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GUARDIANWATCH: AI-POWERED PUBLIC SAFETY SURVEILLANCE

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Abstract

Nowadays, public safety is a key concern, particularly in fast urbanizing areas, urban development plans, and "smart city" projects where strong security measures have been implemented due to new security threats. The increasing trend of urbanization should be reflected in a coordinated approach to establishing efficient urban security systems. Current security systems have numerous constraints, including threat identification, on-the-spot analysis, and communication. These limitations become particularly emphasized in extremely complex urban areas with high populations and a broad range of activities. GuardianWatch, a groundbreaking AI-powered surveillance system, was developed in reaction to the above-mentioned difficulties with the primary goal of improving urban security. Real-time monitoring, detection, and alerting capabilities for a wide range of security concerns are precisely what GuardianWatch does. This includes identifying firearms, detecting physical aggressions, keeping an account of auto accidents, and identifying license plates. To achieve these goals under various urban settings and varying lighting and image quality issues, GuardianWatch employs a variety of cutting-edge artificial intelligence algorithms. This all-in-one innovative platform has tailored its algorithmic approach to the novel urban security settings with innovative artificial intelligence algorithms including YOLO v8, SK's image models, TensorFlow, Haar cascades, and PyTorch.

Keywords:

GaurdianWatch, Public Security, Smart Surveillance, IDS

1. INTRODUCTION

Public safety has become a subject of significant interest in recent times. With the emergence of concepts like the "smart city" and the "safe city," along with various planned urban development initiatives, a robust urban security framework has been put in place. The focus remains on data collection and monitoring activities. Moreover, despite the common practice of simply transmitting video feeds to the cloud for subsequent analysis, there is a lack of emphasis on exploring different dimensions, such as real-time Internet video analysis, enhancing communication, or streamlining the deployment of security protocols. Additionally, the intricate nature of urban environments and the presence of large crowds render the precise identification of various behaviours unnecessary.

GuardianWatch, a surveillance system for public safety empowered by artificial intelligence, signifies a notable progression in the domain of public safety and security. By harnessing the capabilities of AI, GuardianWatch has been crafted with the purpose of continuously monitoring, detecting, and promptly notifying relevant authorities about various security concerns in real-time. The functionalities of this system encompass a wide spectrum, including the identification of firearms, physical altercations, car accidents, and license plate numbers. Moreover, it is equipped to oversee the movement of vehicles on the streets and issue alerts in instances where a vehicle surpasses the speed limit. Despite the inherent obstacles posed by real-world conditions, such as variations in lighting, image clarity, and intricate scenarios, GuardianWatch is committed to upholding a commendable standard of precision and dependability. This groundbreaking system exemplifies the potential of artificial intelligence in enhancing public safety, thereby positioning it as a valuable subject for examination within the realm of AI research.

Some drawbacks that we encountered from previous research papers were as follows: Cloud video analysis may cause latency and communication overhead, while limited training data for the PyTorch model can lead to inaccurate gun detection predictions [1]. YOLOv3's detection accuracy struggles in complex environments, with challenges in identifying multiple objects and diverse scales, making the verification process resource-intensive [2]. BFAN and blur mapping networks face limitations in object recognition due to poor image quality, resolution, or insufficient capture of distinctive features [3]. Identifying people in photos and videos faces challenges due to variations in body positions, clothing, lighting, and complex situations, while non-parallel background sampling is computationally demanding. [4]

GuardianWatch comes with a range of safety and security enhancements. One notable feature is the weapon detection system, which can identify firearms within its view. Another important aspect is the combat detection parameters, designed to recognize altercations based on criteria, like the presence and intensity of a fight in an image. Additionally, the system includes a vital car crash detection feature to promptly respond to accidents. It also boasts a license plate recognition function, for identifying vehicle plates. Lastly the Live Car Detection and Speed Alert feature monitors moving vehicles on the road. Alerts you if a car surpasses the speed limit.

2. LITERATURE REVIEW

Ahmed A et al. [1] Hawk-Eye is one of the most advanced surveillance systems designed to use AI and IoT to independently track threats to security. Featuring a Raspberry Pi 3, Intel NCS 2, and Logitech C920 webcam, it is capable of detecting individuals dressed in masks and possessing weapons in different positions in the body and abnormal traffic patterns. Both cloud servers and edge-based cameras are possible implementational options for this flexible deployment, which makes use of CNN models for image classification and motion detection for recording any new activity. This edge computing strategy lowers the delay, which in turn shortens response time. The segmentation masks, confidence scores, and classification times of the system increase the effectiveness. Hawk-Eye may improve imprecise passive surveillance capabilities to proactive safety by preventing violent occurrences in public spaces.

