Prepared by group 6

GARBAGE DETETCTION using CCTV

EOC - MFC

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INTRODUCTION

India is expected to generate 165 million tonnes of waste annually by 2030, much of it poorly managed. Manual waste monitoring is slow and inefficient, especially in crowded cities. At the same time, over 1.5 million CCTV cameras installed under smart city projects remain underutilized. This work proposes a real-time garbage detection system using YOLOv8n and SVD preprocessing, leveraging existing CCTV infrastructure for efficient and automated waste surveillance.

OBJECTIVE

- Automate garbage detection using existing CCTV systems.
- Improve object detection using image preprocessing (SVD).
- Train and evaluate a lightweight model (YOLOv8n).

LITERATURE REVIEW

Model / Approach	Paper / Study	Dataset & Setup	Key Results	Remarks
YOLOv8n	*Garbage Overflow Detection Algorithm Based on Improved YOLOv8n*	Real-time CCTV detection	mAP: 91.2%	Lightweight and fast for real-time use
YOLOv5n	*Cleanliness Follow-up using Deep Learning*	5,000 augmented images from 1,000 manual annotations	Precision: 0.87, Recall: 0.95, F1 Score: 0.89	Best performer among YOLO variants tested
ResNet-50	*Automatic Garbage Detection Framework Using CNN*	20,000 images; trained for 8 hours	Accuracy: 95%, better than Faster R-CNN and Inception	Accurate but computationally heavy
YOLOv5n vs YOLOv8n	*Garbage Detection using YOLO Algorithm for Urban Management in Bangkok*	1,383 labeled images (Trash/Can)	YOLOv5n mAP@0.5 = 0.945, YOLOv8n = 0.938	Both models highly accurate

METODOLOGY

STEP 1:

- Collecting the Dataset from multiple sources such as roboflow, kaggle.
- The dataset contains 1683 images which can be annotated to various categories as Broken trash can, Close empty, Close full, Healthy trash can, Open empty, Open full, Trash flow.

STEP 2:

Preprocessing (SVD)

- Goal: Denoise input images without losing key features.
- Applied Singular Value Decomposition (SVD) in MATLAB.
    - Convert image to R, G, B matrices.
    - Perform SVD on each channel.
    - Truncate top 200 singular values.
    - Reconstruct cleaner image.
- Result: Sharper, more informative input for YOLO.

RESULT (SVD)

Fig: Image

Fig: Image preprocessed

STEP 3:

- Annotate the images into 7 key classes are used for annotating Broken trash can, Close empty, Close full, Healthy trash can, Open empty, Open full, Trash flow

STEP 4:

Model: YOLOv8n (nano version by Ultralytics)

- Lightweight and optimized for real-time detection.

Input Image Size: 640 × 640 pixels

- Ensures uniformity and compatibility with the model.

Dataset Split:

- Total images: 1,683
- Training: 99%
- Validation: 1%

Training:

- 20 epochs to allow iterative learning and performance improvement.

Evaluation Metrics:

