

# The Recycling Pipeline is Broken.



Contamination sends vast amounts of recyclable material to landfills, undermining our best efforts.

# Manual Sorting is Slow, Unsafe, and Inefficient.



## Labor-Intensive & Slow

Manual sorting cannot keep pace with the volume of modern waste streams. It is a tedious, fatiguing process that creates bottlenecks.



## Unhygienic & Unsafe

Workers are exposed to potentially hazardous and unhygienic materials, posing significant health risks.

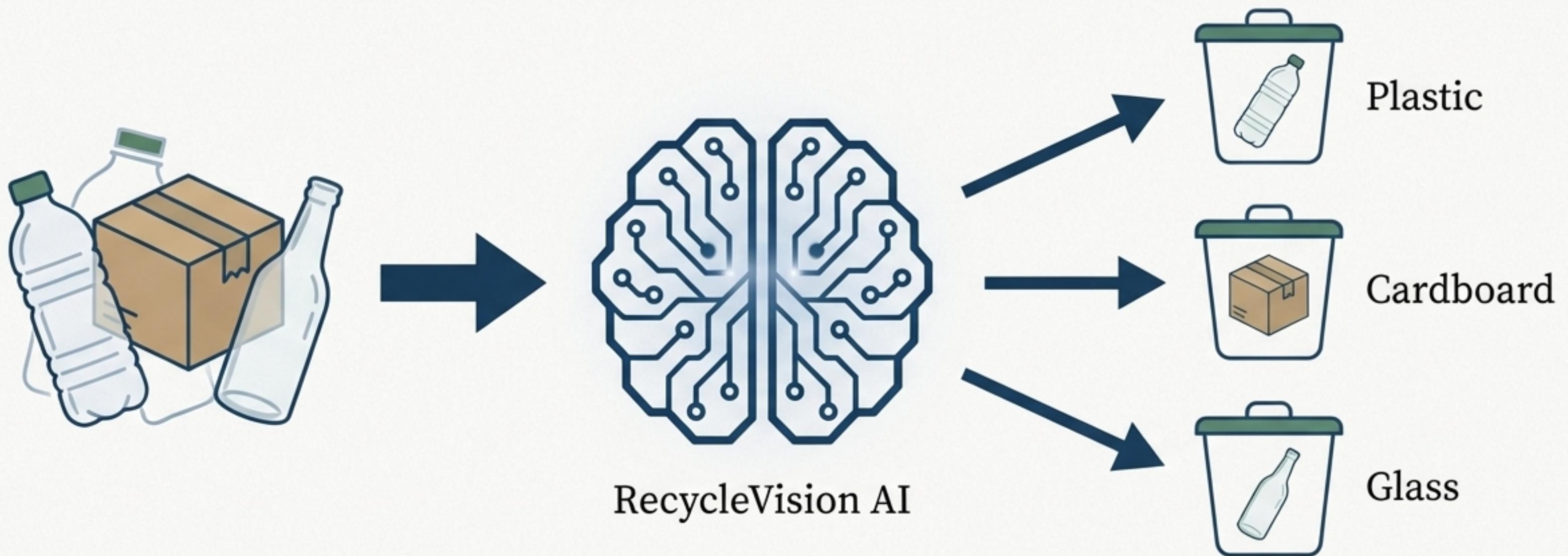


## Error-Prone

Human error in segregation leads to high rates of contamination, rendering entire batches of recyclable materials unusable.

# Introducing RecycleVision

Automated Waste Intelligence, Powered by Deep Learning.



Making recycling cheaper, faster, and more reliable.

# Our Mission: A Smart, Accurate, and Deployable Classifier

**1.**

## High Accuracy

Design and train a deep learning model to classify waste images into six key categories with state-of-the-art precision.

**2.**

## Full Automation

Create a system that can identify materials from an image, removing the need for manual human intervention in the sorting process.

**3.**

## Future-Ready Efficiency

Build a model using a lightweight architecture (EfficientNetB0) suitable for future deployment on resource-constrained hardware like robotic arms or smart bins.

