# Waste Classification Using Computer Vision


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  Course: ITAI 1378 — Computer Vision & AI
  Project Tier: Tier 1
  Platform: Google Colab + PyTorch

# Problem Statement

Manual trash sorting is slow, error-prone, and leads to recycling contamination.

When waste is placed in the wrong bin, it reduces recycling efficiency and increases processing cost.

Why it matters:

1. Contaminated recycling → wasted materials
2. Higher labor & sorting cost
3. Environmental pollution
4. Goal: Use AI to classify waste images automatically and support smarter recycling systems.

# Proposed Solution

The proposed solution is to build a computer vision system that automatically classifies waste into six categories using a deep learning model. By analyzing images and predicting the correct material type in real time, the system can assist recycling efforts, reduce sorting mistakes, and support the development of smart and sustainable waste-management technologies.

# Technical Approach

Method: Image classification (Computer Vision)

Model: EfficientNet-B0 (pretrained on ImageNet)
Technique: Transfer learning

Why this approach:

Strong performance on small datasets

Efficient for limited compute (Colab GPU)

Proven architecture for real-world image tasks

Tools:
PyTorch, torchvision, grad-cam, sklearn, Colab GPU

# Dataset

a) Source: TrashNet-style dataset structure
 Classes (6): Cardboard, Glass, Metal, Paper, Plastic, Trash

b) Format:

c) train/

d) val/

e) test/

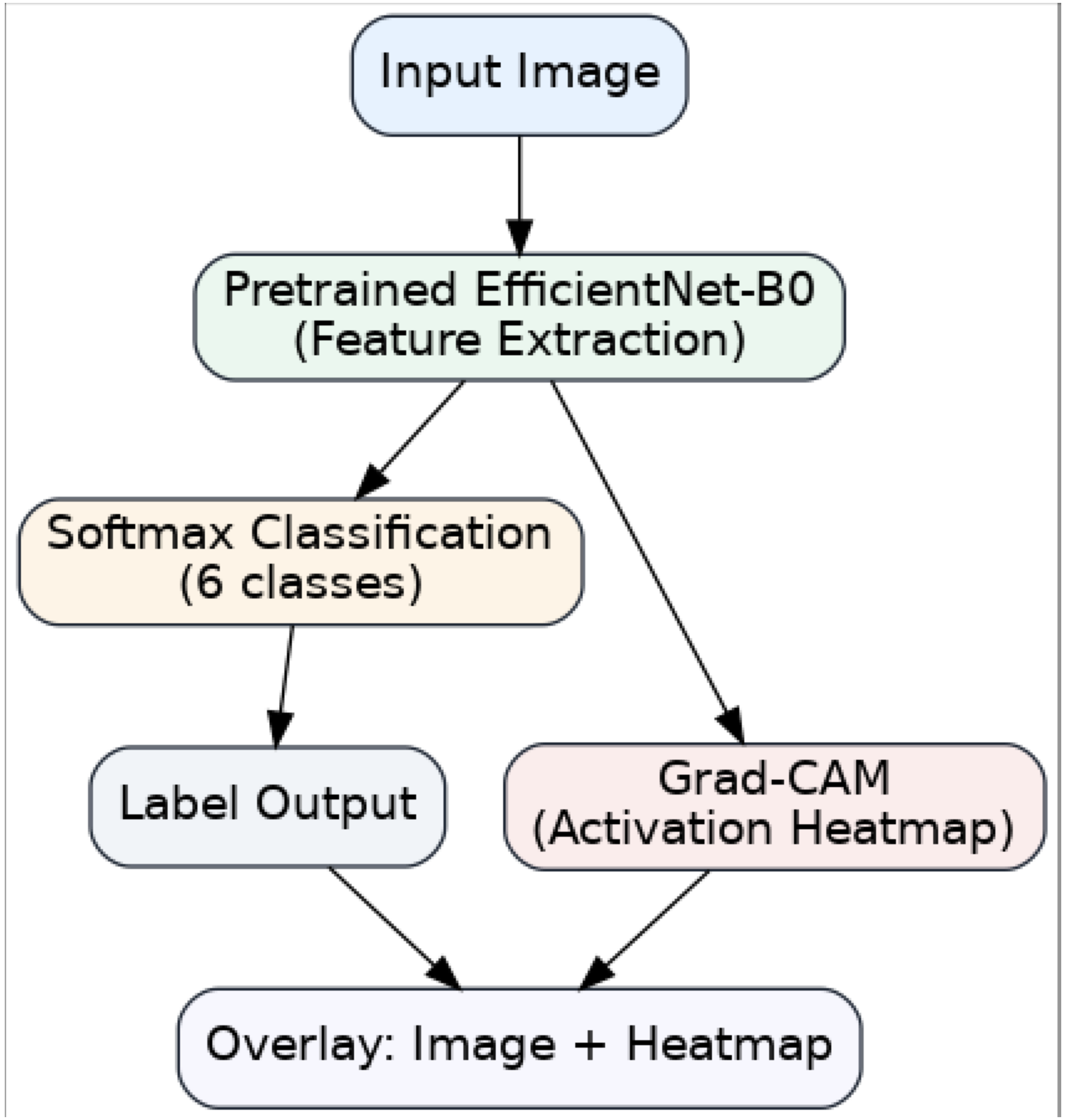
f) Total images: ~2527 (balanced across classes)
 Synthetic fallback dataset used if missing (for reproducibility)

