

WASTE SEGREGATION APPLICATION

1. What Are We Building?

The Waste Segregation System is an Artificial Intelligence-based application developed using Python, OpenCV, and YOLOv8 for detecting and classifying waste materials in real time through a webcam.

The system identifies objects shown to the camera and classifies them into:

- Biodegradable Waste
- Non-Biodegradable Waste

This project helps in promoting smart waste management and environmental sustainability.

2. Technologies Used



Technology	What it is used for
Python	Programming language
OpenCV	Camera handling and image processing
YOLOv8	Object detection model
Ultralytics	YOLO implementation
CvZone	Bounding box visualization

3. Before Starting (Setup)

- Install Python (Version 3.10 or above)

Download from: <https://www.python.org>

- While installing → check “Add Python to PATH”

Step 3.2: Install the following libraries:

Open terminal and type:

```
pip install ultralytics opencv-python cvzone
```

This installs:

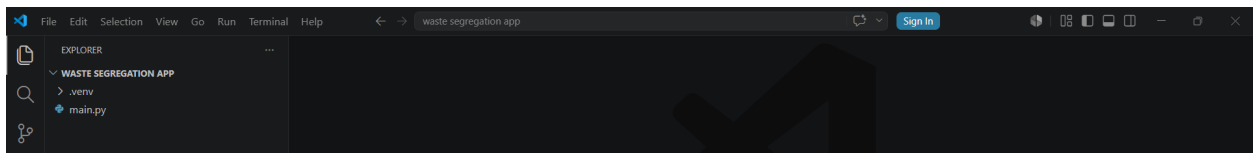
- YOLOv8
- OpenCV
- CvZone

required to run the project.

4. Create Project Structure

Create a folder named `WasteSegregationApp`

Inside it, create:



5. Backend Development

`main.py` is the brain of the application.

Step 5.1: Import Required Modules

```
import cv2
from ultralytics import YOLO
```

```
import cvzone
```

These help:

- Open webcam
- Detect objects using AI
- Draw detection boxes

Step 5.2: Load YOLO Model

```
model = YOLO("yolov8n.pt")
```

Explanation:

- Loads YOLOv8 AI model
- Used for object detection
- Automatically downloads first time

Step 5.3: Open Webcam

```
cap = cv2.VideoCapture(0)
```

Explanation:

- Starts webcam
- Captures live video

Step 5.4: Create Biodegradable Object List

```
bio = [  
    "banana",  
    "apple",  
    "orange",  
    "broccoli",  
    "carrot",  
    "potted plant"  
]
```

Explanation:

These objects are treated as biodegradable waste.

Step 5.5: Capture Camera Frames

```
success, img = cap.read()
```

Explanation:

- Reads webcam frame
- Stores image in variable `img`

Step 5.6: Detect Objects

```
results = model(img, stream=True)
```

Explanation:

YOLO analyzes image and detects objects.

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Step 5.7: Get Detected Objects

```
for r in results:  
    boxes = r.boxes
```

Explanation:

- Loops through detected objects
- Gets bounding boxes

Step 5.8: Get Object Information

```
cls = int(box.cls[0])  
name = model.names[cls]
```

Explanation:

Gets object name such as:

- banana
- bottle
- cell phone

Step 5.9: Waste Classification

```
if name in bio:
    label = "Biodegradable"
else:
    label = "Non-Biodegradable"
```

Explanation:

Checks whether the object belongs to the biodegradable list.

Step 5.10: Detect Objects

```
cvzone.cornerRect(img, (x1, y1, w, h))
```

Explanation:



Draw a rectangle around the detected object.

Step 5.11: Detect Objects

```
cv2.putText(
    img,
    f"{name} - {label}",
    (x1, y1 - 10),
    cv2.FONT_HERSHEY_SIMPLEX,
    0.7,
    color,
    2
)
```

Explanation:

banana - Biodegradable

on screen.