# The Foundation: Training on a Diverse, Real-World Dataset.

Sample Images



clothes



plastic



battery



plastic



plastic



glass



clothes

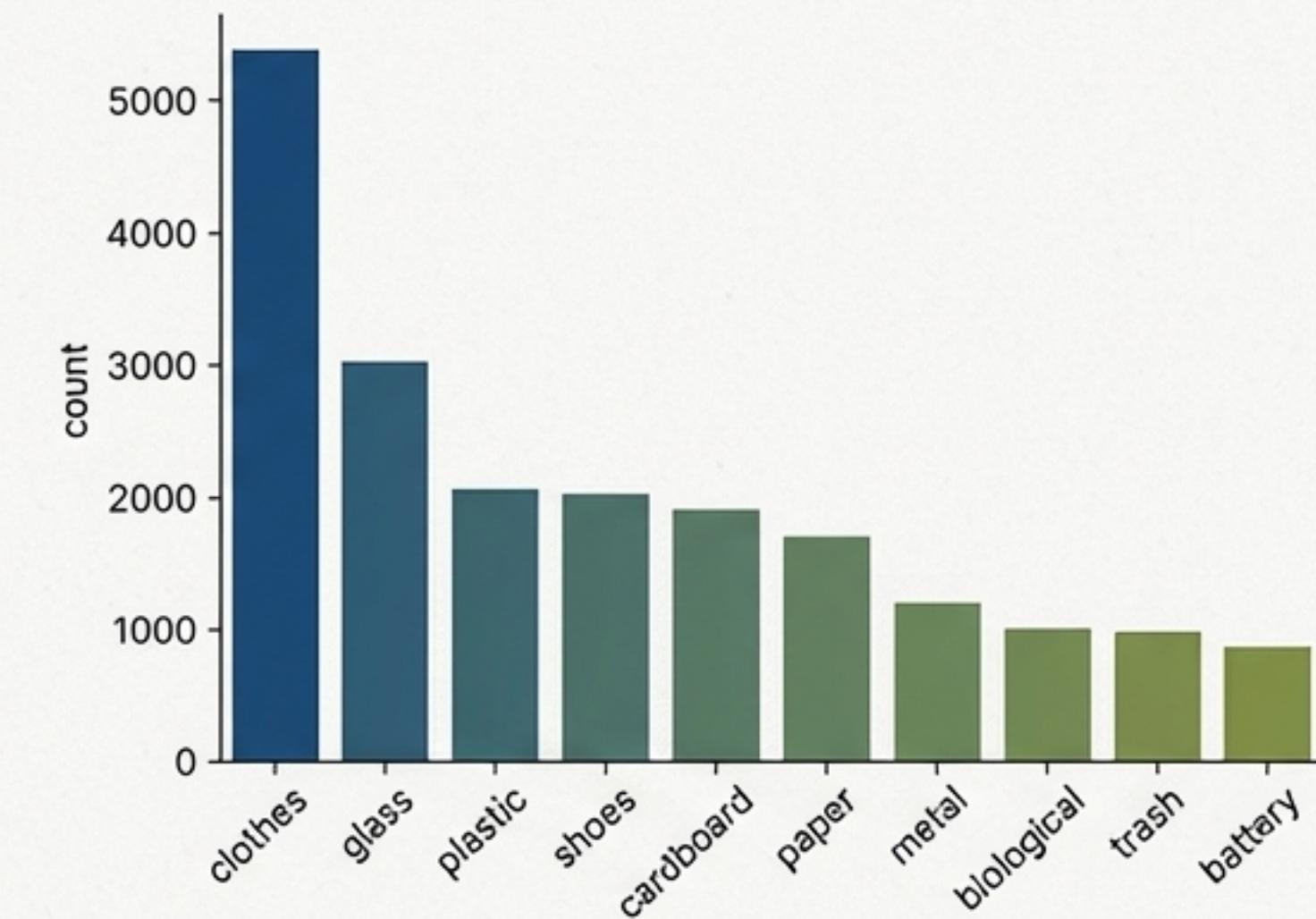


clothes



clothes

An Imbalanced Challenge



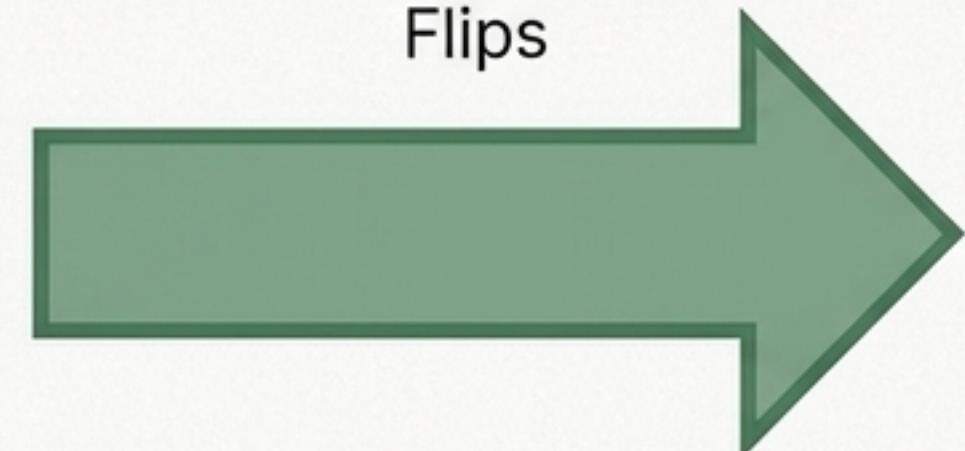
The dataset reflects real-world collection, with some material types (like clothes and glass) being far more common than others. Our model must