Xia et al. [5], Abnormal behavior detection is one of the improvements made in urban security by DS-YOLO algorithm, designed by Smart City Security System (SCSS) using YOLOv4

and DeepSORT. SCSS utilizes GPS and WiFi to detect anomalies in real time with the help of TensorRT and DeepSORT integration with YOLOv4. This system is capable of boosting the surveillance of crowded areas by identifying dangerous conducts, thus contributing to the development of smart cities. The fact that it has real-time capabilities which enhance public safety as well as promoting intelligent urban growth makes SCSS a significant improvement from traditional setups.

Hong et al. [2], In the YOLOv3 framework, the paper presents a vehicle detection model that makes use of Darknet53 and PyTorch. Its main objective is to identify multi-scale vehicles, especially small ones in intricate traffic situations. Scale variance is handled by the model using a multi-level feature pyramid structure based on codecs, and 3x3 convolution layers are used for both upsampling and downsampling. It shows remarkable detection performance in a range of environments, with small target identification being its strongest suit. Powered by non-maximum suppression and clustering, the model guarantees accurate vehicle frame recognition. It makes a substantial contribution to the field of video surveillance research due to its wide range of applications, which include intelligent transportation systems, vehicle tracking, license plate recognition, and traffic analysis.

Wu et al. [3], The research proposes the implementation of a Deep Blur Mapping (DBM) network to assess object blur levels together with a Convolutional Neural Network (CNN) for feature extraction and classification. For enhanced video object detection precision, the Blur-Aid Feature Aggregation Network (BFAN) has been designed to aggregate blurred traits like motion blur and defocus. By evaluating the degree of blurring, DBM network clearly distinguishes between motion and out-of-focus blur. This advancement provides increased accuracy and dependability in detection which is vital for robots, autonomous vehicles and video surveillance.

Paul et al. [4], To detect human activities in surveillance footage, several techniques, that is, background subtraction optical flow and spatio-temporal filtering are combined. There are several human-like motion-based, texture-based, and shape-based features of moving objects whose shapes can be described with blobs, boxes, and points. This process achieves many things such as; person identification where gender categorization falls under it while traffic monitoring is part of it. Human gait analysis is another function carried out by this method among abnormal event detection and fall detection for elderly people. Prompt identification of anomalies by accurate human detection sustains the efficiency of video surveillance systems. Such applications as person tracking, pedestrian detection, people counting, geriatric fall detection have been made available through efficient security provision in various settings concerning human activity. For better surveillance systems' capabilities improvement, the point is to identify individuals on videos using different tools to respond to possible threats quickly enough.

3. PROPOSED SYSTEM

The main goal of GuardianWatch is to amplify the level of public safety through the identification and prompt response to occurrences of road accidents and pedestrian incidents, as well as potential risks like acts of violence, vehicles exceeding speed limits, possession of firearms unlawfully, and the presence of unauthorized vehicles, all achieved by leveraging an AI-driven surveillance system. Within the framework of this system, there is extensive coverage that involves the continuous real-time monitoring of various public areas, which encompass but are not limited to roads, intersections, and pedestrian pathways, facilitated by the utilization of cameras and sensors for the purpose of recognizing and notifying relevant authorities about any potential safety threats and risks that may arise.

4. ALGORITHMS

4.1 YOLOV8

The YOLOv8 algorithm is a state-of-the-art development, in object detection enabling identification and categorization of objects in video streams. By using YOLOv8 GuardianWatch can swiftly spot vehicles involved in traffic incidents and people, in areas speeding up emergency response and assistance delivery. [6]

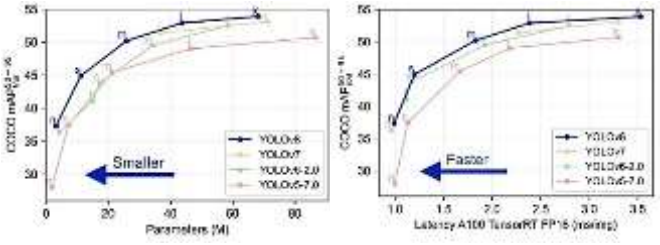

Fig.1. YOLO-v8 comparison with predecessors [6]

4.2 SCIKIT-IMAGE (SKIMAGE)

Python-based Scikit-learn is a general-purpose machine learning library. It offers effective applications of cutting-edge algorithms that are reusable across scientific domains and application fields, understandable to non-machine learning specialists. Additionally, it makes use of Python's modularity and interaction to provide quick and simple prototyping. [7]

