SilentWasteDetector
AI-Based Identification of Ignored Waste Zones

Student Details

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1. SDG Alignment

Primary SDG:SDG 11 – Sustainable Cities and Communities

Secondary SDGs: SDG 12 – Responsible Consumption and Production, SDG 13 – Climate Action

This project contributes to building cleaner and more sustainable urban and semi-urban environments by enabling early identification of waste accumulation zones.

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2. Problem Statement

Inmany campuses, cities, and public spaces, waste does not always accumulate inside designated bins. Instead, garbage piles up in ignored or less-visible areas such as open grounds, behind buildings, roadside corners, and near overflowing bins. These waste zones often remain unnoticed until they grow into serious environmental and health hazards.

Problem Statement Format:
How might we use AI to identify and classify waste-heavy areas from images so that timely cleaning and preventive action can make communities more sustainable?

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3. Target Users

- Municipal andlocal cleaning authorities
- Campus and hostel management teams
- NGOs and community volunteers
- Citizens involved in cleanliness drives

4. Why AI Is Needed

Manualinspection of waste-prone areas is time-consuming, inconsistent, and reactive. AI enables: - Automatic analysis of images captured from the field - Early detection of waste accumulation - Consistent and objective decision support - Scalability without continuous human supervision

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5. AI Solution Overview

The**Silent WasteDetector** isanAI-powered decision-support system that analyzes images from local storage to determine whether an area is clean, moderately polluted, or heavily polluted by waste.

AI Techniques Used

- **Object Detection (YOLOv8):** Identifies visible waste-related objects such as bottles, plastic items, and bins.
- **Scene Understanding (CNN-based Image Classification):** Analyzes the overall scene to detect waste-dump or landfill-like environments that may not contain distinct objects.
- **Rule-Based Decision Logic:** Combines object count and scene-level analysis to produce a final classification.

The system supports common image formats including JPG, PNG, and JFIF, ensuring compatibility with real-world mobile images.

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6. Design Thinking Approach

Empathize

- Urban residents and students are affected by unhygienic surroundings.
- Waste persists due to delayed detection and lack of timely action.

Define

- **Core Issue:** Ignored waste zones grow unnoticed.
- **Gap:** No simple AI tool exists for early identification using everyday images.

Ideate

- Use AI to analyze images captured during routine inspections.
- Provide clear, human-readable waste severity output.

Prototype

- Python-based AI prototype
- Image input → AI analysis → Waste classification output

Test & Refine

- Tested on multiple real-world waste images
- Improved logic to handle large dumping grounds and overflowing bins

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7. Responsible AI Considerations

- **Fairness:** The system evaluates locations, not people.
- **Transparency:** Decision logic is explainable using object counts and confidence scores.
- **Ethics:** No surveillance or facial recognition is involved.
- **Privacy:** Images are processed locally without storing personal or sensitive data.

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8. Expected Impact

If implemented, the solution can: - Enable early identification of waste-prone zones - Reduce large-scale dumping through timely action - Support data-driven cleaning schedules - Improve public hygiene and environmental quality

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9. Impact Statement

What changes if implemented?
Waste accumulation is identified early, preventing environmental degradation.

Who benefits and how? Communities benefit from cleaner surroundings, while authorities gain for decision a low-cost AI tool support.

10. Conclusion

The Silent Waste Detector demonstrates how AI can be applied responsibly and practically to address sustainability challenges. Rather than solving the entire waste management problem, the project focuses on early detection and awareness, aligning with the goals of the AI for Sustainability Virtual Internship.