g) Preprocessing:

h) Resize (224x224)

i) Normalization

j) Data augmentation (flip, rotation)




# System Diagram

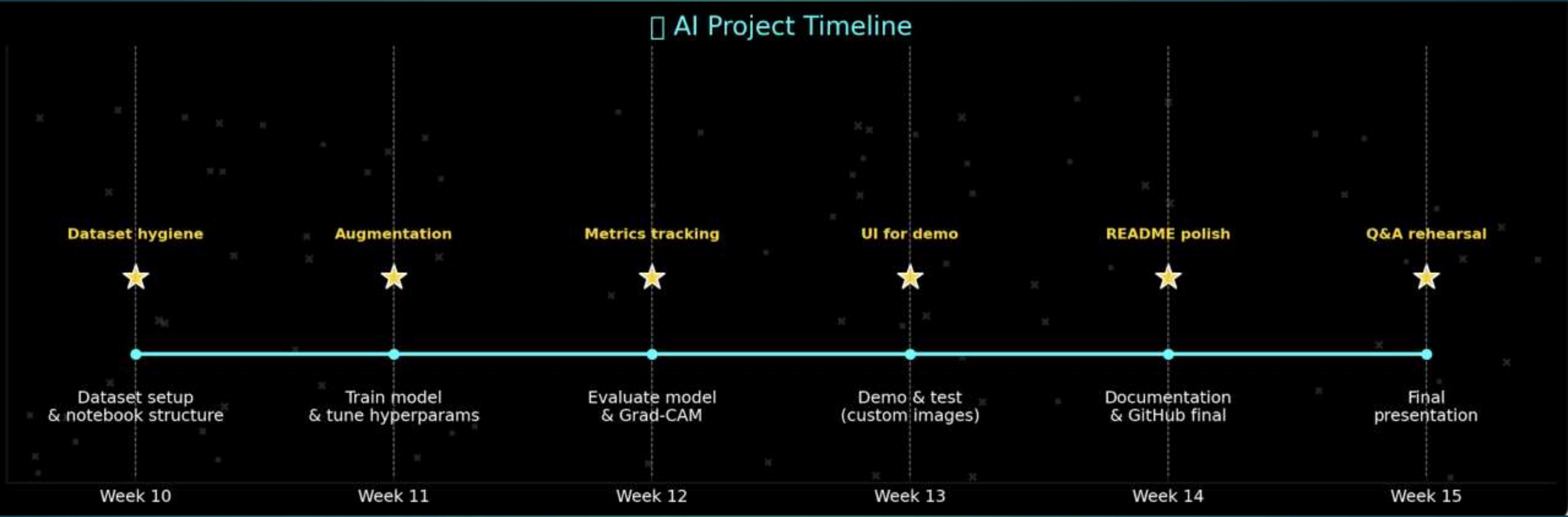
# Metrics & Targets

**Outputs:**

- Accuracy score
- Confusion matrix
- Class-by-class precision/recall
- Attention heatmaps

| Metric | Target |
|---|---|
| Accuracy | ≥ 90% |
| Recall (similar classes) | ≥ 88% |
| Explainability | Grad-CAM heatmaps |

# Timeline


AI Project Timeline
Dataset hygiene
Augmentation
Metrics tracking
UI for demo
README polish
Q&A rehearsal
Dataset setup
& notebook structure
Train model
& tune hyperparams
Evaluate model
& Grad-CAM
Demo & test
(custom images)
Documentation
& GitHub final
Final
presentation
Week 10
Week 11
Week 12
Week 13
Week 14
Week 15

# Challenges & Backup

| Challenge | Solution |
|---|---|
| Class imbalance | Weighted loss + augmentation |
| Model overfitting | Early stopping + data augmentation |
| Low accuracy | Adjust learning rate / optimizer / batch size |
| Data missing | Synthetic dataset auto-generated |

# Expected Impact

Improves recycling accuracy

Reduces human error

Supports sustainability

Foundation for smart bins & robotics

This project demonstrates how AI can contribute to real-world environmental solutions while developing practical computer-vision skills.

# References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# THANK YOU !!