- Precision: 91.2% – Low false positives.
- Recall: 87.5% – High detection accuracy.
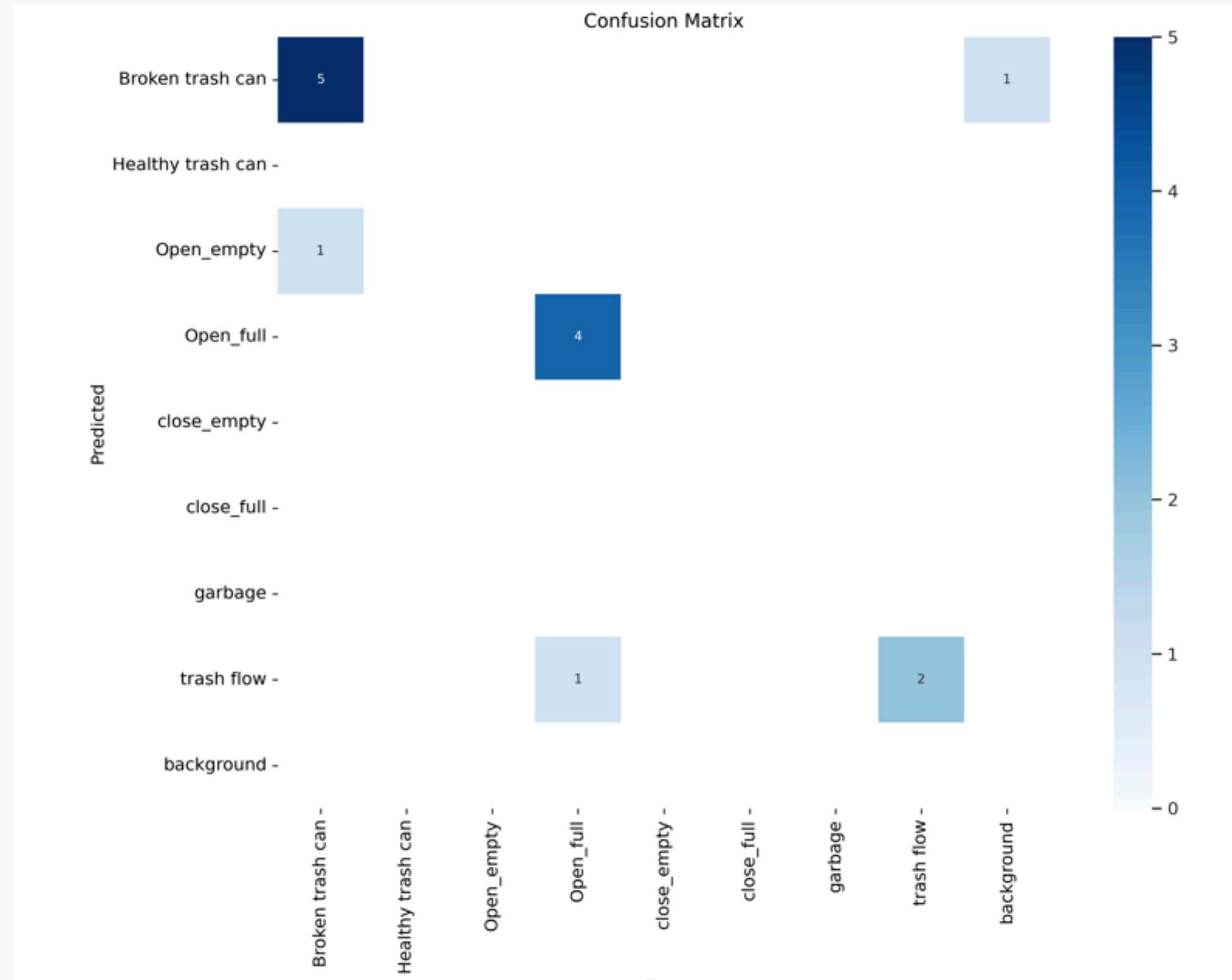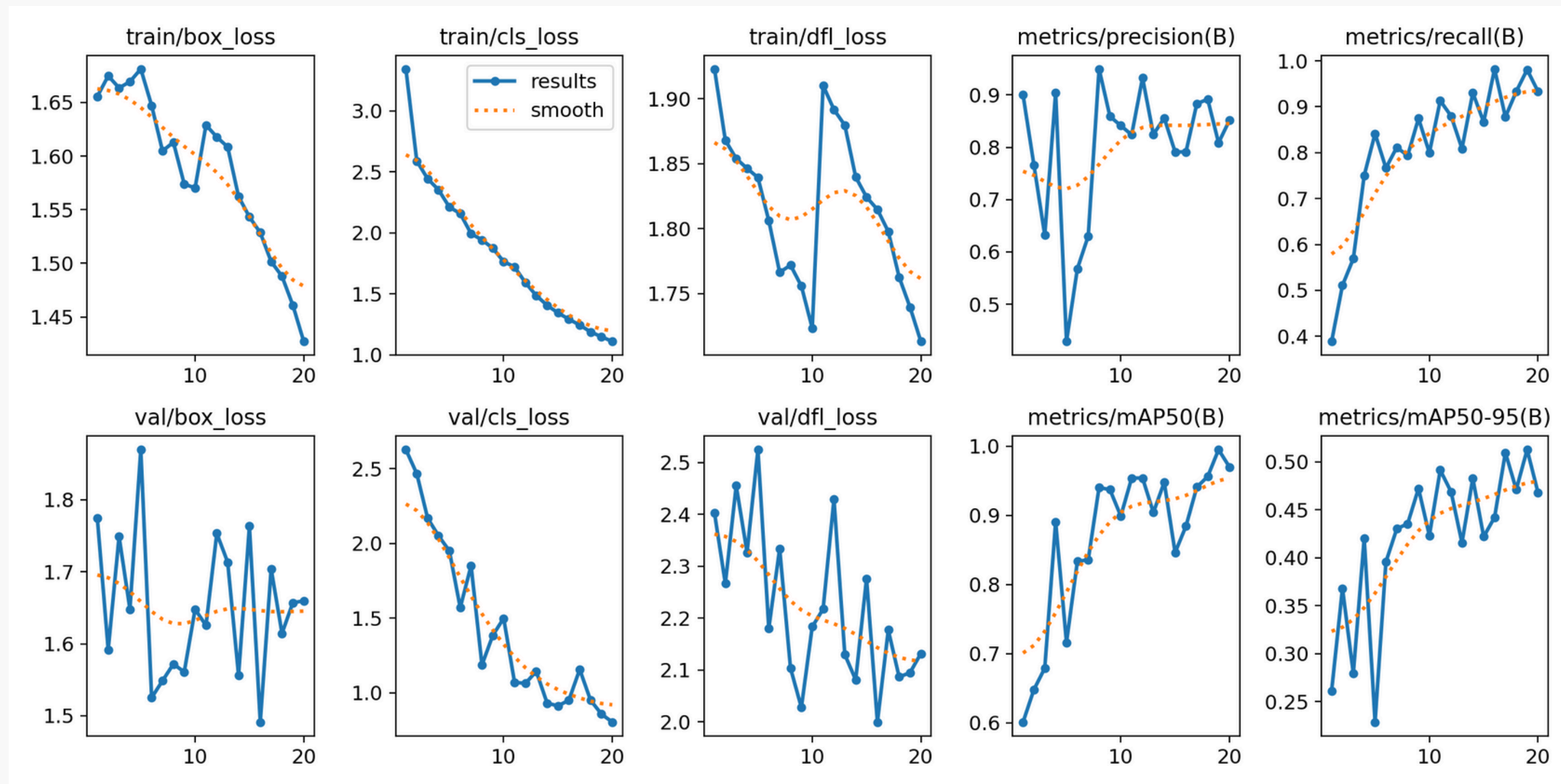- mAP@0.5: 89.3% – Strong overall performance.