perform well across all classes, not just the most frequent ones.

# Building Robustness Through Data Augmentation.

Before



Random Rotations,  
Width/Height Shifts,  
Shear/Zoom, Horizontal  
Flips

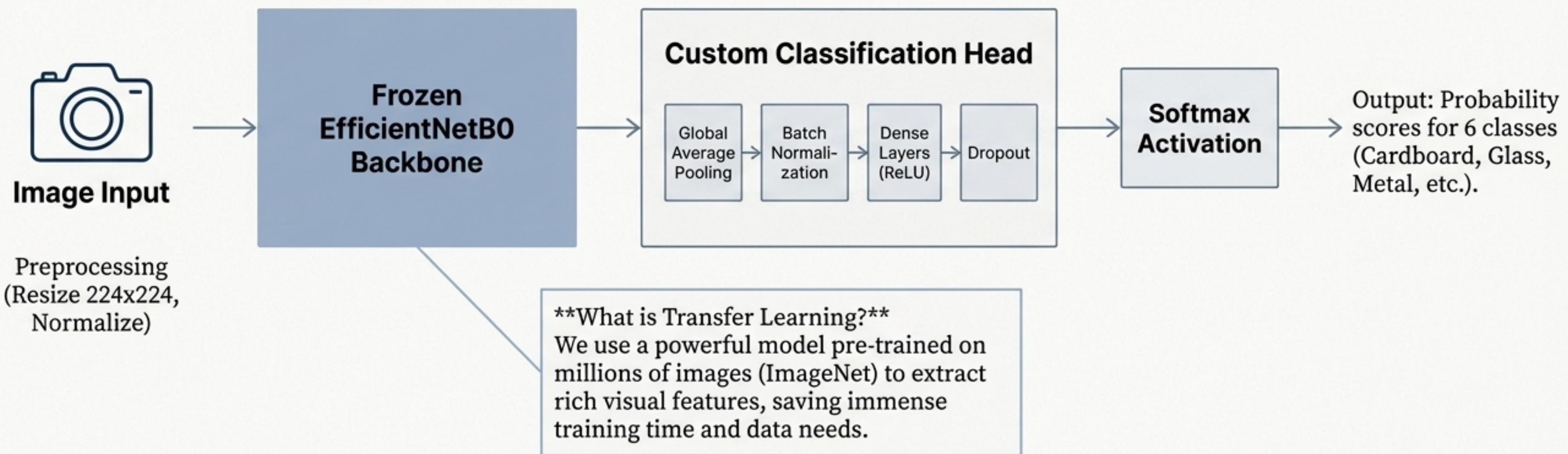


After



We synthetically expanded our training data, teaching the model to recognize objects regardless of their position, lighting, or orientation—just like in the real world.

