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Smart Surveillance System for Highways

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Abstract: ***In today's world, everyone on the planet is concerned about security. Every citizen wishes to eliminate the possibility of a future threat to himself or his possessions. This tremendous increase in the need for security needs for individuals and organizations necessitates the installation of an appropriate and up-to-date surveillance system. Real-time video surveillance has become an essential component of the transportation system. It also prevents accidents and other difficult issues on highways for a transportation system. With numerous advancements, various machine learning and artificial intelligence-based techniques are progressing to handle such issues via smart surveillance systems. Various researchers have contributed various techniques for vehicle detection and tracking to the literature. These methods are both effective and time-consuming. For the safety and security of people and their resources, proper surveillance is critical. The innovation of an aerial surveillance system could be very efficient at addressing surveillance system challenges. Current systems are both costly and complex. A cost-effective and efficient solution that is easily accessible to anyone with a moderate budget is required. Highways are a critical component for transportation purpose, and it is necessary to make them as secure as possible.***

Our project aims to prepare a model in which surveillance cameras will be used to detect any accident or any unusual activity happening on the highway. This paperwork has concentrated on the investigation of various methods, currently accessible datasets, and current AI- and ML-based techniques that may be applicable in the future. This research focuses on metrics like speed measurement, vehicle counting, feature extraction, detecting driver behaviour, traffic flow prediction, surveillance, and so on. This article additionally illustrates existing research for deep learning, machine learning, and artificial intelligence-based methodologies to solve more complex problems. Real-time processing, an important issue that has yet to be fully explored in this field, is also considered. There are a few methods for dealing with all these issues at the same time. The flaws in existing methods are identified and summarized. Future directions are also provided to reduce the identified obstacles.

I. INTRODUCTION

Artificial intelligence enables computers to think like humans. Machine learning smooths the path by incorporating training and learning components. The accessibility of huge datasets and high-performance computers paved the way for the concept of deep learning, which automatically extracts features or factors of variation that distinguish objects from one another. Video surveillance data is one of the many data sources that contribute to the terabytes of big data that exist today. The wide availability of surveillance data from cameras installed in residential areas, industrial plants, educational institutions, and commercial firms contributes to private data, whereas cameras installed in public places such as city centres, public transportation, and religious institutions contribute to public data. Current world events have led to a change in the security paradigm from "enquiry of incidents" to "prevention of potentially devastating incidents". Modern digital video surveillance systems simply offer the infrastructure for capturing, storing, and distributing video, leaving human operators solely responsible for threat detection. Monitoring surveillance video with humans is a time-consuming task. It is widely acknowledged that watching video feeds necessitates a greater level of visual attention than most everyday tasks. Vigilance, or the ability to pay attention and react to rare events, is particularly demanding and prone to error due to lapses in attention. In the years since, the concept of smart transportation has been constantly enhanced and refined, spawning numerous new technical forms such as smart highways, smart pavements, and smart infrastructures. Video police investigation is additionally the most cost-effective option because it does not necessitate major expenditures or infrastructure changes.Road traffic is a major issue around the world. Traffic jams are common in countries all over the world. Researchers all over the world are working to find a solution to this problem. Various options and approaches are being considered to solve or at least mitigate this problem. A traffic police investigation is also considered as a possible solution to the problem. Intelligent Traffic Systems resolves issues such as incident detection, traffic monitoring, traffic rule violations, real-time traffic updates, and automotive vehicle mated traffic signals. Intelligent traffic system management and increased access to real-time and historical data assist commuters in planning their route. It may help to reduce congestion and also the number of accidents occurring on the highways. An important aspect of this research is object recognition and detection.

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II. NEED FOR STUDY

Despite significant advances in surveillance systems on the highways, existing systems still face challenges in accurately and efficiently solving many of the traffic problems that arise due to a variety of reasons. Furthermore, security concerns are increasingly important considerations in the country, as many of the accidents that occur are not attended to causing severe fatalities. To address these challenges, this project aims to develop a smart surveillance system that leverages the latest deep learning and machine learning techniques to achieve high accuracy, speed, and scalability, while also prioritizing privacy and security by incorporating robust encryption and authentication mechanisms. The system will be trained and tested on a large and diverse dataset of images and videos and will be evaluated based on various performance metrics such as recognition rate, false positive and false negative rates, and processing time. The project will greatly help in detection of crimes on the highway as well as report any mishap that occurs on the highway and in this way, we can save people's lives.

