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REAL TIME TRAFFIC ACCIDENT DETECTION BASED ON THE DERIVATIVE OF TRAFFIC PARAMETERS

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Abstract:

This novel approach for real-time traffic accident detection by leveraging the derivative of traffic parameters. Through a comprehensive study, both the traffic flow and occurrences of vehicle accidents are analyzed on a daily basis. The investigation reveals a correlation between the fluctuations in traffic flow and the incidence of accidents on roadways, indicating a potential predictive relationship. The proposed system utilizes surveillance camera video records for real-time monitoring of public traffic conditions, with a specific emphasis on crowded situations. To enhance accuracy and efficiency, a deep learning in Convolutional Neural Network (CNN) algorithm is employed to analyze the video data. The primary objective is to promptly identify potential accidents or emergencies and notify police stations, thereby facilitating timely and effective response measures. This innovative approach combines the analysis of traffic parameters with advanced video processing techniques to create a robust real-time accident detection system, contributing to the enhancement of overall road safety and emergency response capabilities.

Keywords — Encrpted domain motion information,Recurrent neural network,Convolutional neural network.

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I. INTRODUCTION

The associated with urban traffic organization and the imperative to enhance road safety have spurred innovative research in the field of real-time traffic accident detection. This article focuses on a unique methodology that delves into the imitative of traffic parameters as a pivotal element for promptly identifying and responding to traffic accidents. A comprehensive analysis of both daily traffic flow and vehicular accidents reveals intriguing patterns, particularly discernible in the fluctuations of these parameters. Leveraging the wealth of information available through surveillance camera video records, this study concentrates on real-time monitoring of public traffic, with a explicit emphasis on crowded situations. To harness the power of deep learning, a Convolutional Neural Network (CNN)algorithm is integrated into the system, providing a sophisticated means of processing video data. The ultimate goal is to establish an effective early-warning system capable of promptly notifying police stations in the event of potential accidents or emergencies. This research amalgamates the realms of traffic parameter analysis and advanced video processing, presenting a cutting-edge solution for real-time accident detection, thereby contributing significantly to the enhancement of road safety and emergency response mechanisms.

II. DEEP LEARNING

Deep learning can be defined as the process of machine learning and artificial intelligence that is intended to intimidate humans and their actions based on certain human brain functions to make

valuable decisions. It is a very important data science element that channels its modelling based on data-driven techniques under predictive modelling and statistics. To drive such a human-like ability to adapt and learn and to function accordingly, there have to be some strong forces which we popularly called algorithms. The multiple hidden layers to model complex patterns or representations from data. These algorithms are capable of automatically learning hierarchical representations of data, which allows them to capture intricate patterns, make predictions, and perform tasks such as image recognition, speech recognition, natural language processing, and playing games. Deep learning algorithms typically consist of multiple layers of interconnected nodes, or neurons, organized into input, hidden, and output layers. Each neuron in a layer receives input from neurons in the previous layer, processes it using an activation function, and passes the output to neurons in the next layer. The connections between neurons are weighted, and these weights are updated during the training process to optimize the model's performance. One trendy deep learning algorithm is the Convolutional Neural Network (CNN), which is commonly used for image and video processing tasks. CNNs use convolutional layers to automatically learn local patterns in images, and pooling layers to reduce spatial dimensions while retaining important information. Another commonly used deep learning algorithm is the Recurrent Neural Network (RNN), which is well-suited for sequential data processing tasks such as speech recognition and language modelling. RNNs have recurrent connections that allow them to maintain a memory of precedent inputs, making them suitable for processing sequences of data. It require large amounts of labeled data for training, as well as substantial computational resources for training and inference. However, they have shown remarkable performance in a wide range of applications, and have been widely adopted in fields such as computer vision, speech recognition, natural language processing, and autonomous vehicles, among others.

III. RELATED WORKS

2.1 SMART ACCIDENT DETECTION AND ALERT SYSTEM[2021]

Arnav Chaudhari; Harsh Agrawal [1] discussed with street car crashes are a major public health issue as they bring about substantial loss of lives, property, and time. Clinical help given promptly will save many lives. This paper presents a smart mishap detection and caution system that notifies the emergency contacts of the user when a mishap happens by sending a message with the detected location. At the point when the vehicle is in a mishap, the vehicle's sensor distinguishes it promptly and sends an SMS to the crisis contacts. There is a reset button that can be pressed to prevent the alarm from being sent to the crisis contacts in an event where everybody inside the vehicle is safe. In recent times the number of vehicles on the road has increased at an alarming rate, even faster than the economy and population. Since 2009, when the first Global Status Report on Roads was released by WHO, India has been at the top of the list of countries with the highest number of road fatalities. It has a six-million-kilometer road network, making it one of the busiest countries in terms of road traffic. Road traffic injuries and fatalities are increasing at an alarming rate. According to government reports, 50 percent of India's road traffic deaths could have been avoided if the victims had received basic trauma treatment within the first hour after the crash.

2.2 ROAD ACCIDENT DETECTION USING MACHINE LEARNING[2021]

Bharath Kumar M; Abdhul Basit [3] discussed with preventing or detecting the car accidents involves lots of studies and researches. In this case, most of the researches includes detecting objects which may or might result in accident. In the system we proposed, a system is designed in such a case that it detects when the accident happens and it will be gone through. This proposed system will gather appropriate information from vehicles that are adjacent to each other and process the data with the help of machine learning tools which are used to detect accidents that are possible

to happen. Machine learning techniques has given success on differentiating abnormal behaviors than normal behaviours. The system's main goal is to examine behavior of the traffic and consider the vehicles that move to different than the present traffic as an road accident.

