SMART INDIA HACKATHON 2024

"SWACHHTA & LIFE DASHBOARD: AI-POWERED INSIGHTS FOR CLEANLINESS AND GREEN PRACTICES IN POST OFFICES"

- Problem Statement ID – SIH1751

- Problem Statement Title – Dashboard for Swachhta and LiFE.
  Develop a dashboard aimed at maintaining cleanliness and LiFE practices, integrating AI-powered image processing technology for effective monitoring of Swachhta and green practices adopted in post offices.

- Theme – Clean & Green Technology

- PS Category – Software

- Team ID – 586

- Team Name – TERMINATORS

TERMINATOR
VERSION 2

Shuddhinetra
AI-Powered Dashboard For Swachhta and LiFE Monitoring System

SMART INDIA HACKATHON 2024
SIH
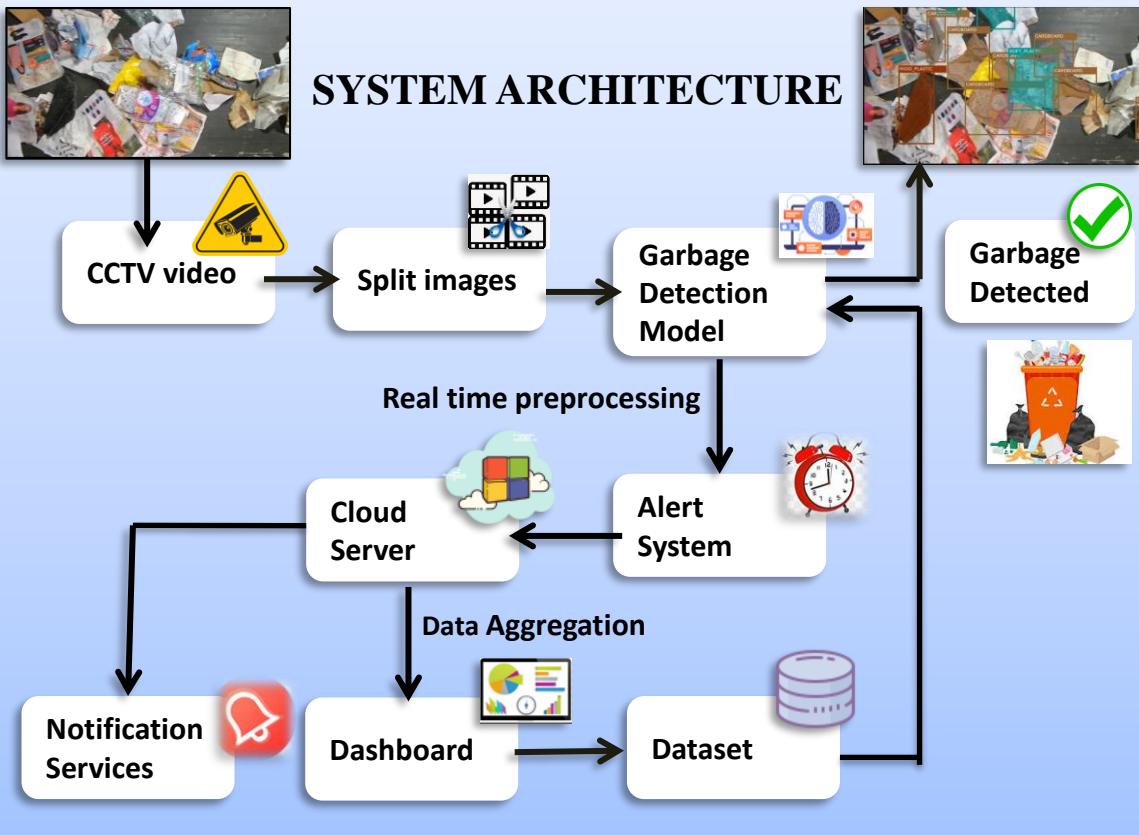
IDEA : ShuddhiNetra Nirikshak - AI-Driven Cleanliness and **Ambience Monitoring Alert** System For the **Department of Posts** Which leverages **image processing** to **monitor Swachhta** (cleanliness) & **LiFE** (Lifestyle for Environment) practices in post offices using existing **CCTV** infrastructure .

PROPOSED SOLUTION :

➢ **Continuous AI-Driven Monitoring:** AI-driven **pictorial data analysis** through existing **CCTV** and monitors post office locations ensuring clean environmental standards.

➢ **Automatic Real-time Alerts : Trigger alerts** when are anomaly detected further **notify** the divisional officer with **alerts** of **time-stamped geo-tagged pictorial images** within the post office ambience.