III. SCOPE

Today, along with drones, AI and IoT, facial recognition technology is also defining our millennium. Facial recognition is a biometric technology used for authentication and examination of individuals by correlating the facial features from an image with the stored facial database. Face Recognition is one of the most popular applications of image analysis software and no more considered as a subject of science fiction. Earlier, this technology was only used for security and surveillance purposes, but it has safely transitioned to the real world in recent times. Today, companies are pitching facial recognition software as the future of everything from retail to policing.

A facial recognition system is used to identify and verify a person from an image or video source. It uses biometric software's along with AI enabled devices for mapping facial features and brings out the recognition step. Facial recognition software differentiates a face from rest of the background in the image. The software first recognizes the face then measures different facial features. The software recognizes these features as nodal points. A human face consists of 80 nodal points. After measuring these features a numerical code for the same is created and stored in the database. This is known as the faceprint.

Earlier the software relied on 2D image to identify or verify another 2D image from the database but today it uses a 3D model for the same. This 3D model is more reliable, better, effective and accurate than its 2D counterpart. Using the 3D software, the system goes through a series of steps, facial recognition forming the last one.

The future of facial recognition technology is bright. Forecasters opine that this technology is expected to grow at a formidable rate and will generate huge revenues in the coming years. Security and surveillances are the major segments which will be deeply influenced. Other areas that are now welcoming it with open arms are private industries, public buildings, and schools. It is estimated that it will also be adopted by retailers and banking systems in coming years to keep fraud in debit/credit card purchases and payment especially the ones that are online. This technology would fill in the loopholes of largely prevalent inadequate password system. In the long run, robots using facial recognition technology may also come to foray. They can be helpful in completing the tasks that are impractical or difficult for human beings to complete.

IV. OBJECTIVE

The objective of this project is to design, implement, and evaluate a surveillance system using state-of-the-art deep learning techniques, with the goal of achieving high accuracy, speed, and scalability. The system should be able to detect and recognize vehicle accidents from a large and diverse dataset of images and videos, and accurately identify individuals even under challenging conditions such as variations in pose, illumination, expression, and occlusion. Additionally, the project aims to explore different approaches for data preprocessing, feature extraction, and model optimization, and investigate the impact of different factors on the performance of the system, such as the size of the dataset, the choice of neural network architecture, and the use of transfer learning. Finally, the project aims to demonstrate the practical utility of the system by deploying it in a real-world application scenario and evaluating its performance and usability.

V. METHODOLOGY

The fundamental goal is to locate an object in static images or video frames for complex object behavioral patterns, such as infringing vehicle movement, it is difficult to find features and algorithms that will handle the huge variety of instances of the object class. Thus, vehicle detection in a constrained environment is an open problem. When the appearance is contaminated by noise, recognition errors occur. We recommend a vehicle surveillance system in this paper that can detect, track, and acknowledge vehicles in various video sequences.

Only one camera, still mounted on a pole and looking down on the observed highway, is used in this system to monitor different vehicles. Initially, various vehicles are retrieved from video sequences using the image subtraction technique. Because this technique is sensitive to changes in lighting, the background is modelled using an adaptive background updating method. To count the vehicle, an algorithm written in OpenCV (Intel® open-source Computer vision library) will be used. Tracking objects will be accomplished by using a smart camera that encompasses frames and detects illegal driving of vehicles on highways and motorways before sending the image signals to the main server. Images may also be saved in a server for future use, while the smart camera performs image processing for potential dangers. The system's goals will be as follows: direct streaming, updating the background directly frame by frame, real-time tracking of all moving vehicles by placing them inside a box, then detecting and saving all illegal driving of the vehicles. The primary goal of this project is to detect and count vehicles as well detect any unusual activity from an IP camera feed to provide an idea of the real-time on-street situation across the road network. subsequently save the video data set and the detailed data set for future projects such as traffic prediction, toll collection, and traffic flow. This will help in saving lives of people involved in an accident. We will, for instance, place cameras along the highway at 1km intervals and the camera will perform the surveillance. If anything, unusual is recorded, then the images will be sent to the nearest headquarters, and they will do the necessary.