Step 5.12: Show Camera Window

```
cv2.imshow("Waste Segregation System", img)
```

Explanation:

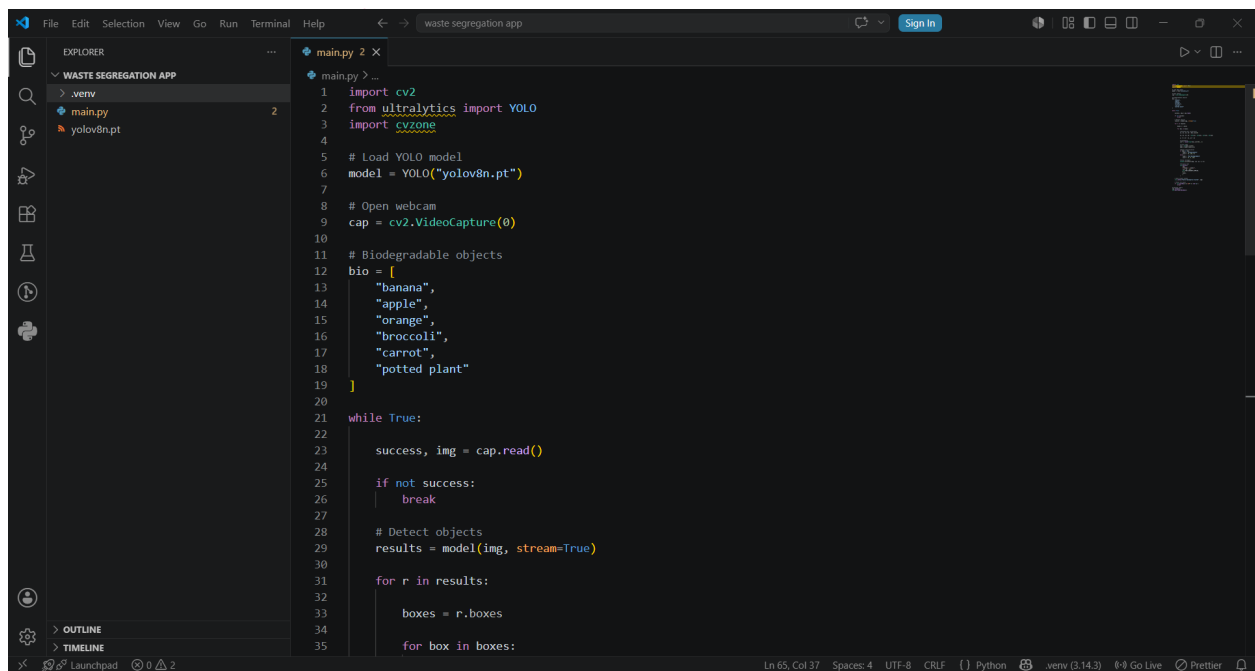
Displays final output window.

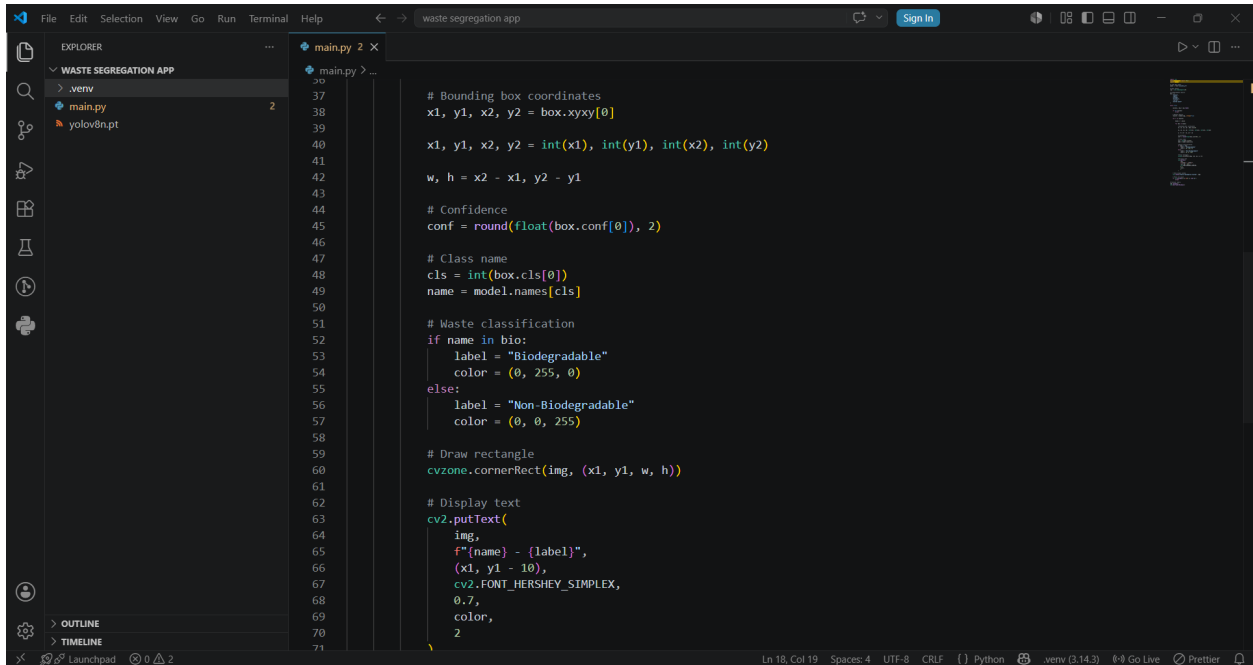
Step 5.13: Exit Application

```
if cv2.waitKey(1) & 0xFF == ord('q'):  
    break
```

