# Vandalism Detection in Urban Environments Using Computer Vision

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***Abstract*— This project develops a basic computer vision system to detect vandalism actions in urban environments, focusing on graffiti and property damage. Using OpenCV and Python, the prototype combines image preprocessing, edge detection, and machine learning classification to identify anomalies in static images and video feeds.**

***Keywords*— Computer vision, vandalism detection, OpenCV, machine learning, urban monitoring, SBrT 2025.**

## I. Introduction

Urban vandalism poses significant challenges to public infrastructure, with traditional monitoring methods proving inefficient for large-scale urban environments. Manual monitoring remains slow and error-prone, motivating automated solutions. This conceptual study explores the integration of computer vision techniques to address two core aspects: technical framework and ethical design.

### A. About vandalism detection in urban spaces

Urban vandalism in public transport incurs millions in annual repair costs. Developed as part of a computer vision course, this project aims to automate damage identification using OpenCV/Python while addressing ethical challenges inherent in AI-driven surveillance systems. The work focuses on balancing technical feasibility with societal concerns, particularly privacy preservation in public spaces.

### B. Anticipated Challenges

The project has some anticipated challenges as well:

- **Environmental Variability**: Theoretical analysis of lighting/occlusion impacts on detection reliability.
- **Algorithmic Trade-offs**: Balancing false positives (over-reporting) vs. false negatives (missed vandalism).
- **Ethical risks**: Possibility that the algorithms may exhibit bias in detecting vandalism depending on the individuals or contexts.

## II. System description and problems

### A. Problem Context

Vandalism in public transportation systems remains a costly and persistent issue. Current monitoring solutions suffer from three key shortcomings:

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- **Passive Surveillance**: Existing systems only record footage without real-time anomaly alerts.
- **Human Limitations**: Manual monitoring is prone to oversight due to operator fatigue.
- **Cost Barriers**: Commercial AI solutions are prohibitively expensive for small municipalities.

### B. Proposed Solution

Our system provides a low-cost computational tool designed to:

- **Input**: Process images and videos from basic cameras and surveillance systems, enabling real-time detection using lightweight computer vision techniques.
- **Processing**:
  1) Detect graffiti/property damage using edge and color contrast analysis.
  2) Highlight suspicious areas with bounding boxes.
  3) Identify individuals using image preprocessing and edge detection, including Gaussian and bilateral filters for noise reduction, followed by Sobel and Canny operators to enhance and extract edge features.

### C. System Limitations

- Optimal performance requires daytime lighting conditions.
- May misinterpret shadows/textures as vandalism.
- Face/body detection accuracy drops in crowded scenes or oblique angles.
- Edge detection can produce false positives due to shadows or textures, while excessive smoothing may lead to the loss of important details, affecting the accuracy of individual identification and vandalism detection.

## III. Solution

This work proposes the development and deployment of an intelligent computer vision system to monitor BRT (Bus Rapid Transit) stations in real time, aiming to automatically detect actions classified as vandalism — such as equipment damage, graffiti, forced entry, and destruction of turnstiles.

The system leverages deep learning models, particularly neural network architectures for human action recognition in video, trained with representative data of real vandalism scenarios. The proposed infrastructure integrates existing or

strategically placed surveillance cameras, real-time video processing modules, motion detection algorithms, pose estimation, and action recognition (e.g., kicking, hitting, breaking objects).

This solution aims to reduce public property damage, improve safety, and improve response times, contributing to more secure and efficient public transportation operations.

## IV. Results

As an initial result, we successfully detected the edges of the image, partially isolating the individual present in the photo by applying Canny edge detection and the Sobel operator to highlight object contours. Regarding the filters, we used the Gaussian filter as a linear smoothing technique that reduces image noise and detail by averaging pixel values using a Gaussian kernel and the bilateral filter as a non-linear, edge-preserving smoothing technique that reduces noise while maintaining sharp edges by considering both spatial proximity and pixel intensity differences. The future goal is to fully segment the image of the person committing vandalism at BRT stations.

## V. Conclusions

Although the project is still in its early stages, initial results demonstrate the potential of the proposed solution for automated vandalism detection at BRT stations using edge detectors and filters. Future developments aim to improve individual segmentation and accurately identify suspicious behaviors, contributing to enhanced security and preservation of public infrastructure.[1]

## Acknowledgements

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## References

[1] R. F. A. S. Lima, D. N. G. Cavalcanti, B. R. B. Loureiro, L. Lanzellotti, J. V. G. de Araújo, L. C. P. Macedo, and R. P. Fernandes, “Detecção de vandalismo em ambientes urbanos com visão computacional,” in *XLII Simpósio Brasileiro de Telecomunicações e Processamento de Sinais*. Natal, RN, Brazil: Sociedade Brasileira de Telecomunicações, September 29th, October 2nd 2025. [Online]. Available: http://dx.doi.org/10.14209/sbrt.2024.1571036315