A. Hardware Module

To implement a surveillance system and identification system in CCTV cameras, you would need the following hardware modules:

1) *Camera:* The first hardware module you need is a camera to capture images of people's faces. CCTV cameras are a good option as they are already commonly used for surveillance purposes
2) *Computer:* A computer is required to process the facial recognition algorithms and store the facial recognition system software. A dedicated computer with a powerful processor and graphics card is recommended for fast processing and accuracy.
3) *GPU:* A graphics processing unit (GPU) is recommended to speed up the processing of facial recognition algorithms. GPUs are much faster than CPUs when it comes to complex mathematical computations such as those involved in deep learning.
4) *Storage:* Storage is required to store the facial recognition system software and the database of face templates. A solid-state drive (SSD) is recommended for fast access to data.
5) *Network Connection:* A network connection is required to communicate with the central server that stores the face templates and to send alerts in real-time when a match is found.
6) *Power Supply:* A stable power supply is required to power the CCTV camera and computer system.
7) *Enclosure:* An enclosure is recommended to protect the hardware from damage due to weather or other environmental factors.

VI. DISCUSSION

A. Smart Surveillance System -Literature Survey

In India, the use of vehicles on the road is skyrocketing. As a result, red-light violations are on the rise. Such violations increase the number of traffic accidents. As a result, CCTV cameras are installed at traffic lights to monitor and control traffic flow. The main component of the Smart Surveillance System is the development of an automated Red Light Violation Detection (RLVD) system. The current surveillance system used in a few other developed city areas includes the use of sensors and electronics to turn on cameras during red light periods, as well as image processing or sensors to detect red light runners. The interdependence of sensor networks and video processing techniques complicates the system. To address this issue, a surveillance system based on video processing techniques is being researched. This paper examines current surveillance systems and the various methodologies available for object detection, red light violation detection, and number plate recognition. It has been discovered that using Haar-like feature extraction and haar for classification improves the accuracy of vehicle detection. Background subtraction produces accurate occlusions for the red-light detection system, while OCR produces the best results for the number plate recognition system. The basic strategy is to generate new key Haar-like features from new training data and combine them with previously generated key Haar-like features. This dramatically improves the algorithm's performance. The experimental results show a higher accuracy rate, which can be used in real-time application.

B. Real-Time Surveillance Using Deep Learning

Every citizen wishes to eliminate the possibility of a future threat to himself or his possessions. This tremendous increase in the need for security needs for individuals and organizations necessitates the installation of a proper and up-to-date surveillance system. Existing systems are costly and difficult to operate.

As a result, a system that can account for security concerns while remaining simple is essential. A cost-effective, simple, and efficient surveillance system is required for every organization, whether public or private, for internal monitoring and post-event analysis. Many robotic applications are currently being developed to perform tasks autonomously without the need for human intervention. A system that allows a robot to conduct surveillance, such as detecting and tracking a moving object, will lead us to a more advanced task. The drone serves as a flying robotic platform for the role of UAV (Unmanned Aerial Vehicle) AR. In terms of implementation, they created an algorithm to detect and track an object by analyzing its shape and color. Unmanned Aerial Systems (UAS) are classified into various transportation engineering areas. The systems are highly compatible with traffic analysis and groundwork. Such studies are beneficial for comprehending and employing UAS in transportation.

By increasing the number of trespassers detected by the quadcopters, a heuristic-based scheduling algorithm is used. In addition, techniques for localizing sensors using RFID technology, as well as optimal computing positions and relay data between isolated islands of nodes, were used to assess the performance of the WSN-based surveillance system. In another paper This study investigates a deep learning-based security and surveillance method for a company, institution, or other official procession. The surveillance system communicates with the control room in real time. The air surveillance system validates individual and community protection by notifying relevant departments about vulnerabilities to lay the groundwork.

C. Camera based Smart Surveillance System

We have mentioned a few approaches that helped us solve this problem. While deep learning eliminates all of the drawbacks of other techniques, it does require the development of a feature extractor. CNNs are the most effective and efficient way to classify images. CNNs can be trained on a large-scale database and then their learnings can be enhanced and used in other tasks that require less training data. Haar Cascade features include the ability to detect objects in a cluttered background under varying conditions such as illumination, position, object size, and position. The Haar Classifier detects objects in low-light conditions by comparing the contrast values of adjacent rectangular groups of pixels rather than the intensity values of the pixels. The Haar Cascade classifier will detect human faces in a video frame and save the cropped image for further processing, where the pretrained CNN model will classify it and provide us with information about the specific person. We discussed data collection, storage, and analysis techniques for CCTV camera surveillance in this paper. We discovered that conc cascade was useful for feature extraction and tuning systems that worked in tandem with deep learning models. Images could be be stitched using the Image Mosaicing technique, and camera position limitations were removed. Thus, among the many methods of collecting camera input, we found the IP-based camera technique on a distributed network to be useful, and the CNN model to be useful for detail analysis.