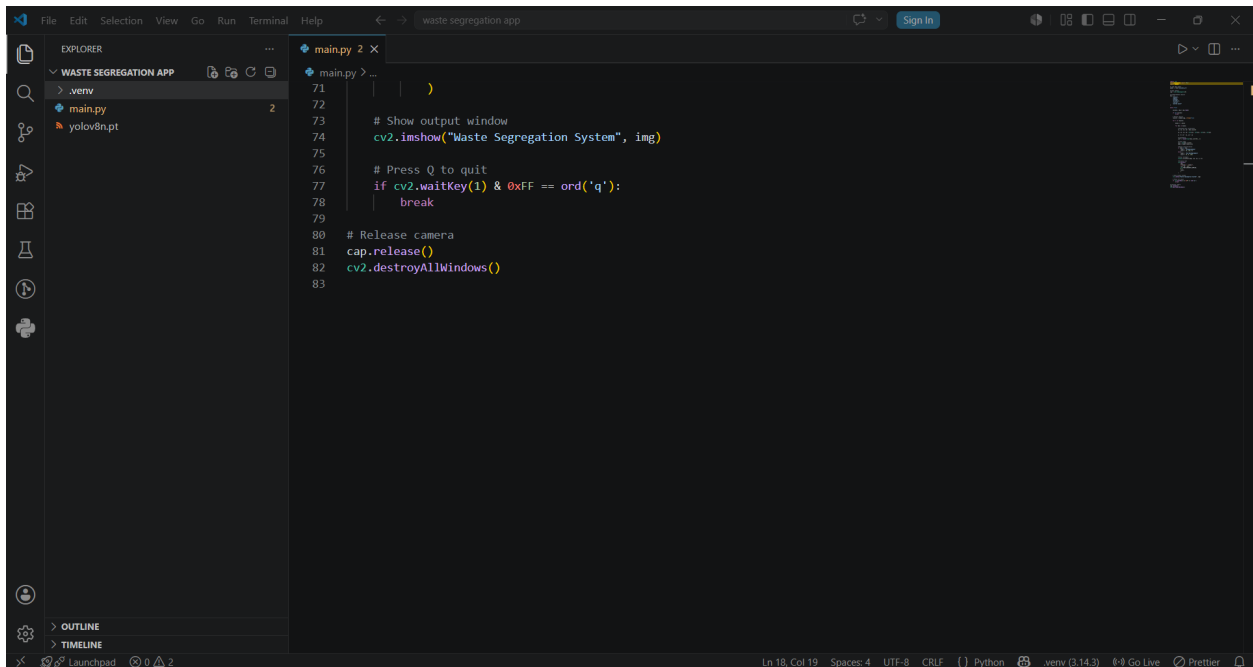
Explanation:

Press Q to close the application.





```
37 # Bounding box coordinates
38 x1, y1, x2, y2 = box.xyxy[0]
39
40 x1, y1, x2, y2 = int(x1), int(y1), int(x2), int(y2)
41
42 w, h = x2 - x1, y2 - y1
43
44 # Confidence
45 conf = round(float(box.conf[0]), 2)
46
47 # Class name
48 cls = int(box.cls[0])
49 name = model.names[cls]
50
51 # Waste classification
52 if name in bio:
53     label = "Biodegradable"
54     color = (0, 255, 0)
55 else:
56     label = "Non-Biodegradable"
57     color = (0, 0, 255)
58
59 # Draw rectangle
60 cvzone.cornerRect(img, (x1, y1, w, h))
61
62 # Display text
63 cv2.putText(
64     img,
65     f"{name} - {label}",
66     (x1, y1 - 10),
67     cv2.FONT_HERSHEY_SIMPLEX,
68     0.7,
69     color,
70     2
71 )
```



