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TrashAI: Camera Vision Based Trash Classification and Detection System Using Deep Learning

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ABSTRACT: Trash is a residual object that no longer used anymore. Usually, it was a result of some process, which is by a human doing or natural ecosystem. This organic waste usually likes leafage and animal carcasses. On the other hand, non-organic waste is hardly decomposed by the organism. Regular trash removal enhances the visual appeal of neighborhoods and public spaces, contributing to a cleaner and more pleasant environment. Therefore, trash classification attracted a lot of researchers recently is also a promising application of computer vision in the industry. In this project, Camera Vision Based Trash Classification and Detection System Using Deep Learning are introduced. TrashAI aims to revolutionize this process by incorporating cutting-edge computer vision techniques to classify and detect trash items in real-time. This solution not only enhances the efficiency of waste management but also contributes to environmental sustainability.

KEYWORDS: Trash AI, Trash Detection, Tesseract OCR, Machine Learning.

I. INTRODUCTION

Trash can include various materials such as household waste, packaging, food scraps, and other items that people dispose of.

Trash can make an area look dirty and unpleasant. It can harm plants, animals, and water sources, making the environment unhealthy.

To address these issues, present TrashAI, an innovative Camera Vision-Based Trash Classification and Detection System that harnesses the power of deep learning for intelligent waste management.

Develop a robust TrashNet model using Convolutional Neural Networks (CNNs) to classify different types of trash such as plastic, paper, metal, etc.

Implement real-time trash detection using Temporal Convolutional Networks (TCNs).

II. EXISTING SYSTEM

The traditional system of trash management has been the backbone of waste disposal for many years, primarily relying on manual labor, basic sorting processes, and conventional disposal methods.

MANUAL SORTING

Waste sorting in traditional systems heavily relies on manual labor. Workers manually segregate different types of waste into categories such as paper, plastic, glass, and organic waste.

Transportation: Collected waste is transported to transfer stations or landfills using specialized vehicles.

Sorting: At transfer stations or landfills, waste is manually sorted by workers into broad categories such as recyclables (plastic, paper, glass, metal), organic waste (food scraps, yard waste), and non-recyclable/non-compostable waste.

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Processing: Recyclable materials are further processed through various methods such as shredding, melting, or pulping to prepare them for recycling. Organic waste may undergo composting or anaerobic digestion to produce compost or biogas.
Disposal: Non-recyclable/non-compostable waste is typically disposed of in landfills, while recyclables and compostable materials are sent to recycling facilities or composting sites, respectively.

III. ALGORITHMS

Several existing image processing and machine learning algorithms can be employed for trash classification and detection.

Haar Cascades
Haar Cascades, originally designed for face detection, can be adapted for trash detection. These cascades are effective in recognizing specific patterns within images.

Support Vector Machines (SVM)
Support Vector Machines (SVM) are robust classification algorithms applicable to image classification tasks. SVMs work by finding optimal hyperplanes in feature space and are effective in separating different classes.

Decision Trees and Random Forests
Decision trees and ensemble methods like Random Forests offer interpretability and versatility in image classification. These algorithms can effectively handle non-linear relationships in image data.

IV. PROPOSED SYSTEM

The proposed system, TrashAI, aims to revolutionize waste management through the integration of advanced image processing and deep learning techniques.

TrashNet Model with CNN:
To enhance the accuracy of trash classification, we propose the development of a TrashNet Model utilizing Convolutional Neural Networks (CNNs). This model will be trained on a diverse dataset containing labeled images of various trash types, ensuring adaptability to different environmental conditions.

Real-Time Trash Detection with TCN:
The real-time aspect of trash detection will be addressed through the implementation of Temporal Convolutional Networks (TCNs). By integrating object detection principles, the TCN will provide precise bounding box localization for identified trash items in images or video streams.

Waste Segregation
A dedicated waste segregation module employs intelligent algorithms to categorize waste items accurately, enhancing the efficiency of downstream recycling processes.

Alert to Municipality
In addition to the core components, the proposed TrashAI system will feature an integrated alert mechanism to notify the municipality or relevant authorities. When the system detects anomalies or specific issues in waste management, automated alerts will be triggered.

