Visão Computacional

Detecção de imagens - AP1 (Ibmec 2025.1)

Grupo: Rafael Lima, Bernardo Loureiro, Daniel Gripa, Lucca Lanzellotti, Luis Pastura e João Araújo | Professor: Rigel P. Fernandes

PROBLEMA

RIO DE JANEIRO

Nova frota do BRT do Rio é alvo de depredação e vandalismo

Os novos ônibus circulam há cerca de um mês e vários já foram vandalizados.

Por Jefferson Monteiro e Guilherme Peixoto, RJ1

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CRÉDITOS: G1

IDEIA ESCOLHIDA

PROJETO

Identificação de faces e atos de vandalismo no transporte público

Problema

Alto índice de vandalismo urbano nos transportes públicos do Rio de Janeiro, principalmente no BRT

Solução

Desenvolvimento de um sistema de visão computacional para monitorar estações de BRT, com o objetivo de detectar ações classificadas como vandalismo

Limitações

Desempenho ideal em iluminação diurna; sombras e texturas podem gerar falsos positivos; detecção de rosto/corpo é menos precisa em multidões ou em certos ângulos

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DOCUMENTAÇÃO

Vandalism Detection in Urban Environments Using Computer Vision

Rafael Lima, Bernardo Loureiro, Lucca Lanzellotti, Daniel Gripa, João Araujo, Luis Pastura and Rigel P. Fernandes

***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, LaTeX, 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).
- **Public Acceptance**: Ethical risks of normalized surveillance in smart cities.

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 CCTV 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/videos from smartphones or basic cameras.
- **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.

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.

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, enhance safety, and improve response times, contributing to more secure and efficient public transportation operations.

PAPER (OVERLEAF)

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PRINCIPAIS CONCEITOS UTILIZADOS

MÉTODOS APLICADOS

Filtro bilateral	Canny	Gaussian Blur	Sobel
Suaviza a imagem reduzindo ruídos, mas preserva as bordas importantes, o que o torna ideal para preparar a imagem antes de detectar contornos.	Identifica as bordas mais marcantes da imagem, destacando onde há mudanças bruscas de intensidade.	Reduz ruídos e detalhes finos e ao suavizar a imagem aplicando uma média ponderada dos pixels vizinhos com base na distribuição Gaussiana.	Identifica bordas ao calcular os gradientes de intensidade da imagem, destacando mudanças abruptas nos eixos horizontal e vertical.

