

ABSTRACT

Retail stores face a significant challenge in detecting theft, which often evades manual surveillance via CCTV. This issue is exacerbated by the reliance on human monitoring a method suseptible to negligence and time constraints. This research presents a solution by developing a suspicious behavior detection system based on computer vision and machine learning, which integrates the YOLOv11 aarchitecture for object detection and pose estimation with XGBoost algorithm for customer behavior classification. This study utilizes spatial features derived drom hand to object interactions (invloving items such as products, bags, and jackets), extracted from human body keypoints. It also incorporates an automated documentation feature that generates classification videos, screenshots of suspicious behaviors, dan reports in CSV format. The entire development process adheres to the Cross-Industry Standard Process for Data Mining (CRISP-DM) framework, from the business understanding pahse through to deployment, and employs the Synthetic Minority Over-sampling Technique (SMOTE) to address data imbalance. The developed classification model demonstrates excellent perfromance, achieving an accuracy of 96,77%, a precision of 96%, a recall of 96%, and an F1-Score of 96%for detecting the “suspicious” class. This model is implemented as a web-based prototype, enabling automated and efficeint detection of suspicious behacior within the retail environment. This research contributes to the advancement of automated surveillance systems that not only enhance monitoring efficiency but also bolster store security without compromosing the customer experience.

Keywords— *Retail sore, Suspicious behavior, Theft detection, Surveillance system, Computer vision, Keypoint, Pose estimation, YOLOv11, XGBoost, CRISP-DM.*