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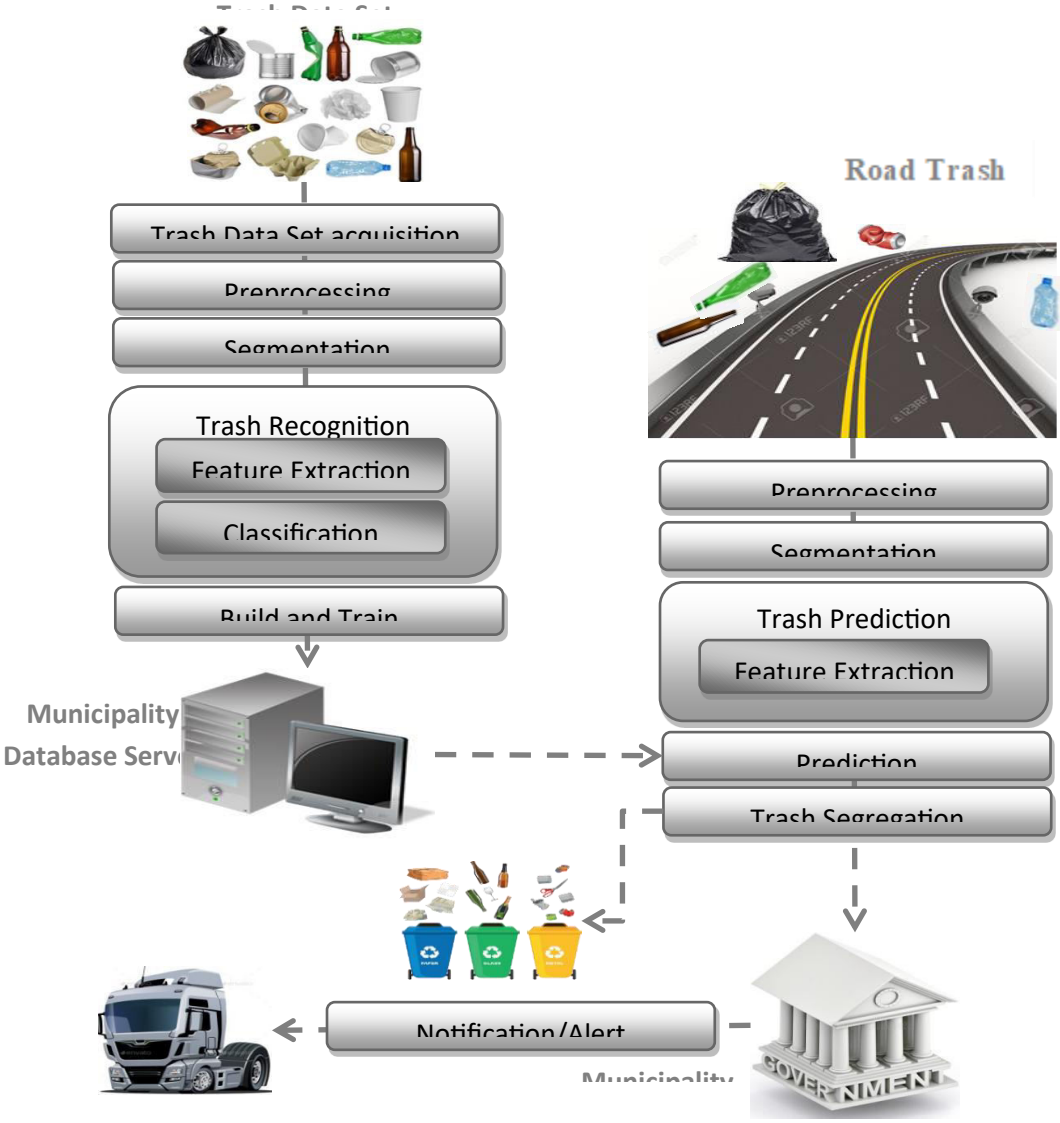
V. SYSTEM ARCHITECTURE



VI. CONCLUSION

In conclusion, the TrashAI project represents a groundbreaking initiative in waste management, leveraging advanced technologies to revolutionize the way we handle and categorize waste.

By combining the power of Convolutional Neural Networks (CNNs) and Temporal Convolutional Networks (TCNs), our system, comprising the Municipality Web App, TrashNet, Trash Detector, Trash Segregator, and Alert Generator, offers a comprehensive solution for municipalities seeking to enhance their waste management practices.

TrashAI project is not just a technological advancement; it is a step towards fostering environmentally conscious practices, promoting sustainability, and contributing to a cleaner and healthier future.

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With scalability, adaptability, and continuous improvement at its core, TrashAI is poised to redefine waste management practices, making them more efficient, intelligent, and responsive to the evolving needs of municipalities and communities.

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