➢ **Centralized Dashboard :**
  Offers **insightful user-friendly analytical** swachhta dashboard.
  Visualize data trends and **compliance status**.
  Equipped with **priority**-based **waste hotspot popups** on **3D map GUI.**
  Waste **monetization**-based detailed **quantitative** waste **analytics reports**.
  Comprehensive Records **reviewed** and **rated** by divisional office.

HOW IT ADDRESSES THE PROBLEM :
➢ **Automates** waste management using AI-driven monitoring.
➢ **Enhances** efficiency in garbage collection and cleanliness **maintenance**.
➢ **Reduces manual monitoring** efforts across all post offices.
➢ **Analyzes data** and **sends alerts** for quick action

SYSTEM ARCHITECTURE

CCTV video → Split images → Garbage Detection Model → Garbage Detected

Real time preprocessing

Cloud Server ← Alert System

Data Aggregation

Notification Services ← Cloud Server → Dashboard → Dataset
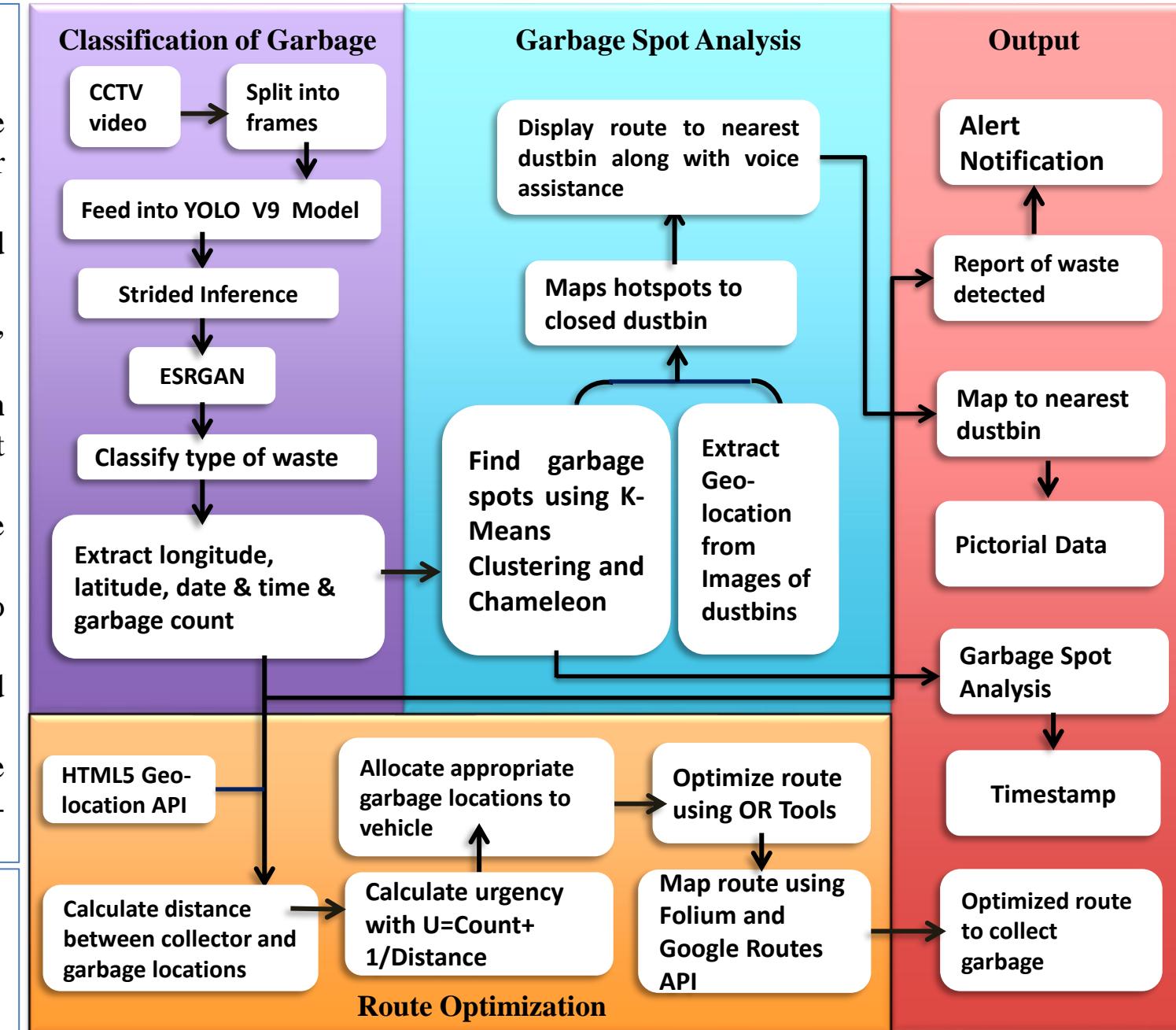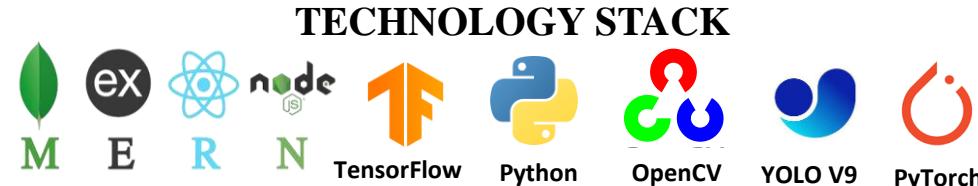
UNIQUENESS :
➢ **YOLO V9** model is used to analyze **CCTV** footage **in real-time** for **waste object detection**.
➢ **Strided Inference** approach **enhances accuracy** and enables the **detection of tiny objects** that would have otherwise been missed.
➢ **ESRGAN** improves the **accuracy** of **digit** and **alphabet detection** for verifying essential documents.