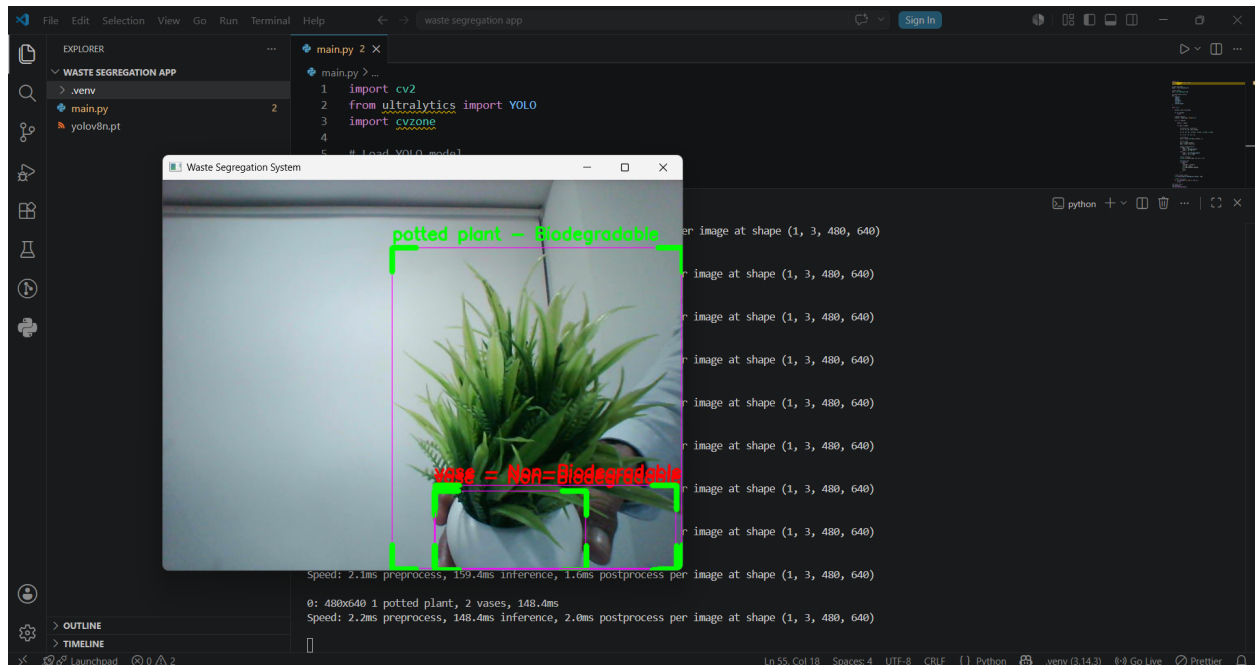
```
71
72
73 # Show output window
74 cv2.imshow("Waste Segregation System", img)
75
76 # Press Q to quit
77 if cv2.waitKey(1) & 0xFF == ord('q'):
78     break
79
80 # Release camera
81 cap.release()
82 cv2.destroyAllWindows()
83
```

6. Run the app

Open terminal

```
python main.py
```

Then the webcam opens automatically.



7. How Everything Works Together (Flow)

- User opens application
- Webcam starts
- User shows object to camera
- YOLO detects object
- Program checks:
 - Biodegradable?
 - Non-Biodegradable?
- Result displayed on screen

8. Common Mistakes (Very Important)

8.1 Missing Libraries

Error:

No module named cvzone

Fix:

`pip install cvzone`

8.2 Camera Not Opening

Fix:

Close:

- Zoom
- Google Meet
- Camera app

8.3 Wrong Camera Index

Change:

```
cv2.VideoCapture(0)
```

to:

```
cv2.VideoCapture(1)
```

8.4 YOLO Model Not Downloading

- Check internet connection.
- YOLO automatically downloads:

```
yolov8n.pt
```

11. Tips & Tricks

11.1 Add More Biodegradable Objects

Example:

```
bio.append("leaf")
```

11.2 Improve Accuracy

Use:

- Custom dataset
- Custom YOLO training

11.3 Improve UI

Add:

- GUI
- Buttons
- Voice output
- Waste counter

11.4 Create Smart Dustbin

Connect with:

- Arduino
- Servo motor
- Sensors

12. Final Summary

This project teaches:

- Computer Vision
- Artificial Intelligence
- Object Detection
- OpenCV basics
- YOLOv8 implementation
- Real-time camera applications

The logo for Innovbit AI Lab, featuring the word "innovbit" in blue, a pink triangle, and "AI Lab" in red and blue.