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„___” ________ 2025

RECOGNITION AND VISUALIZATION OF DATA OF AN AUTOMATED SURVEILLANCE SYSTEM

Master's project

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Chisinau, 2025

ABSTRACT

This paper presents the application of the YOLO v8 (You Only Look Once) model for real-time object detection within an automated video surveillance system. YOLO v8, recognized for its superior balance between speed and accuracy, is leveraged to detect various objects in live surveillance feeds. The proposed system processes video streams in real-time, using the latest advancements in convolutional neural networks to achieve object detection with minimal latency, which is crucial for time-sensitive environments like security monitoring.

As experiments have demonstrated, YOLO v8 achieved an average precision (AP) of 52.7% on the COCO dataset and processed up to 60 frames per second (FPS) on 1080p video, outperforming previous YOLO versions in both detection accuracy and processing speed [1]. This represents a notable improvement over YOLOv4, which reported an AP of 43.5% and a speed of 50 FPS under similar conditions [2].

The primary objective of this thesis is demonstrating how YOLO v8 can be effectively integrated into a real-time video surveillance system, offering both high detection accuracy and performance efficiency. Future work will focus on extending the system's capability to detect complex human activities and refining the interface for enhanced user interaction.

REZUMAT

Această lucrare prezintă aplicarea modelului YOLO v8 (You Only Look Once) pentru detectarea obiectelor în timp real în cadrul unui sistem automatizat de supraveghere video. YOLO v8, recunoscut pentru echilibrul superior între viteză și acuratețe, este utilizat pentru detectarea diverselor obiecte în fluxuri video de supraveghere live. Sistemul propus procesează fluxurile video în timp real, folosind cele mai recente progrese în rețele neuronale convoluționale pentru a realiza detectarea obiectelor cu latență minimă, un aspect de bază pentru medii sensibile la timp, cum ar fi monitorizarea de securitate.

Experimentele au demonstrat că YOLO v8 a obținut o precizie medie (AP) de 52,7% pe setul de date COCO și a procesat până la 60 de cadre pe secundă (FPS) la rezoluție video 1080p, depășind versiunile anterioare YOLO atât în ceea ce privește acuratețea detecției, cât și viteza de procesare [1]. Acest lucru reprezintă o îmbunătățire notabilă față de YOLOv4, care a raportat un AP de 43,5% și o viteză de 50 FPS în condiții similare [2].

Contribuția principală a acestui studiu constă în demonstrarea modului în care YOLO v8 poate fi integrat eficient într-un sistem de supraveghere video în timp real, oferind atât o acuratețe ridicată a detecției, cât și eficiență în performanță. Lucrările viitoare se vor concentra pe extinderea capacității sistemului de a detecta activități umane complexe și pe rafinarea interfeței pentru a îmbunătăți interacțiunea cu utilizatorul.

CONTENTS

INTRODUCTION

Automated surveillance systems have become increasingly essential in various sectors, from public security and traffic monitoring to industrial safety and property protection. As these systems generate vast amounts of data, the need for real-time object detection and accurate visualization of critical events has become paramount. Traditional video surveillance approaches often rely on manual monitoring, which can be inefficient, prone to human error, and incapable of handling the scale and speed required in high-risk environments.

The recent advancements in artificial intelligence (AI), particularly in the field of computer vision, have transformed how surveillance systems process and interpret video feeds. Among the cutting-edge techniques in object detection is the YOLO (You Only Look Once) algorithm, which is known for its remarkable balance between speed and accuracy. YOLOv8, one of the latest versions of this algorithm, introduces significant improvements in both detection precision and processing efficiency, making it a suitable candidate for real-time surveillance applications where quick and accurate responses are critical.

This thesis explores the integration of the YOLOv8 algorithm into an automated surveillance system, focusing on the recognition of objects and the effective visualization of the system's output. By leveraging the capabilities of YOLOv8, this research aims to enhance the system's ability to detect objects in real-time video streams while providing intuitive and actionable visual representations of the detected objects. The system's real-time performance and high detection accuracy are vital in applications such as security monitoring, where rapid identification of potential threats is necessary to ensure prompt responses.

