Real-Time Garbage Classification Using Lightweight CNN and Webcam

- **This presentation explores an innovative, low-resource solution utilizing a lightweight CNN and webcam technology for sustainable waste management. Presented by Hang Zhao from Northeastern University.**

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Overview of the presentation

- Introduction
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- Methods - Real-Time Classification
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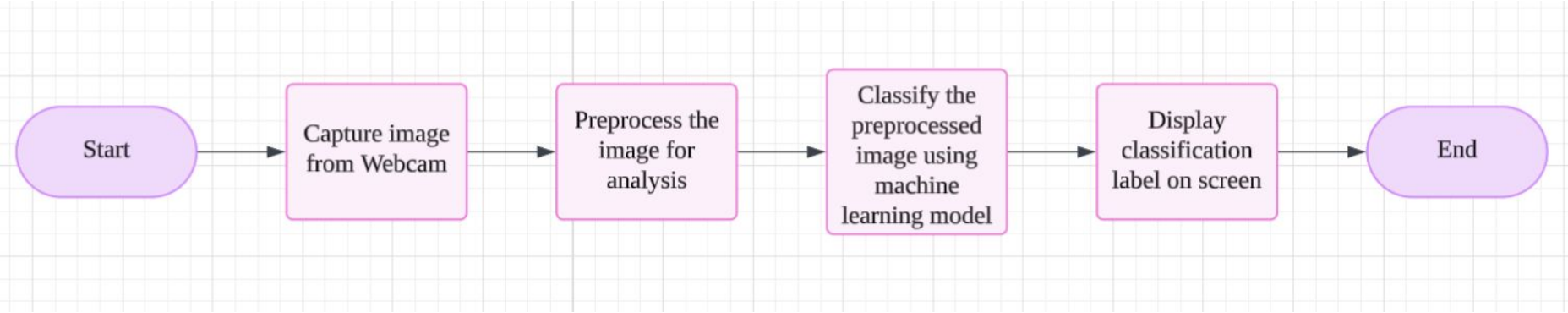
Introduction

- Garbage classification is crucial for effective waste management.
- Manual sorting is inefficient and error-prone.
- Project Goal: Develop a lightweight real-time garbage classification system using a webcam and CNN.
- Input: Webcam video frames; Output: Garbage category labels (Recyclable, Wet, Dry).



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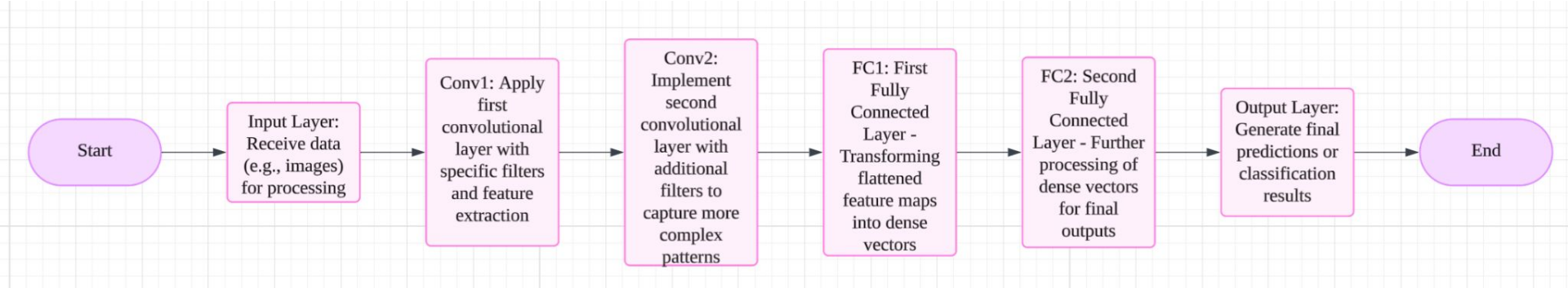
Related Work

- Yang et al. (CVPR 2019): TrashNet dataset, 87% accuracy, complex model.
- Bircanoğlu et al. (ICCV 2018): RecycleNet, 91% accuracy, high computational demand.
- Chu et al. (WACV 2018): CNN-SVM hybrid model, 88% accuracy, high complexity.
- Our Work: Lightweight model, real-time CPU performance.