# The Engine: An EfficientNetB0 Transfer Learning Pipeline



# The Verdict: 92.9% Test Accuracy.

**92.9%**

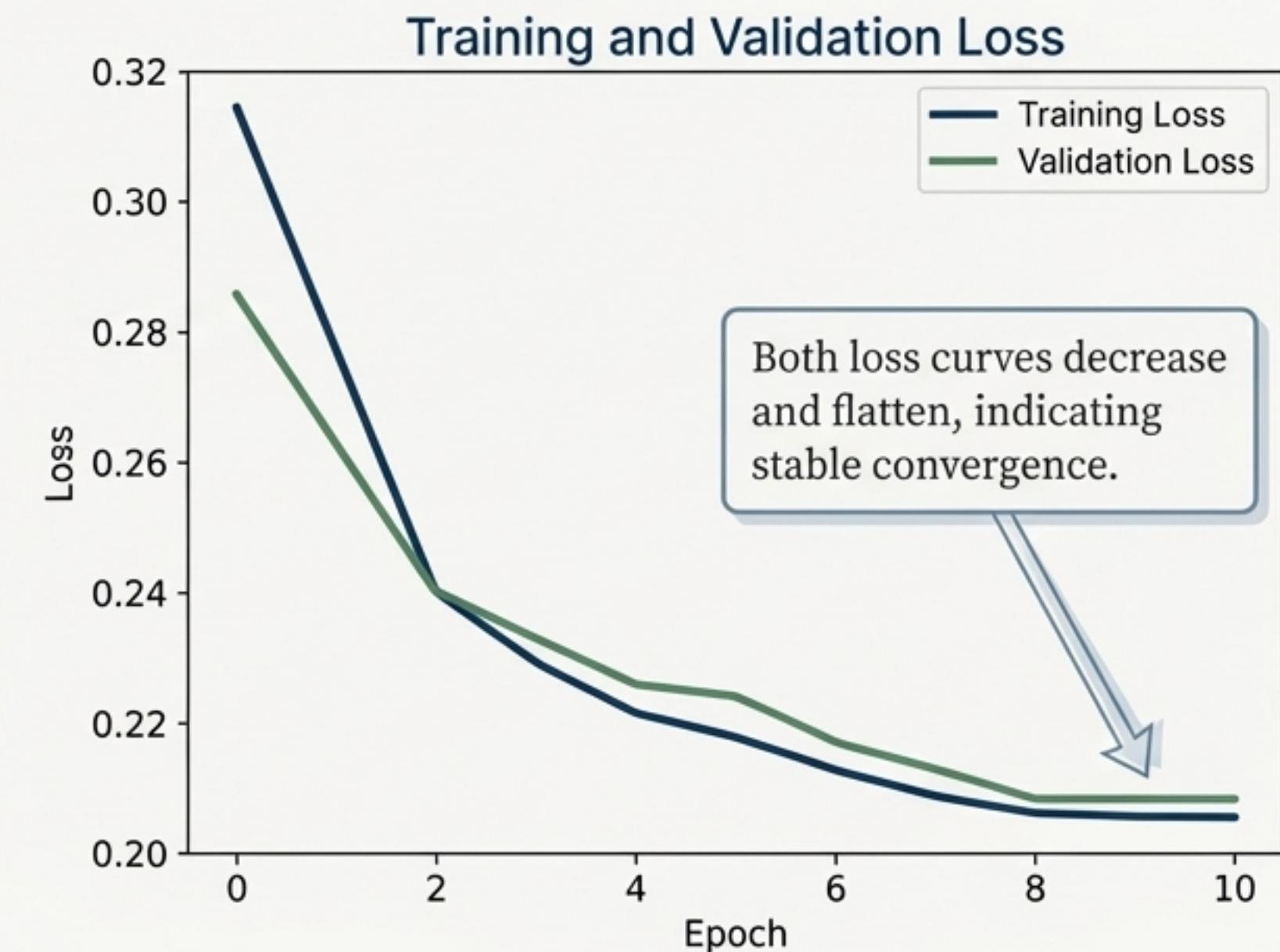
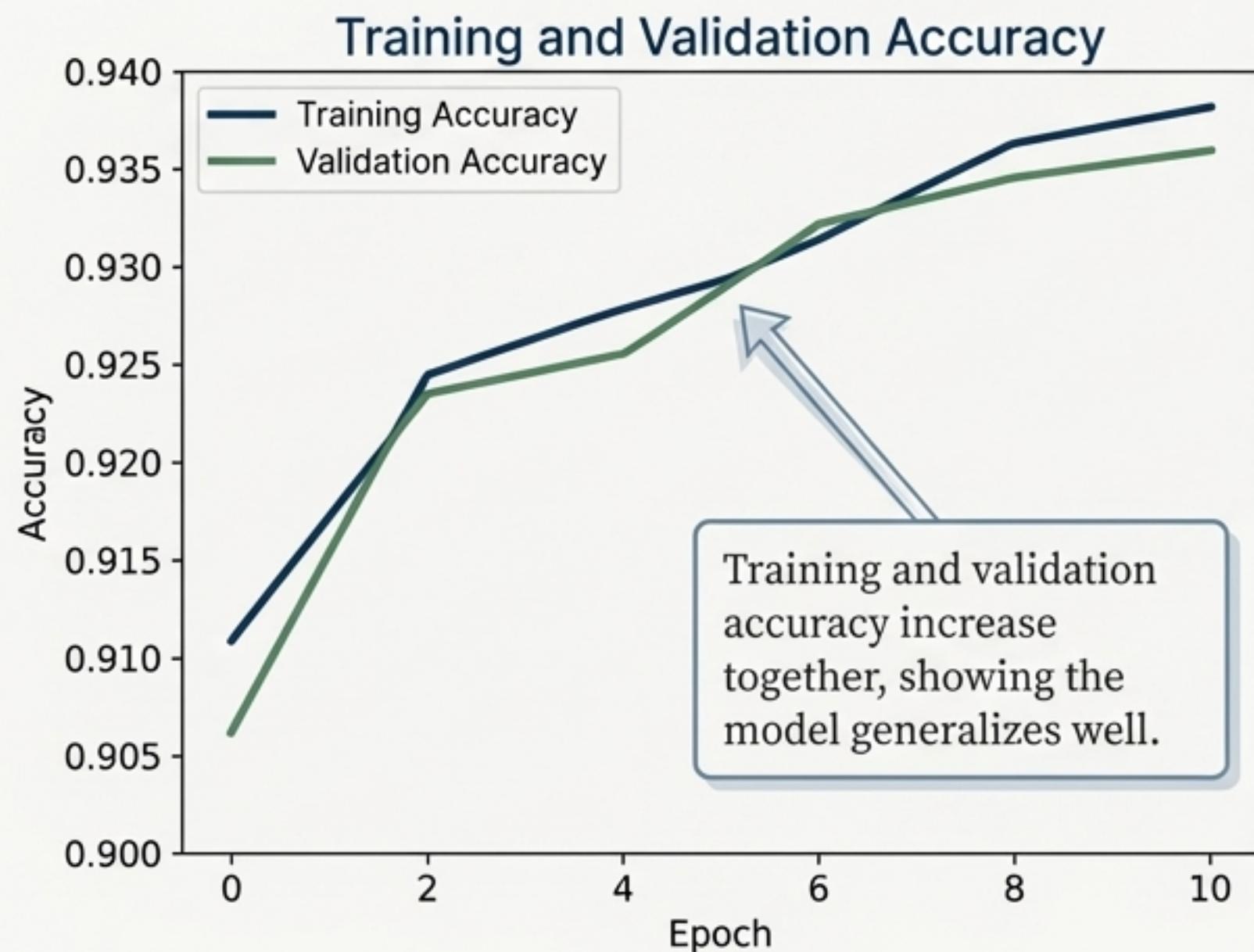
Precision  
**0.95**