In addition to object recognition, this thesis also addresses the challenge of visualizing the results in a manner that aids operators in making informed decisions quickly. Effective visualization is crucial for reducing cognitive load and ensuring that critical information is presented clearly and concisely. The combination of YOLOv8’s advanced object detection capabilities and sophisticated visualization techniques will contribute to the development of a robust, automated surveillance system capable of meeting the growing demands of modern security environments.

The subsequent chapters will delve into the architecture of the proposed system, experimental results that demonstrate its efficacy, and potential improvements for future implementations.

BIBLIOGRAPHY

[1] Talib, Moahaimen, et al. “YOLOv8-CAB: Improved YOLOv8 for Real-Time Object Detection.” Karbala International Journal of Modern Science, vol. 10, no. 1, Jan. 2024. DOI.org (Crossref), https://doi.org/10.33640/2405-609X.3339.

[2] Bochkovskiy, Alexey, et al. YOLOv4: Optimal Speed and Accuracy of Object Detection. arXiv:2004.10934, arXiv, 23 Apr. 2020. arXiv.org, https://doi.org/10.48550/arXiv.2004.10934.

[3] Redmon, Joseph, and Ali Farhadi. “YOLO9000: Better, Faster, Stronger.” 2017 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), IEEE, 2017, pp. 6517–25. DOI.org (Crossref), https://doi.org/10.1109/CVPR.2017.690.

[4] *YOLO Object Detection Explained: Evolution, Algorithm, and Applications*. https://encord.com/blog/yolo-object-detection-guide/. Accessed 16 Dec. 2024.

[5] Gandhi, Rohith. “R-CNN, Fast R-CNN, Faster R-CNN, YOLO — Object Detection Algorithms.” Medium, 9 July 2018, https://towardsdatascience.com/r-cnn-fast-r-cnn-faster-r-cnn-yolo-object-detection-algorithms-36d53571365e.

[6] Klingler, Nico. “RetinaNet: Single-Stage Object Detector with Accuracy Focus.” Viso.Ai, 17 Apr. 2024, https://viso.ai/deep-learning/retinanet/.

[7] Tan, Mingxing, et al. “EfficientDet: Scalable and Efficient Object Detection.” 2020 IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), IEEE, 2020, pp. 10778–87. DOI.org (Crossref), https://doi.org/10.1109/CVPR42600.2020.01079.

[8] Zhou, Xingyi, et al. Objects as Points. arXiv:1904.07850, arXiv, 25 Apr. 2019. arXiv.org, https://doi.org/10.48550/arXiv.1904.07850.

[9] He, Kaiming, et al. Deep Residual Learning for Image Recognition. arXiv:1512.03385, arXiv, 10 Dec. 2015. arXiv.org, https://doi.org/10.48550/arXiv.1512.03385.

[10] Katta, Rajesh. “Object Detection Part-3: One Stage Detectors: YOLO.” Medium, 15 July 2024, https://medium.com/@kattarajesh2001/object-detection-part-3-one-stage-detectors-yolo-a4a6b4dd2d33.

[11] Ultralytics YOLOv8; Unparalleled Capabilities - YOLOv8. 27 Feb. 2024, https://yolov8.org/ultralytics-yolov8-yolov8-offers-unparalleled-capabilities/.

[12] Jegham, Nidhal, et al. Evaluating the Evolution of YOLO (You Only Look Once) Models: A Comprehensive Benchmark Study of YOLO11 and Its Predecessors. arXiv, 2024. DOI.org (Datacite), https://doi.org/10.48550/ARXIV.2411.00201.

[13] Safaldin, Mukaram, et al. “An Improved YOLOv8 to Detect Moving Objects.” IEEE Access, vol. 12, 2024, pp. 59782–806. DOI.org (Crossref), https://doi.org/10.1109/ACCESS.2024.3393835.