (CCTV, smartphone, IoT bin).
2. High accuracy achieved with transfer learning (ResNet, MobileNet, EfficientNet).
3. Smart Bin integration for automated sorting.
4. Direct sustainability impact linked to UN SDGs (clean cities, climate action).

Modelling/Block Diagram/Flow of Project

1. **Input:**

   Camera captures waste image.

2. **Image Processing:**

   Preprocessing like resizing, normalization.

3. **Deep Learning Model (CNN):**

   Predicts the waste type.

4. **Output (Prediction):**

   Displays predicted waste type + confidence Percentage.

5. **Visualization:**

   Generates a graph (bar chart/pie chart) showing prediction confidence distribution.

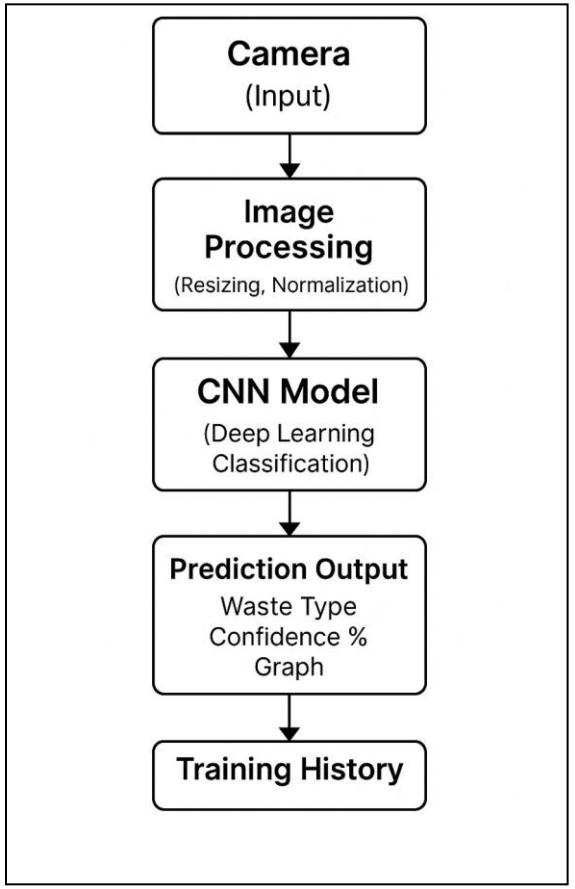

Fig2.Flowchart of Smart Waste Classification

Result/Outcomes

- The developed computer vision model predicted waste categories with confidence scores, showing reliable accuracy.
- Training history and performance graphs highlighted consistent model learning and evaluation.
- The system reduced manual effort in waste segregation by offering automated predictions.
- This outcome supports sustainable waste management and demonstrates the potential of AI-driven solutions.

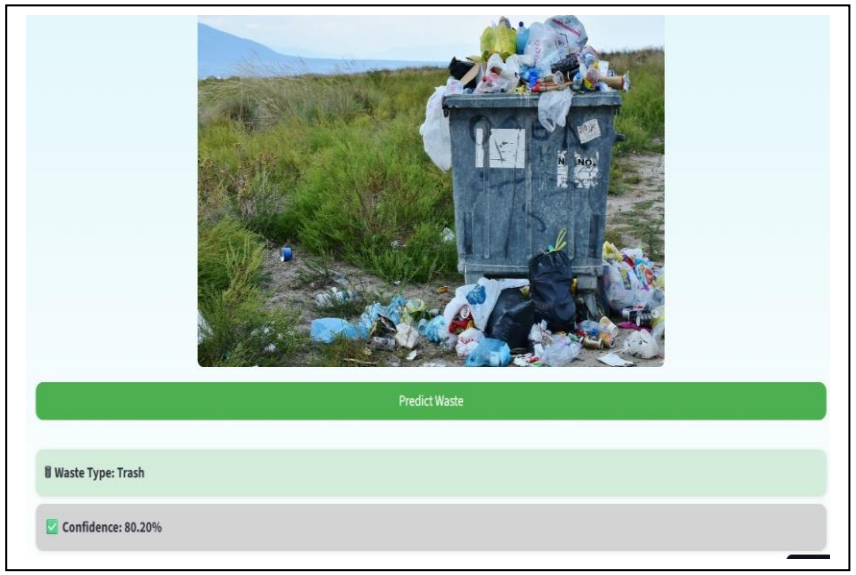

Fig3. Waste Classification Output

Conclusion

- Demonstrated Computer Vision + Deep Learning for waste classification.
- Developed model outputs waste category with confidence percentage.
- Training graphs validate performance (accuracy, loss).
- Scalable for smart bins, recycling plants, urban waste systems.
- AI enables sustainable recycling and smarter waste management.

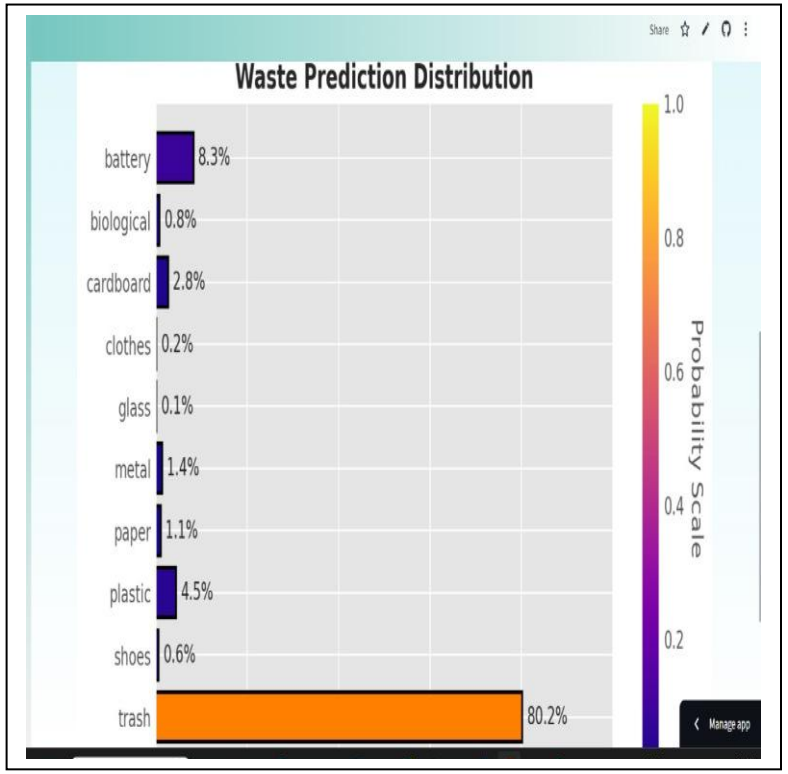

Fig4.Waste Classification Prediction Result

Future Perspective

- **Smart Waste Bins** — AI-powered automatic segregation.
- **IoT & Cloud Connectivity** — Real-time monitoring and analytics.
- **Multi-Category Classification** — Expand to classify plastic, glass, metal, organic, paper, etc.
- **Edge Deployment** —Run the trained model on edge devices or smartphones for real-time waste detection.

Project Link

https://smart-waste-classifier-rlwnnlc6zwbyr2m6kgtxh3.streamlit.app/

Thank You