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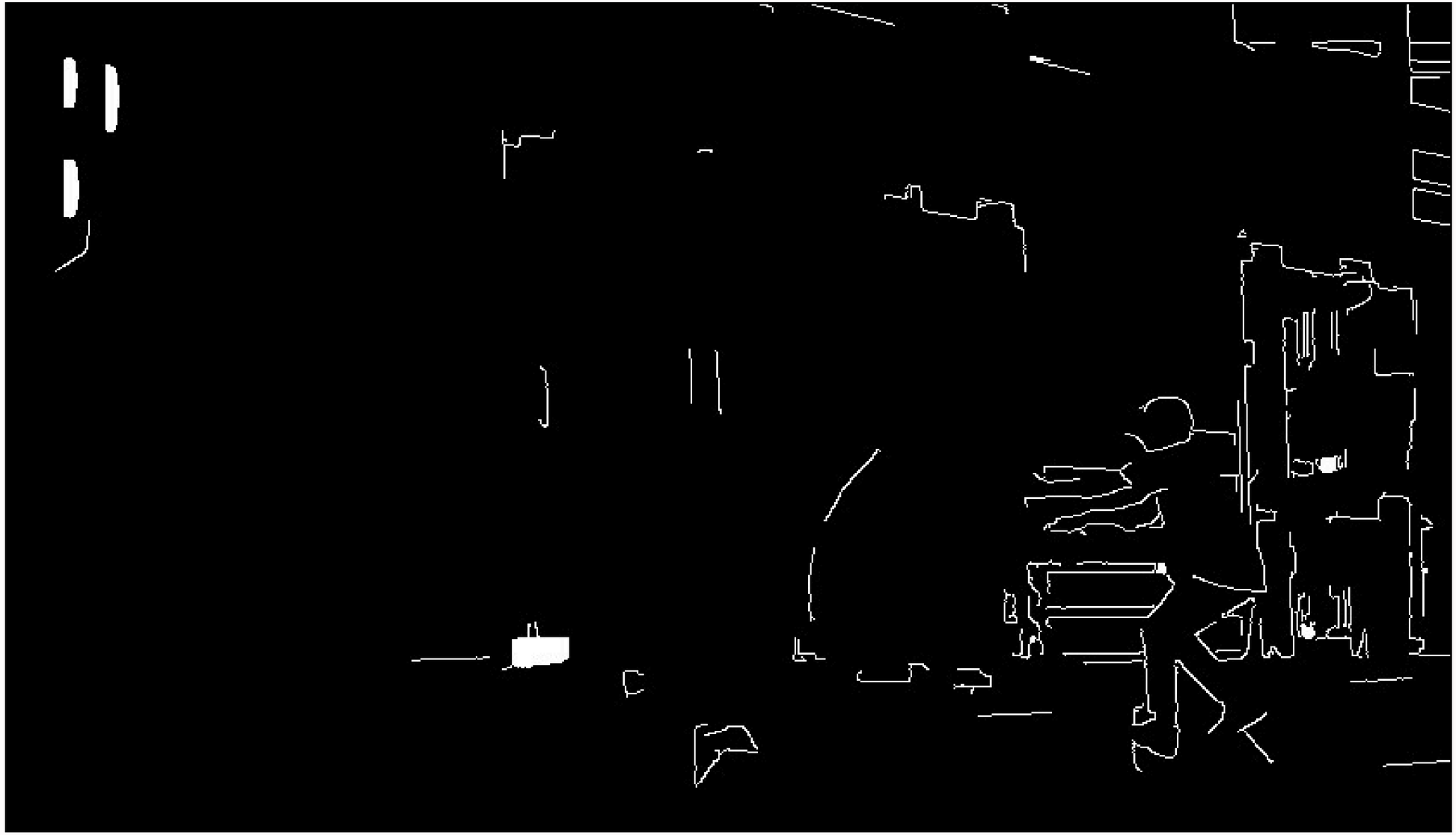
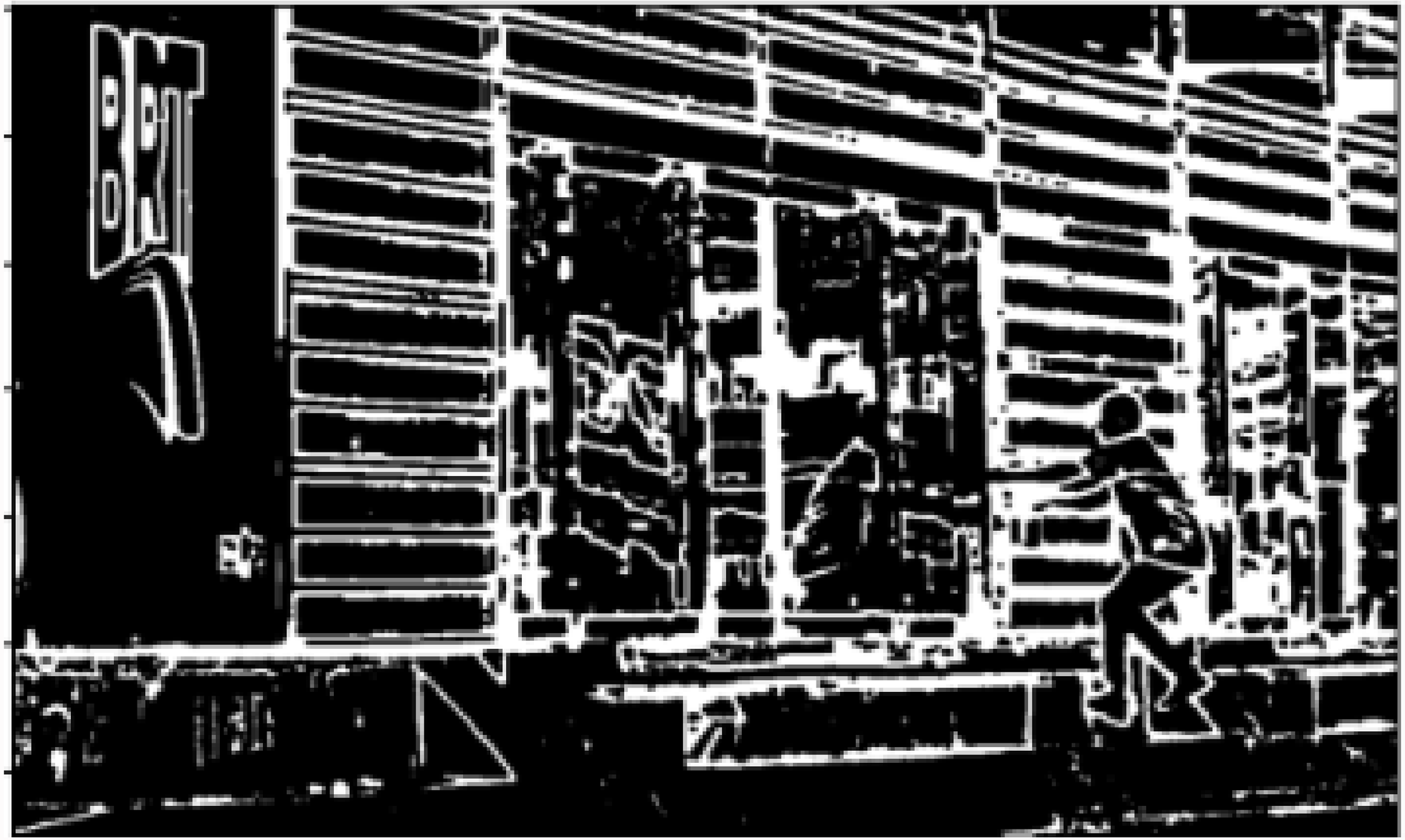
IMAGENS