Methods - Data and Model

- Data: Subset of TrashNet (300 images: plastic, paper, wet waste), 64x64 pixels.
- Data Augmentation: Random flips, brightness adjustments.
- Model: Lightweight CNN (2 conv layers, 2 fully connected layers).
- Training: SGD optimizer, 10 epochs, batch size 16.



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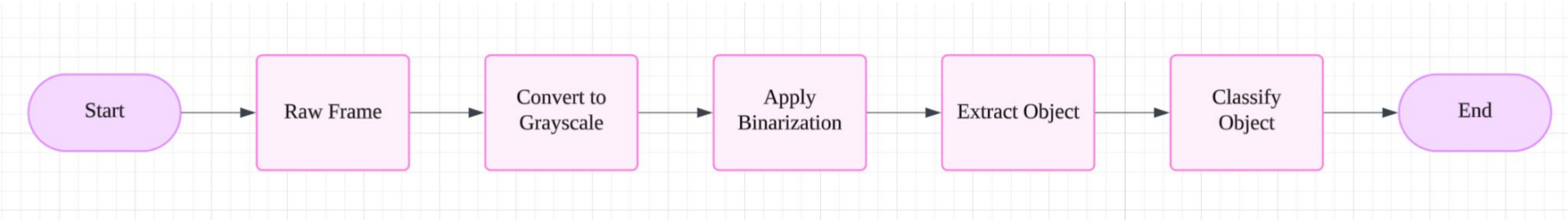
Methods - Real-Time Classification

- Frame Preprocessing: Grayscale, binarization, contour detection, resize to 64x64.
- Inference: Predict category using trained CNN.
- Display: Overlay label (e.g., “Recyclable”) on video frame.
- Performance: 15-20 FPS (Intel i5 CPU).



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Experiments and Results

- Test Accuracy: 86.7% (300 images).
- Training Time: 90.5 seconds (10 epochs).
- Real-Time Performance: 15-20 FPS, correctly classifies common garbage (plastic bottles, food scraps).
- Comparison with Prior Work: Slightly below Yang et al. (87%), but smaller dataset, lower resource needs.