Recall  
**0.92**

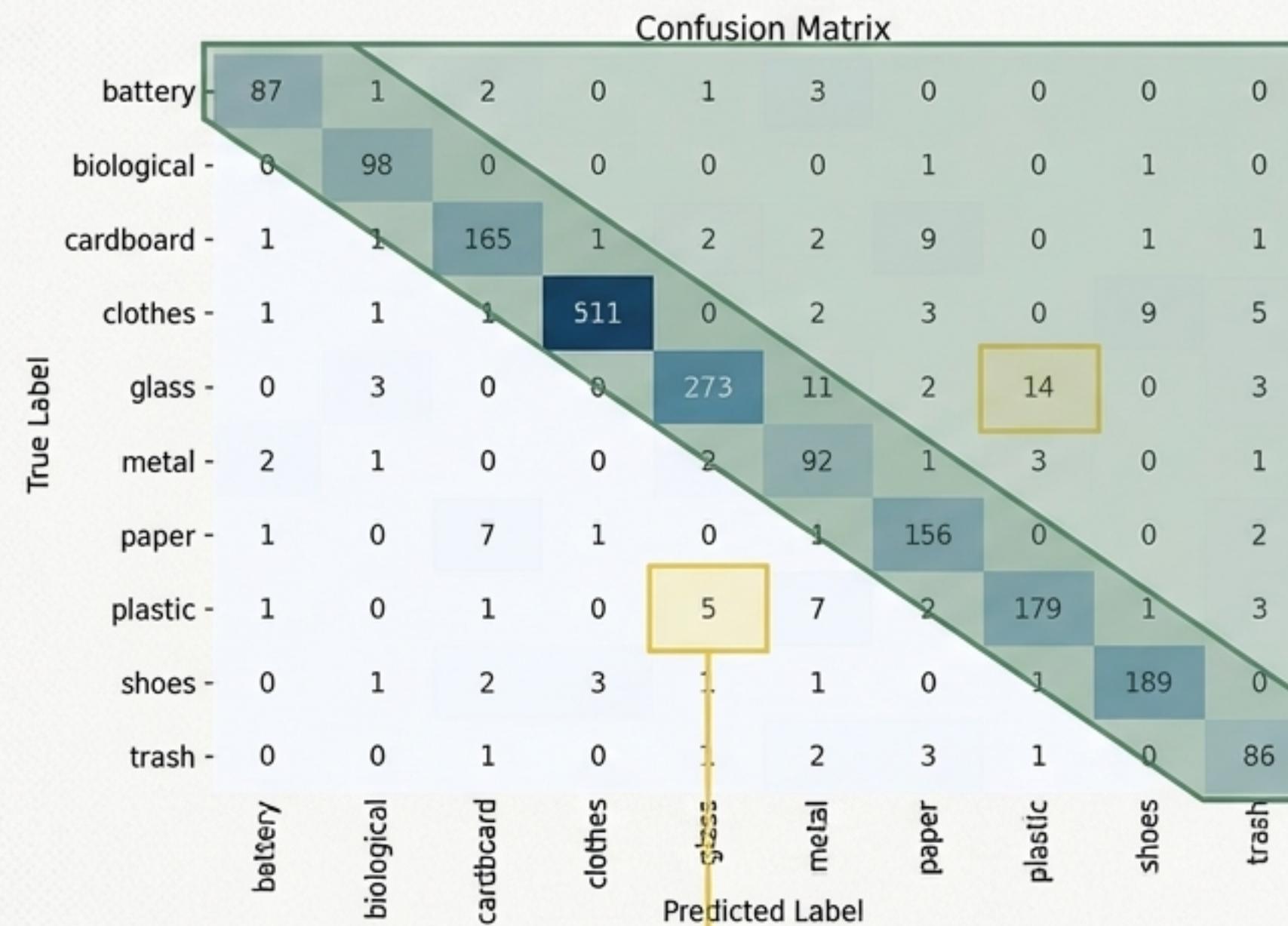
Macro F1-Score  
**0.93**

Test Loss  
**0.22**

# A Stable Learning Process With No Significant Overfitting.



# A Deeper Look: Where the Model Excels (and Where it Gets Confused).



Exceptional performance across most categories, confirmed by the strong diagonal.

