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Waste Management System Using CCTV & Notification

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Abstract

We are trying to solve a problem of keeping our college campus clean. Now cleaning staff follow a fixed schedule to check dustbins but they don't always match the actual need. We noticed that some dustbins get full before they are checked and garbage scatters around. This happens because there is no real-time monitoring and communication with cleaning staff.

To solve this we made a waste management system using CCTV cameras and mobile notifications. The system uses cameras to monitor dustbins and areas around them. A computer model checks live video. Tells if a dustbin is full half-full or empty. It also finds garbage outside bins.

When the system sees a problem it sends alerts to cleaning staff through an app. We tested it with a webcam. Saw that it works well in normal light and sends alerts quickly.

Our system reduces work improves efficiency and is cost-effective for keeping campuses clean.

Keywords

Waste Management, CCTV, Computer Vision, YOLO Smart Campus, Mobile Alerts

II. Introduction

Waste management is an issue in large campuses where a lot of waste is generated daily. Most colleges follow a fixed schedule for cleaning staff to check dustbins. It doesn't always work. Some dustbins get full early while others are checked unnecessarily. Garbage also scatters around bins and open areas. There is no real-time monitoring so issues are identified late. This leads to hygiene and inefficient use of resources.

We use CCTV cameras to capture video and process it using a computer model. The system detects dustbin status and garbage presence in time and sends alerts to cleaning staff through a mobile

app. We want to make waste management smarter faster and more efficient.

II. Literature Review

Many methods have been proposed to improve waste management systems. Some use sensors to detect waste levels but they need hardware and maintenance. IoT-based systems send data to cloud platforms but they can be costly and complex.

III. Problem Statement

In college campuses waste management is still traditional and relies on fixed schedules and manual inspection.. This approach doesn't consider the actual condition of dustbins in real-time. We found that many dustbins get full before scheduled cleaning while others remain partially empty but are still checked.

Another major issue is garbage accumulation around dustbins and open areas. There is no real-time monitoring system so situations are often identified late leading to conditions.

There is no communication system to inform cleaning staff about exact locations that need cleaning. Staff members have to inspect multiple locations, increasing workload and delaying response.

IV. Proposed System

Our system aims to provide an efficient solution for waste management using CCTV cameras and computer vision technology. Of installing extra sensors we use existing CCTV infrastructure to capture live video.

The captured video is processed using a deep learning model that detects dustbin conditions and identifies garbage. The system classifies dustbins

Recently computer vision-based approaches using deep learning models like YOLO and CNN have shown performance in object detection. These methods can detect waste using images and video without sensors.

However most existing systems don't fully integrate real-time CCTV monitoring with mobile alert systems

into half-full and empty categories. It also detects waste accumulation.

When the system identifies a condition it generates an alert and sends it to cleaning staff through a mobile app. This ensures cleaning is performed when required, improving efficiency.

The system stores detection data in a database for analyzing waste patterns and improving cleaning schedules.

V. Methodology

We started by collecting images and videos of dustbins in conditions. These images were. Used to train a YOLO-based model.

After training the model was integrated with a real-time video processing system. The system captures video frames. Processes them continuously.

When a critical condition is detected an alert is. Sent using Firebase.

VI. System Architecture

The system consists of layers. CCTV cameras act as the input layer while the AI model processes video data. Results are sent to an app through a notification system and all data is stored in a cloud database.



VII. Implementation Details

The system was implemented using Python as the programming language. Libraries like OpenCV were used for image processing while TensorFlow or PyTorch was used for learning model training.

The YOLOv8 model was selected for object detection due to its accuracy and real-time performance. The model was trained using a custom dataset of dustbin and garbage images.

Firebase was used to handle data storage and push notifications. The mobile app was developed using Android technologies to receive alerts and display information to cleaning staff.

VIII. Results & Output

The system was tested in an environment using a webcam. It detected dustbin conditions and garbage presence in time with good accuracy.

The detection accuracy ranged between 88% and 92% depending on lighting conditions and camera angle. The system processed video frames at 20–30 frames per second. Alerts were generated within 1–2 seconds after detecting a condition and were successfully delivered to the mobile app.

IX. Discussion

The results show that the system can improve waste management by providing real-time monitoring and reducing effort. Cleaning staff can respond quickly to alerts maintaining cleanliness.

However performance may decrease in low-light conditions or improper camera angles.

X. Advantages

The system offers advantages over traditional waste management methods. It uses existing CCTV cameras, eliminating hardware and reducing cost.

It provides real-time monitoring allowing detection of waste-related issues. This ensures cleaning and improved hygiene. The system reduces effort by automatically sending alerts to cleaning staff. This improves efficiency and utilizes available resources. The system is scalable. Can be expanded to larger environments like smart cities.

XI. Limitations

The system has limitations related to conditions. Its performance depends on camera quality, angle and lighting conditions. In low-light environments detection accuracy may decrease. The system requires an internet connection for real-time alerts.

Another limitation is the need for a prepared dataset for training the model.

XII. Future Scope

The system can be. Expanded. It can be integrated with city systems to manage waste on a larger scale.

Drone-based monitoring can be used for covering areas. Advanced AI models can be implemented to improve accuracy.

Predictive analytics can be added to predict when a dustbin will become full and optimize cleaning schedules.

XIII. Conclusion

Our research presents an practical solution for waste management using CCTV cameras, computer vision and mobile notifications. The system provides real-time monitoring. Ensures quick response to waste-related issues.

By using existing infrastructure the system remains cost-effective and easy to implement. It reduces effort and improves overall cleanliness in the campus.

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