2024 IEEE 9th International Conference for Convergence in Technology (I2CT)
Pune, India. Apr 5-7, 2024

Anomaly Detection in Video Surveillance

M Thanga Subha Devi
Assistant Professor
Department of Computer Science
New Horizon College of Engineering
Bengaluru, India
thangasubhadevi@gmail.com

Dr. M Dhanalakshmi
Professor
Department of Computer Science
New Horizon College of Engineering
Bengaluru, India
mdhanalak72@gmail.com

Sowrabha A
Student
Department of Computer Science
New Horizon College of Engineering
Bengaluru, India
sowrabhaa.bharadwaj@gmail.com

Sowmya ML
Student
Department of Computer Science
New Horizon College of Engineering
Bengaluru, India
mlsowmya8686@gmail.com

Lavanya N
Student
Department of Computer Science
New Horizon College of Engineering
Bengaluru, India
nlavanya1404@gmail.com

***Abstract*—As surveillance cameras have become more widely deployed in recent decades, the requirement for effective real-time monitoring to protect public safety has become critical. The bulk of existing cameras, however, provide passive logging services, which causes delays in the detection of abnormal behaviors such as robberies, carjacking, mugging, and terrorism. Human specialists are frequently faced with the issue of having to wait for hours to recognize these occurrences. To address this constraint, our proposal proposes a solution that makes use of artificial intelligence (AI) and machine learning (ML) technologies. The major goal is to automate the detection of anomalous actions in video footage and to notify relevant authorities as soon as they are identified. This proactive strategy not only benefits in the avoidance of criminal activity, but it also allows for the quick apprehending of responsible individuals. Our research aims to modernize video surveillance by minimizing delays in anomaly detection using advanced technology. We want to improve the efficiency and reactivity of video surveillance systems by adding AI and ML, so contributing considerably to the overall safety and security of public spaces.**

Keywords: Identification of anomalous activities, video surveillance

I. INTRODUCTION

The discovery of odd events such as traffic accidents, robbery, or illegal behavior is a major goal of video surveillance. Most contemporary monitoring systems still require human operators and manual scrutiny, although this is prone to interruptions and fatigue. As a result, good computer vision approaches for detecting video anomalies/violence are becoming more important. Developing algorithms that detect certain abnormal occurrences, such as violence detectors, fight action detectors, and traffic accident detectors, is a modest step toward overcoming the issue of anomaly detection. Our initiative aims to accomplish the same thing: to make it easier to discover unusual occurrences. We hope to accomplish this through the use of artificial intelligence and machine learning technologies.

Human activities are classified into two types: normal and abnormal. Normal activities are those that do not hurt the individual or the environment, whereas abnormal actions are those that deviate from normal conduct and harm the person or the environment. Using AI/ML techniques, we hope to make it easier to spot unusual events in private assets such as dwellings. Our solution consists of a surveillance camera installed in households such as single-family homes and apartments that records video and turns it into frames for human detection.

Our system involves a surveillance camera set up in residences like independent houses and apartments, that captures video and converts it into frames for human detection. Once a human is detected, the data is used to train an activity detection system. This system then classifies the detected human activity as either normal or abnormal. If the activity is determined to be abnormal, for example, a person trying to trespass, an alarm is triggered, and the concerned authority is notified.

In this project, our focus is on the reduction of the entire process of investigation that takes place once a crime is committed. To do so, once the anomalous activity is detected, the concerned is notified immediately so they can take necessary actions.

II. LITERATURE SURVEY

You Only Look Once (YOLO) is an acronym for an algorithm which excels at real-time object detection. YOLO, which operates as a regression problem, employs CNN for instant recognition of various items within images. YOLO is distinguished by its detection capability of objects with a single forward propagation through a neural network covering the entire image in a single algorithm run. Using CNN, this method predicts multiple class probabilities with bounding boxes.

The YOLO algorithm has several variants, the most acclaimed of which are Tiny YOLO and YOLOv3. YOLO, meant for its speed, precession, and robust learning capabilities, excels at predicting objects in real- time, increasing detection efficiency.

The YOLO prediction methodology ensures precise results with low background errors, demonstrating its ability to learn object representations for effective detection. In [1,] the YOLOv2 model and YOLO9000 real-time detection systems are employed to identify and categorize objects in video records, demonstrating the YOLOv2's speed and effectiveness in the detection and classification of objects. Furthermore, [2] investigates YOLO LITE, a real-time object identification model designed for portable devices lacking Graphics Processing Units (GPUs), which achieves significant MAP values.

The petition of a CNN architecture in YOLO's single-stage approach to object detection improves recognition speed. YOLOv5 reflects the evolution of YOLO, which is available in four distinct versions [5].

To detect objects efficiently, the YOLO (You Only Look Once) algorithm employs three key techniques:

Remaining Blocks: The input image is first divided into multiple grids of S x S dimensions. Each grid cell can detect items that enter it. For example, if the center of an object appears within a grid cell, that cell is responsible for identifying the object.