Minor confusion occurs between visually similar materials, such as clear plastic and glass, a known challenge for vision systems.

# A Balanced Perspective: Successes and Current Limitations.



## Key Successes

- High accuracy (92.9%) achieved with efficient transfer learning.
- Data augmentation proved effective at improving generalization.
- The model architecture is compact and suitable for edge deployment.



## Current Limitations

- Dataset consists of clean, single-item images; real-world waste is often messy, crushed, or occluded.
- Does not yet handle multiple objects within a single frame.
- Some confusion persists for highly similar material types.

# The Horizon: An Actionable Roadmap for Real-World Impact.

1.

## Enhance the Brain: Advanced Model Tuning

Fine-tune the upper layers of EfficientNetB0 and experiment with more complex architectures. Collect and train on a more challenging 'in-the-wild' dataset of dirty and crushed items.

2.

## Widen the View: Object Detection Integration

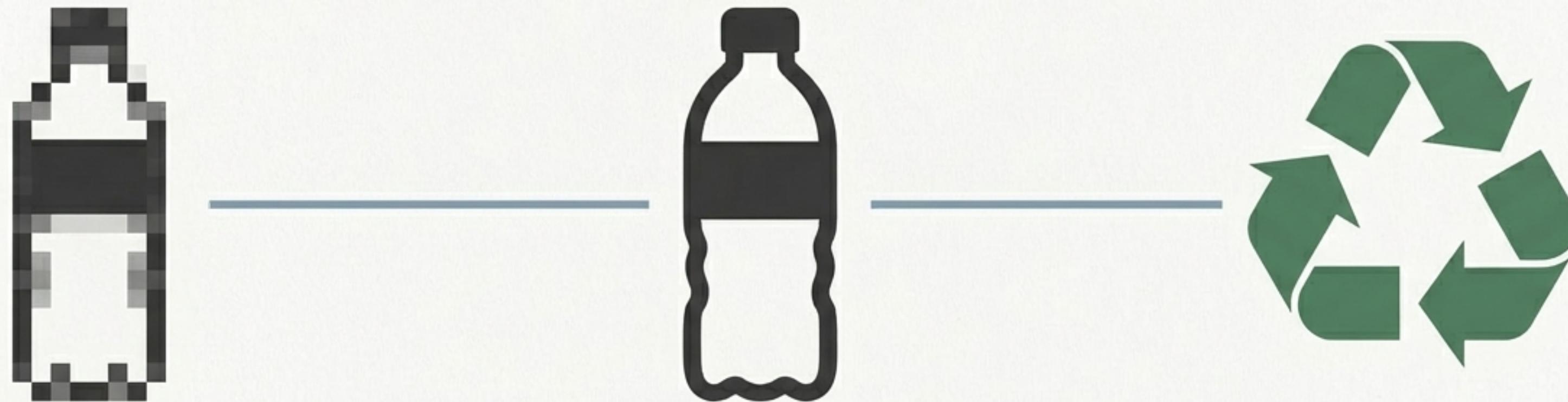
Implement an object detection model like YOLO to identify and classify multiple, overlapping waste items in a single video frame.

3.

## Bring it to Life: Hardware Prototyping

Deploy the model on an embedded device (e.g., Raspberry Pi, NVIDIA Jetson) and integrate it with a robotic arm to build a functional, real-time sorting prototype.

# RecycleVision: From Image to Impact.



By transforming a simple image into an actionable decision, RecycleVision provides the intelligent core for the next generation of automated recycling systems.