TECHNICAL APPROACH

METHODOLOGY :

- **CCTV Cameras** stream real-time video.
- **OpenCV** preprocesses video frames with noise reduction, resizing, and **Histogram Equalization** for pixel enhancement.
- Frames are converted for **YOLOv9** with **Strided Inference** to detect tiny objects.
- **YOLOv9** detects cleanliness issues, small objects, and **ESRGAN** identifies small text for paper usability.
- **K-Nearest Neighbor (KNN)** and **Chameleon Clustering** detect garbage hotspots for efficient cleanup planning.
- **Firebase Cloud Messaging** sends real-time notifications to cleaning staff for prompt action.
- **Google Maps API** tracks and maps detected issues to specific post office locations.
- **OR-Tools** optimizes garbage collection routes based on urgency and garbage levels.
- **HTML5, JavaScript, React.js** provide real-time alerts and data visualization, with **Folium** for geo-visualization.

TECHNOLOGY STACK

M   E   R   N   TensorFlow   Python   OpenCV   YOLO V9   PyTorch

Classification of Garbage

- CCTV video → Split into frames
- Feed into YOLO V9 Model
- Strided Inference
- ESRGAN
- Classify type of waste
- Extract longitude, latitude, date & time & garbage count

Garbage Spot Analysis

- Display route to nearest dustbin along with voice assistance
- Maps hotspots to closed dustbin
- Find garbage spots using K-Means Clustering and Chameleon
- Extract Geo-location from Images of dustbins

Route Optimization

- HTML5 Geo-location API
- Allocate appropriate garbage locations to vehicle
- Optimize route using OR Tools
- Calculate distance between collector and garbage locations
- Calculate urgency with U=Count+ 1/Distance
- Map route using Folium and Google Routes API

Output

- Alert Notification
- Report of waste detected
- Map to nearest dustbin
- Pictorial Data
- Garbage Spot Analysis
- Timestamp
- Optimized route to collect garbage