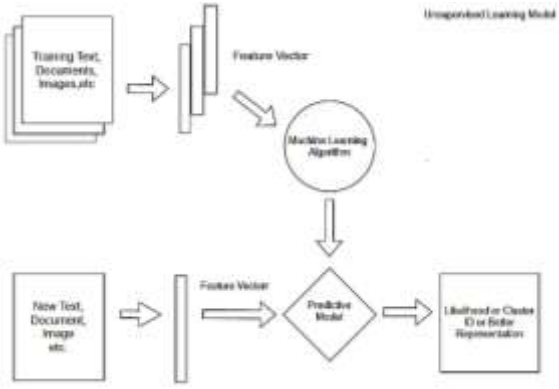

Fig.2. Flow of sci kit image

4.3 TENSORFLOW

GuardianWatch uses TensorFlow to identify and analyze license plates enabling the extraction and interpretation of letters and numbers, on vehicle plates. TensorFlow has the capability of automatic differentiation.[8] This enhancement boosts the

system's ability to identify and track vehicles involved in accidents or violating traffic regulations.

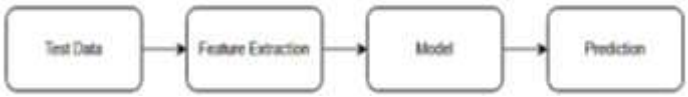

Fig.3. Flow of tensorflow

4.4 HAAR CASCADE

GuardianWatch uses Haar Cascade technology to monitor vehicle speeds enabling real-time detection and recognition of speeding incidents. This feature plays a role, in enhancing road safety by alerting authorities to hazards and ensuring compliance, with speed limits. Haar wavelet-based characteristics resembling Haar. A single rectangle-shaped Haar wavelet the square is depicted in two dimensions using white and dark. If the outcome is higher than the threshold value, the value of Haar-like features is present by decreasing the average value of the pixel in the dark and white areas.[9]

Fig.4. Feature Extraction [9]

4.5 PYTORCH

PyTorch is a library for Python programs that encourages deep learning programs.[10] PyTorch is employed to detect firearms and possible dangers in public areas, thereby allowing GuardianWatch to promptly recognize and address security risks. This advancement in technology bolsters public safety by identifying and discouraging criminal behavior in real time. GuardianWatch seeks to improve existing surveillance systems by using AI algorithms and advanced image processing techniques to enhance detection and response capabilities. By integrating a variety of algorithms that can identify safety threats, GuardianWatch offers a method for public safety monitoring that enables authorities to proactively address incidents and protect citizens. The system's ability to monitor in real-time, along with its skill in identifying and evaluating safety risks, introduces new approaches to improving public safety and emergency response efforts.

5. IMPLEMENTATION

The Fig.5 shows the guns that are getting detected in the system.

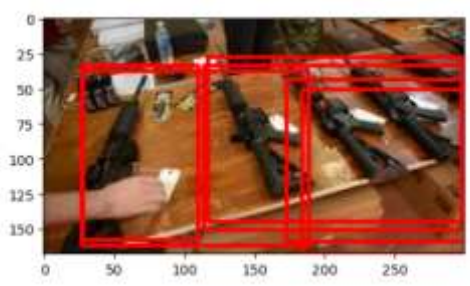

Fig.5. Guns getting detected

The following image Fig.6 and Fig.7, its shows the parameters which are fight, percentage of fight and its processing time. Here the video is being processed.

Fig.6. Fights getting detected i.e. True

Fig.7. Fights getting detected i.e. False

The Fig.8 shows the crash of car that happened in the image.

Fig.8. Car accident getting detected

The Fig.9 shows a green rectangle box around the number plate which is getting detected.

Fig.9. Number plate getting detected

The following image Fig.10 and Fig.11, shows Live detection of cars moving on road and an alert message when car exceeds the speed limit.

Fig.10. Cars getting detected

Fig.11. Alert when over speeding

6. CONCLUSION AND FUTURE SCOPE

GuardianWatch is an AI-assisted surveillance system that helps to increase public safety by identifying and mitigating threats like violent activities, high speed driving, illegal possession of firearms as well as road traffic accidents and pedestrians' incidents. It employs camera and sensors in monitoring public spaces so that authorities are notified. And GuardianWatch app has weapon detection system, combat detection parameters, license plate recognition, auto crash detection, live car detection and speed alert. Its vision can identify weapons within its line of sight; the number of fights per centage wise in the picture can suggest any physical altercations; users will be alerted for any speed limit violations when a vehicle moves on the road. It is estimated that GuardianWatch may accelerate analysis of CCTV data, which could be essential in emergency situations to save lives of ordinary citizens. This is also going to become essential in finding the guilty ones behind perpetrators of violent crimes. Next time around we shall eliminate bad inputs where it does not affect image quality of inputs under contention. These include reducing visibility as well as minimizing traffic to lessen effects of unaccounted-for variables like lightning strikes or number of people fighting. Lastly, we handle the rare input change, such a dirty or broken license plate, and avoid false alarms when the car suddenly changes its speed or body trajectory.

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