D. Information about smart surveillance system

Video surveillance systems are one of the most common real-time applications. Human presence is no longer required to monitor activities captured by video cameras thanks to video surveillance systems. Another advantage of visual surveillance systems is that videos can be saved and analysed for future reference. Traffic surveillance is an important application of video surveillance systems. Vehicle detection, tracking, traffic flow estimation, vehicle speed detection, vehicle classification, and other functions are performed by video traffic surveillance systems. Vehicle classification is required when calculating the percentages of vehicle classes on state-aid streets and highways. Vehicle detection and tracking is a popular application of traffic surveillance systems. We can detect vehicle velocity, trajectory, traffic density, and so on by detecting and tracking vehicles. Another application would be to create an accident detection module at roadway intersections using video processing and then report the detected accident along with the crash video to the appropriate authorities so that immediate action can be taken, potentially saving thousands of lives and property. The main advantage of video monitoring systems over existing systems such as magnetic loop detectors is the cost efficiency involved in installing and maintaining these video systems, as well as the aspect of video storage and transmission to analyse the detected events.

VII. FEATURES OF PROPOSED SYSTEM

Moving cars will be detected on the highway and as an unusual activity is recorded, it will be captured and sent to authorities. The users can contact the authorities themselves by sending an alert. Appropriate actions will be taken according to the depth of the issues. The use of haar cascade classifier and OpenCv have proved useful in this project. Deep learning has also been included in some areas. We are optimistic about the positive modifications this platform will bring to our community, and our efforts highlight the significance of ongoing innovation in the provision of transport services. We think that this platform will help create a more effective and efficient surveillance system in addition to revolutionizing the way accidents are dealt with. This demonstrates our dedication to using technology to the advantage of both the general people and the government.

VIII. CONCLUSION

Overall, surveillance technology is a rapidly evolving field with many opportunities for innovation and development. As the technology continues to improve, it has the potential to transform many aspects of our lives, from security and safety to convenience and personalization.

This research is conducted by designing and testing motion detection and face recognition on a CCTV video. Motion detection using ADI method shows 92.655% success rate. Average time needed to take a decision on motion detection process is 1.115 second.

Vehicle and facial detection using Haar Cascade Classifier produces a 76% success rate. Training data using CPN algorithm results 0.0455 MSE with a 94.286% success rate. Face identification by applying training data value and pattern extraction using SURF and PCA results 60% success rate.

The ideal time for processing is under 0.1 second per frame, while in this research it takes 0.202 second. It can be concluded that the total time of face recognition process of this research results a significant time delay. The testing result, both accuracy and time which resulting delay, shows that this research needs more improvement.