Fig: Confusion matrix

Fig: Result

Fig: Detected images

STEP 5:

- Flask + OpenCV is used for uploading a video and to detect the video.
- Flask is a lightweight Python web framework used to create a web application.
- OpenCV is a powerful computer vision library used for image and video processing.
- Flask handles user input (file upload or webcam selection).
- OpenCV captures video frames and processes them using YOLOv8.
- Flask streams the processed frames to the browser as a live video.
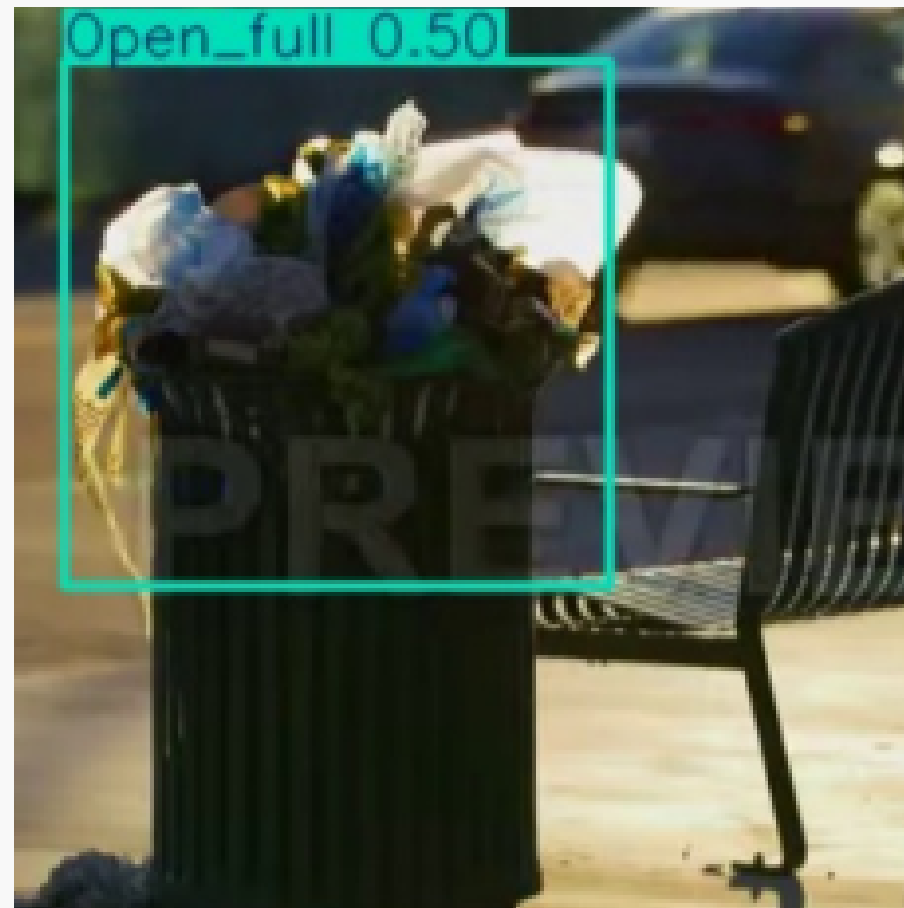- Flask allows stopping the detection, preventing resource wastage

Fig: Detected image

RESULT AND DISSCUSSION

RESULTS

- We extract features to focus on what matters, reduce noise to improve clarity, and
- compress images to save space and make processing fasterEvaluation Metrics:
    - Precision: 91.2% – Low false positives.
    - Recall: 87.5% – High detection accuracy.
    - mAP@0.5: 89.3% – Strong overall performance
- Strong classification performance observed for:
    - Broken trash can
    - Open full
- Misclassifications occurred mainly between:
    - Open empty and Trash flow, likely due to visual similarity.
    - Indicates effective learning with minimal overfitting.

DISCUSSIONS

- The model demonstrates robust generalization, even with a small validation set.
- SVD preprocessing helped reduce image noise, improving feature clarity.

CONCLUSION

- Developed a real-time garbage detection system using YOLOv8n and SVD
- Achieved high accuracy: 91.2% precision, 87.5% recall, 89.3% mAP@0.5.
- System is lightweight, efficient, and ready for real-world deployment.

FUTURE WORK

- Edge Deployment: Port model to embedded devices for real-time city-scale use.
- Alert System Enhancement: Add real-time GPS tagging and mobile notifications to authorities.

THANK YOU