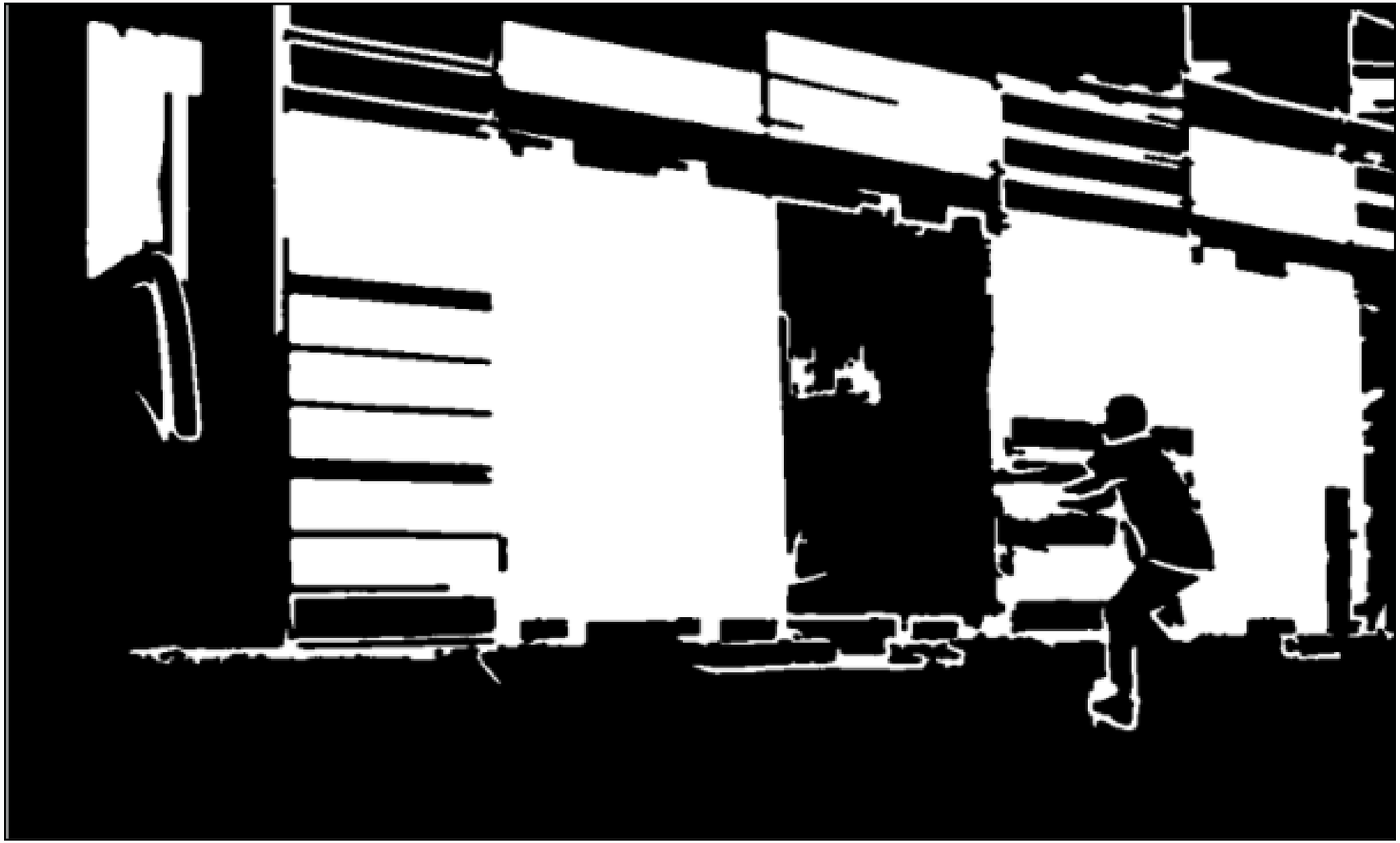
IMAGEM ORIGINAL



FILTRO BILATERAL | CANNY



FILTRO GAUSSIANO | SOBEL



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PRÓXIMOS PASSOS

OBRIGADO!

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