Regression with Bounding Boxes: A bounding box in a visual outline an object and includes the following characteristics: length (bw) Height (in feet). YOLO uses a single bounding box regression determine an object's height, width, center, and class.IOU (Intersection Over Union).

Intersection Over Union (IOU): Because of intersection over union, the predicted bounding boxes are equivalent to the actual boxes of the objects. This phenomenon eliminates bounding boxes that do not fit the size of the objects (such as height and width). The final detection will consist of customized bounding boxes that are tailored to the items.

Using Intersection Over Union, predicted bounding boxes are compared to actual object boxes. Bounding boxes that do not correspond to the dimensions of the objects (for example, incorrect height and width) are removed. The final detection yields precise bounding boxes that fit the objects perfectly. These techniques enable YOLO to identify objects in images efficiently, making it sturdy and widely used algorithm in real- time object detection scenarios.

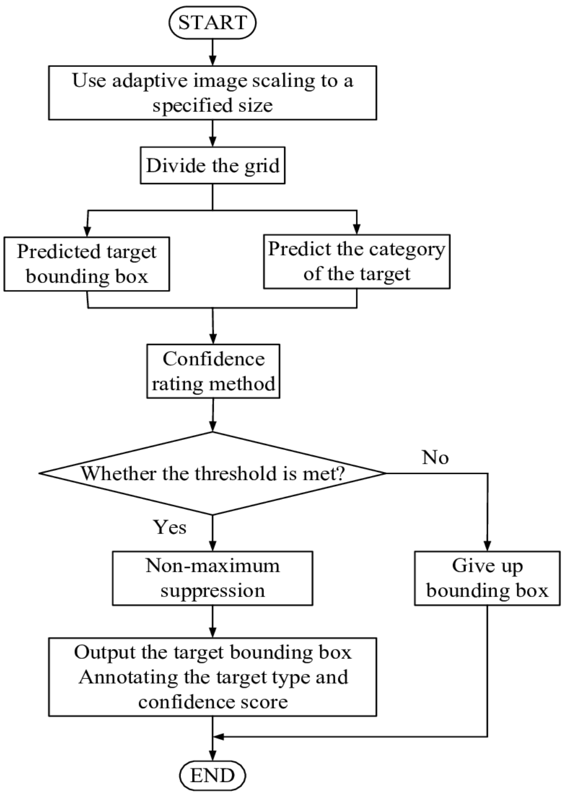

Fig. 1. YOLO Model

III. SYSTEM IMPLEMENTATION

A. Overview

The study focuses on solving the inefficiencies of manual video monitoring through the sought of machine learning and artificial intelligence to achieve automated anomaly detection. It underlines the growing number of surveillance cameras and the importance of constant surveillance to improve public safety. To identify abnormalities such as warfare, abuse, and crashes in traffic, the effort incorporates computer vision methodologies and AI/ML algorithms.

The system is intended for private premises, with security cameras capturing and converting video into frames to detect human movement. anomalies discovered set off alerts, altering authorizes and helping to increased precaution and crime prevention.

A. Proposed Architecture

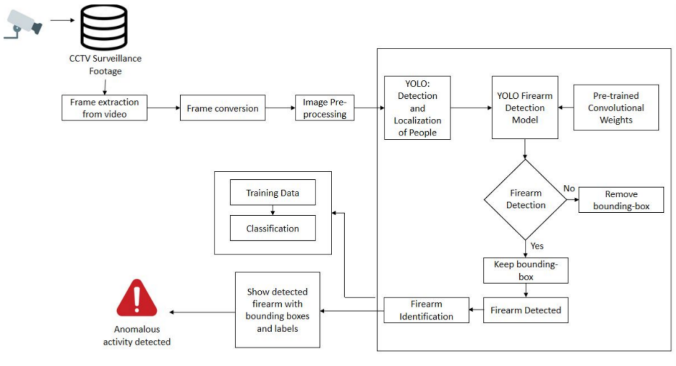

Fig. 2. Architecture

Using a comprehensive methodology, we present a robust video surveillance system built for successful anomaly detection. The first step is to extract raw video frames from the surveillance dataset. The You Only Look Once (YOLO) algorithm, which includes various iterations, is then used to detect objects in real time. The combination of GPU acceleration and Anchor Box approaches improves processing speed and accuracy dramatically.

Person detection is prioritized, followed by complex movement analysis and firearm detection utilizing YOLO. When a firearm is identified, the technology generates real-time alerts that are immediately relayed to necessary authorities. The visual representation, which includes bounding boxes and labels, aids in the clear and understanding portrayal of anomalies.

This architecture takes advantage of YOLO's real-time processing capabilities, allowing anomalies to be identified quickly. Its capacity to adapt to numerous YOLO variants contributes to excellent accuracy and quickness in detecting both people and guns. The rapid alert mechanism allows authorities to respond quickly, while the system's clear visualization improves comprehension and allows for timely action.