Feasibility and Viability:
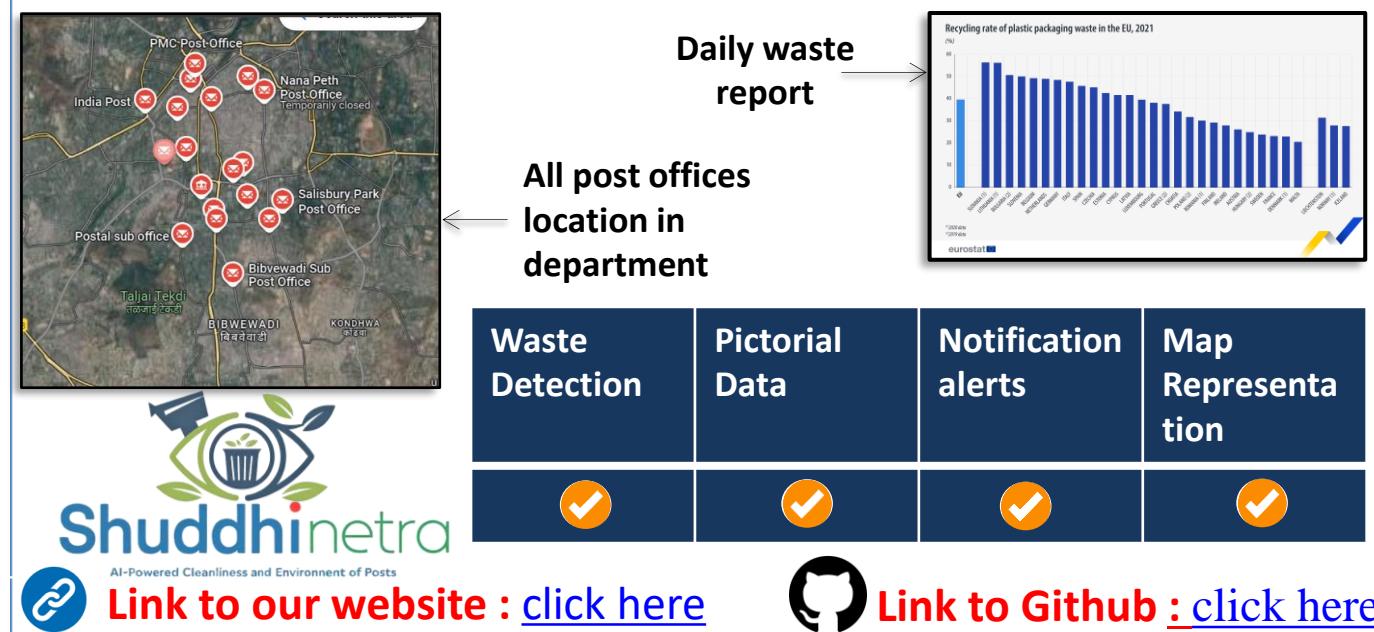
1. **Technical Feasibility** : Uses proven technologies (YOLOv9, OpenCV) for reliable performance.
2. **Operational Feasibility** : Integrates with existing CCTV infrastructure, causing minimal disruption.
3. **Economic Feasibility** : Reduces costs by cutting manual inspection needs and using affordable edge devices.

Potential Challenges and Risks:

➤ **Challenge 1: Privacy and Data Security**
  • **Strategy:** Implement robust encryption and adhere to privacy regulations.

➤ **Challenge 2: Model Accuracy and Performance**
  • **Strategy:** Continuously update and fine-tune models using new data.

➤ **Challenge 3: Integration and Scalability**
  • **Strategy:** Modular design to allow for easy scaling and integration with various systems.

Easy to use UI **Notification** **Search for Cities**

Daily waste report

All post offices location in department

Waste Detection	Pictorial Data	Notification alerts	Map Representation
✅	✅	✅	✅

Link to our website : click here   **Link to Github :** click here

Potential Impact on the Target Audience:

➤ **Enhanced Compliance:** Ensures high standards of cleanliness and environmental practices.
➤ **Efficient Resource Use: Optimizes staff** and **resources** based on real-time data.
➤ **Public Perception:** Demonstrates **commitment** to sustainability and operational excellence.

Benefits of the Solution:

➤ **Social:** Promotes a cleaner and more sustainable environment, **improving workplace** conditions and **public perception**.
➤ **Economic: Reduces costs** associated with manual inspections and improves operational efficiency.
➤ **Environmental:** Supports waste management and **energy conservation efforts**, aligning with broader sustainability goals.

Use Cases:

➤ **Real-Time Monitoring**: CCTV cameras use YOLOv9 to detect cleanliness issues.
➤ **Alerts and Actions**: Sends instant notifications for immediate staff response.
➤ **Location Mapping:** Uses Google Maps API to pinpoint issue locations.
➤ **Compliance Tracking**: Monitors adherence to cleanliness standards.
➤ **Efficiency:** Automates monitoring to save time and resources.

RESEARCH AND REFERENCES

Literature Survey :

[Research on the Recognition and Classification of Recyclable Garbage Based on Improved YOLOv8s](#)

2023 5th International Conference on Control and Robotics (ICCR)

DOI: [10.1109/ICCR60000.2023](#)

Case Studies : Existing Solutions As Reference

[Streamlining Accurate Garbage Detection using AI Video Analytic](#)

[High IQ Garbage Management, Keeping Your City Green and Clean.](#)

[Public Cleanliness : Automatic detection of fly-tipping or illegal waste dumping](#)

[AI helps recover overflow and contamination costs and generate fees for these services.](#)

[AI enabled contamination & overfilled detection.](#)

Field Visit and Survey : A/P Sangamner Post Office, Dist. Ahmednagar.
PIN CODE (Postal Index Number code): 42260
POST OFFICE [Visit & Survey Report](#)by our Team TERMINATORS.

Google Form Link: https://docs.google.com/forms/postoffice/viewform
Website Link : https://shuddinetrasih1751.icipamrutvahini.in/
Video Link: https://youtu.be/AvnI_TFHcHY?si=eIMrfZxUbcxfihe3