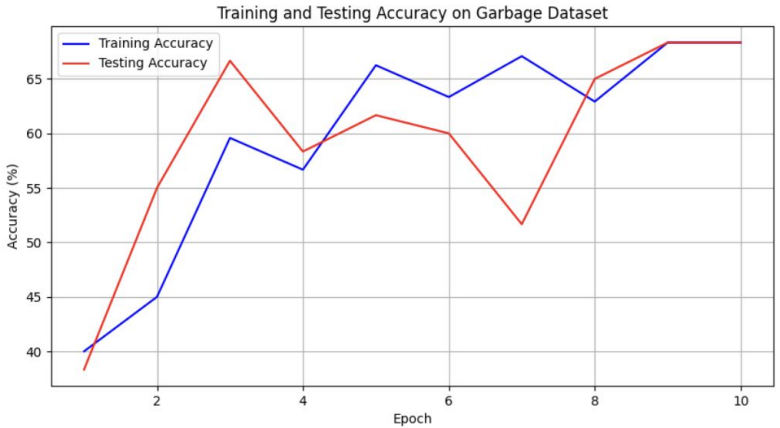
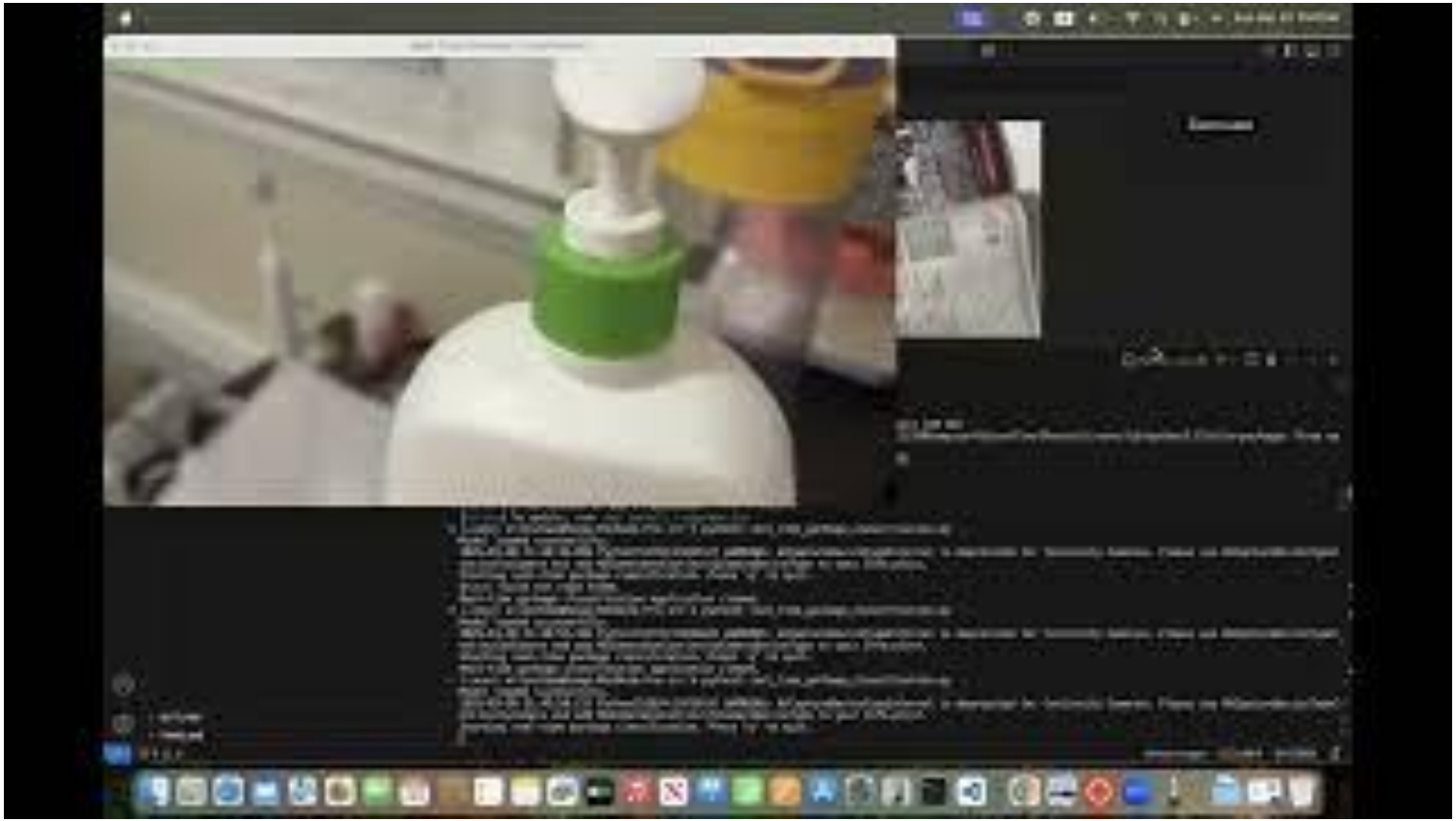


TABLE I
COMPARISON OF GARBAGE CLASSIFICATION ACCURACY.

Method	Dataset Size	Test Accuracy (%)
Yang et al. [1]	2527	87.0
Bircanoğlu et al. [2]	5000	91.0
Chu et al. [3]	1500	88.0
Ours	300	86.7

Demo



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Discussion and Summary

- Successfully achieved real-time classification, 86.7% accuracy, 15-20 FPS.
- Strengths: Lightweight, suitable for low-resource environments.
- Limitations: Small dataset, misclassification in complex backgrounds.
- Future Work: Larger dataset, improved preprocessing, stronger models (e.g., MobileNet).
- Contribution: Practical tool for sustainable waste management.