IX. ACKNOWLEDGEMENT

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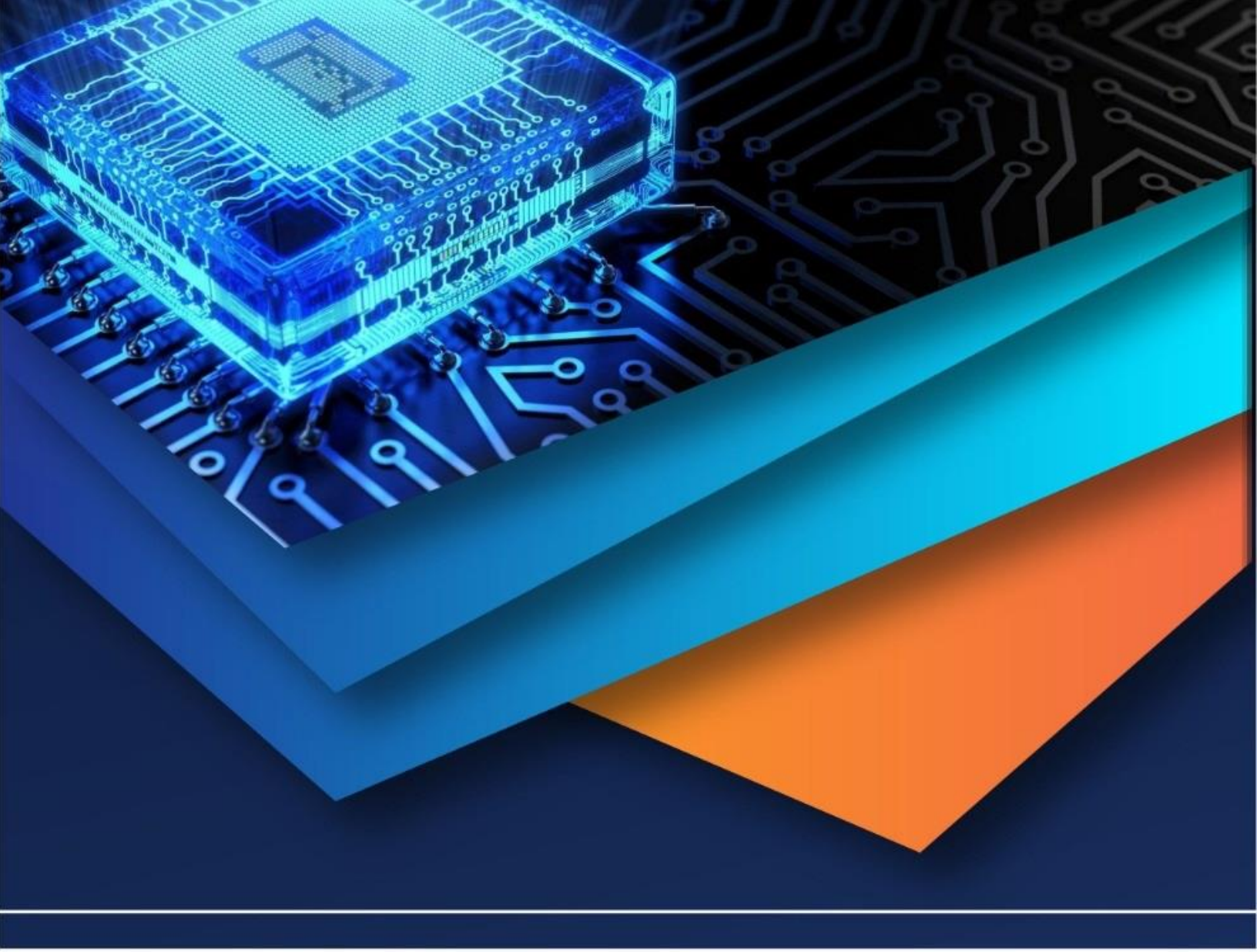
REFERENCES

[1] Wahab et al. (2018) [Wahab, A. W., et al. (2018). Real-Time Face Recognition using Convolutional Neural Networks. International Journal of Computer Applications, 179(32), 32-39]
[2] Facial Recognition using Neural Networks" by El-Khouly et al. (2020) [El-Khouly, M. A., et al. (2020). Facial Recognition using Neural Networks. International Journal of Advanced Computer Science and Applications, 11(2), 91-96
[3] Deep Face Recognition: A Survey" [Zhang, L., et al. (2016). Deep Face Recognition: A Survey. arXiv preprint arXiv:1804.06655]
[4] Smart Surveillance System -Literature survey [Prajwal Dambalkar, Akshay Gupta, Atharva Pande, Ashvini Ladekar]
[5] Information about traffic management - literature survey[Kavi Dilip Pandya1 1 (Information and Communication Technology Institute Of Engineering and Technology/Ahmedabad University, Ahmedabad/India)]
[6] Camera based Smart Surveillance System-Literature Survey [Ishan Kokadwar, Anurag Kulkarni, Sayali Khare, Vaibhav Limbhore, Swati Chandurkar]
[7] Real-Time Surveillance Using Deep Learning [Muhammad Javed Iqbal,Muhammad Munwar Iqbal,Iftikhar Ahmad,Madini O. Alassafi,Ahmed S. Alfakeeh,and Ahmed Alhomoud]
[8] Literature Survey on Smart Surveillance System [Shubham Thakare, Rishabh Paunikar, Utkarsh Anuse, Prof. B.W. Balkhande]



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