In the scenario of video surveillance, the system employs a multi-step process to detect unusual activity, like firearm possession. The initial task is to extract raw video frames from the data set. The system then employs sophisticated algorithms to identify individuals within these frames. When a person is found, system analyzes their movement patterns to ascertain if they are in possession of any firearms.

Fig. 3. Detection of a firearm in footage

When a firearm is detected, the system takes immediate action by sending an alert message to the appropriate authorities. This proactive approach improves the system's real-time response capabilities, responds to potential security threats quickly and effectively. The exactitude of the model is demonstrated by output images, which show its ability to accurately identify firearms and associated risks. The model draws a perimeter box surrounding the suspicious vicinity of the image, displaying a visual representation of the detected firearm. Furthermore, the system labels the identified firearm, which adds an informative layer with relation to the outcome and facilitates a thorough understanding of the situation. This integrated approach combines advanced CV techniques with anomaly detection algorithms to bring out a robust and efficient surveillance system designed specifically for firearm detection.

Fig. 4. Fire Detection In Video Footage

III. RESULTS

The present study represents a significant advancement in the field of video surveillance through the incorporation of artificial intelligence (AI) and machine learning (ML) technologies for automated anomaly detection. The proactive strategy adopted is designed to prevent criminal activities by reducing the time required for the identification of abnormal behaviors. The You Only Look Once (YOLO) algorithm, particularly its variants such as Tiny YOLO and YOLOv3, is recognized for its effectiveness in real-time object detection. The proposed architecture utilizes YOLO for the prioritized detection of persons and firearms, enhancing system responsiveness with a rapid alert mechanism and a clear visualization. The multi-step process implemented for detecting unusual activities, in conjunction with immediate action upon firearm detection, demonstrates the model's accuracy in precise identification as evidenced by the output images. The research contributes to the modernization of video surveillance systems, ultimately enhancing public safety and security.

IV. CONCLUSION

Furthermore, our study tackles the crucial requirement for effective anomaly identification in video surveillance to improve public safety. Recognizing the shortcomings of traditional surveillance systems, we present a solution based on artificial intelligence (AI) and machine learning (ML) technologies, with a special emphasis on the novel You Only Look Once (YOLO) method. The literature review underlines the importance of anomaly detection in numerous applications and the expanding landscape of deep learning approaches, particularly in video surveillance. Notably, the study identifies gaps in real-world deployment parameters and urges a more comprehensive examination to improve the practicability of anomaly detection algorithms. The proposed architecture describes a thorough technique for automated anomaly detection that makes use of YOLO for real-time object detection. Person detection, complicated movement analysis, and firearm detection are prioritized by the system.

REFERENCES

[1] A. P. Jana, A. Biswas and Mohana, "YOLO based Detection and Classification of Objects in video records," 2022 3rd IEEE Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), Bangalore, India, 2022, pp. 2448-2452, doi: 10.1109/RTEICT42901.2018.9012375.

[2] R. Huang, J. Pedoeem and C. Chen, "YOLOLITE: A Real- Time Object Detection Algorithm Optimized for Non-GPU Computers," 2022 IEEE International Conference on Big Data (Big Data), Seattle, WA, USA, 2022, pp. 2503-2510, doi:10.1109/BigData.2018.8621865.

[3] Sarda, S. Dixit and A. Bhan, "Object Detection for Autonomous Driving using YOLO [You Only Look Once] algorithm," 2021 Third Conference on ICICV, Tirunelveli, India, 2021, pp. 1370-1374,doi:10.1109/ICICV50876.2021.9388577

[4] Abirami Sreerenganathan, Vyshali Rao K P and M Dhanalakshmi , "Assistive Application for the Visually Impaired using Machine Learning and Image Processing", 14th ICCCNT IEEE Conference July 6-8, 2023 IIT-Delhi, Delhi, India

[5] J. Redmon, S. Divvala, R. Girshick and A. Farhadi, "You Only Look Once: Unified, Real-Time ObjectDetection," 2021 IEEE Conference on CVPR, Las Vegas, NV, USA,2021, pp. 779-788, doi: 10.1109/CVPR.2016.91.

[6] J. Franklin, Mohana and V. Dabbagol, "Anomaly Detection in Videos for Video Surveillance Applications using Neural Networks," 2020 Fourth Conference on ICISC, 2020, pp. 632-637, doi: 10.1109/ICISC47916.2020.9171212.

[7]]D. Koshti, S. Kamoji, N. Kalnad, S. Sreekumar and S. Bhujbal, "Video Anomaly Detection using Inflated 3D Convolution Network," 2020 International Conference on Inventive Computation Technologies (ICICT), 2020, pp. 729- 733, doi:10.1109/ICICT48043.2020.9112552.

[8] Y. Lu, L. Zhang and W. Xie, "YOLO-compact: An Efficient YOLO Network for Single Category Realtime Object Detection," 2020 Chinese Control and Decision Conference (CCDC), Hefei, China, 2020,pp. 1931-1936, doi:10.1109/CCDC49329.2020.9164580.