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Intelligent Campus Monitoring: YOLOv8-Based High-Accuracy Activity Recognition

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Abstract : Background: Recent advances in computer vision and pattern recognition have significantly improved activity recognition through video analysis, particularly with the application of Deep Convolutional Neural Networks (CNNs). One-stage detectors now enable efficient video-based recognition by simultaneously predicting object categories and locations. Such advancements are highly relevant in educational settings where CCTV surveillance could automatically monitor academic activities, enhancing security and classroom management. However, current datasets and recognition systems lack the specific focus on campus environments necessary for practical application in these settings.Objective: This study aims to address this gap by developing a dataset and testing an automated activity recognition system specifically tailored for educational campuses. The EthioCAD dataset was created to capture various classroom activities and teacher-student interactions, facilitating reliable recognition of academic activities using deep learning models. Method: EthioCAD, a novel video-based dataset, was created with a design science research approach to encompass teacher-student interactions across three domains and 18 distinct classroom activities. Using the Roboflow AI framework, the data was processed, with 4.224 KB of frames and 33.485 MB of images managed for frame extraction, labeling, and organization. The Ultralytics YOLOv8 model was then implemented within Google Colab to evaluate the dataset's effectiveness, achieving high mean Average Precision (mAP) scores. Results: The YOLOv8 model demonstrated robust activity recognition within campus-like settings, achieving an mAP50 of 90.2% and an mAP50-95 of 78.6%. These results highlight the potential of EthioCAD, combined with YOLOv8, to provide reliable detection and classification of classroom activities, supporting automated surveillance needs on educational campuses. Discussion: The high performance of YOLOv8 on the EthioCAD dataset suggests that automated activity recognition for surveillance is feasible within educational environments. This system addresses current limitations in campus-specific data and tools, offering a tailored solution for academic monitoring that could enhance the effectiveness of CCTV systems in these settings. Conclusion: The EthioCAD dataset, alongside the YOLOv8 model, provides a promising framework for automated campus activity recognition. This approach lays the groundwork for future advancements in CCTV-based educational surveillance systems, enabling more refined and reliable monitoring of classroom activities.

Keywords : deep CNN, EthioCAD, deep learning, YOLOv8, activity recognition
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