2.3 SECURE DEEP LEARNING FRAMEWORK FOR MOVING OBJECT DETECTION IN COMPRESSED VIDEO[2023]

XianhaoTian; PeijiaZheng [16] discussed with in the cloud, there is an urgent need to implement intelligent video surveillance in a privacy-preserving way. Moving object detection is an important task in the intelligent surveillance system. In this paper, we propose a privacy-preserving deep learning framework to detect moving objects on compressed videos. We encrypt video bit streams using selective video encryption to protect the private video content. We propose encrypted domain motion information (EDMI) without decryption and decompression to design three motion feature maps. Due to the sparsity of the EDMI distribution, existing convolutional backbones designed for RGB images have difficulty providing satisfactory performance. We design a novel convolutional backbone using a ”subtraction” strategy to reduce model complexity. Our backbone employs residual blocks and skipping connections to reuse the EDMI at deeper layers. We evaluate our model on two large high-definition surveillance video datasets, i.e., VIRAT and Duke-MTMC. The experimental results show that the proposed framework achieves state-of-the-art detection performance compared with the most recent works. Our approach achieves an excellent privacy-utility tradeoff. Compared to previous solutions, it performs more robustly in crowded scenarios with challenges like occlusion. To our best knowledge, this is the first reported deep learning framework for moving object detection in encrypted-compressed video.

IV. PROPOSED METHODOLOGY

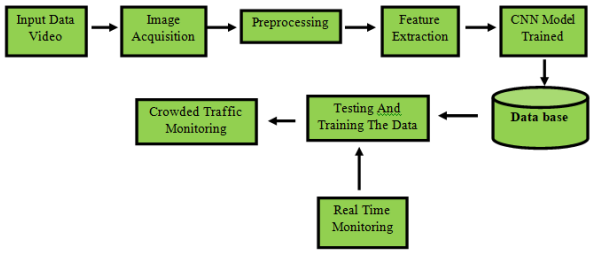

Fig.1 System Srchitecture

The proposed system in this paper embodies an innovative and comprehensive approach to real-time traffic accident detection, leveraging advanced technologies for enhanced accuracy and efficiency. At the interior of the system is the utilization of the derivative of traffic parameters as a key indicator for potential accidents. The system systematically analyzes both the each day traffic flow and historical data on vehicular accidents to separate patterns and correlations. To facilitate real-time monitoring, the system integrates surveillance camera video records, capturing a detailed view of public traffic conditions. This approach particularly emphasizes crowded situations, as they often present heightened risks for accidents. The integration of a Convolutional Neural Network (CNN) algorithm plays a pivotal role in processing the video data. CNNs are well-suited for image and video analysis, enabling the system to recognize complex patterns and anomalies related with potential accidents. The planned system operates on a continuous basis, constantly evaluating traffic parameters and video data. When anomalies or patterns indicative of potential accidents are detected, the system triggers timely alerts to inform nearby police stations. This proactive approach ensures fast responses to emerging traffic incidents, thereby falling response times and mitigating the severity of accidents. The integration of the CNN algorithm not only enhances the accuracy of accident detection but also allows for adaptive learning, enabling the system to continuously progress its performance over time. The proposed

system, with its focus on the derived of traffic parameters and real-time video analysis, stands as a robust and forward-thinking solution for addressing the critical need for timely accident detection in urban traffic management.

V. SYSTEM IMPLEMENTATION

A. System Modules

1. Image Acquisition
2. Pre-processing
3. Feature extraction
4. CNN model trained
5. Data based Real time monitoring
6. Testing and training the data
7. Crowded Traffic Monitoring
8. Alerting and warning system

1. Image Acquisition

Image Acquisition is the initial stage of a computer vision or image processing pipeline. In this module, high-resolution images are captured using cameras or other imaging devices strategically placed along roadways or in specific environments. These images serve as the raw input for subsequent analysis, providing visual data that represents the current state of the scene being monitored.

2. Pre-processing

Pre-processing is a crucial step following image acquisition to enhance the quality and usability of the raw images. This module involves a series of operations, such as resizing, normalization, and noise reduction. Resizing ensures uniformity in image dimensions, normalization standardizes pixel values to a common scale, and noise reduction techniques, such as blurring, help eliminate unwanted artifacts.

3. Feature Extraction

In the Feature Extraction module, relevant traffic parameters such as vehicle speed, density, and flow are extracted from the pre-processed images. This step involves identifying key features that contribute to the analysis of traffic conditions, laying the groundwork for subsequent modeling.

4. CNN Model Trained

This module involves training a Convolutional Neural Network (CNN) model, a deep learning algorithm accomplished of analyzing image patterns. The model is trained on a various dataset of traffic scenarios, enabling it to recognize patterns related with normal traffic flow and potential accidents.

5. Data-based Real-Time Monitoring

The Data-based Real-Time Monitoring module integrates the trained CNN model to continuously analyze live camera feeds. By processing data in real-time, the system monitors traffic conditions and swiftly identifies anomalies or potential accidents based on the patterns learned during the model training phase.

6. Testing and Training the Data

This module focuses on iteratively testing and refining the system's performance through the use of labeled datasets. The testing phase helps validate the accuracy of the CNN model, while training ensures that the system adapts to various traffic scenarios, enhancing its reliability.

7. Crowded Traffic Monitoring

The Crowded Traffic Monitoring module specifically addresses scenarios with high traffic density. By continuously analyzing parameters related to density and flow, the system can identify potential congestion and efficiently manage traffic in densely populated areas.

8. Alerting and Warning System

In the event of potential accidents or emergencies, the Alerting and Warning System module is triggered. This module promptly notifies relevant authorities, such as nearby police stations, through a responsive alert mechanism, ensuring swift intervention and minimizing response time.

VI. CONCLUSIONS

In conclusion, the proposed modular system for real-time traffic accident detection and public traffic crowd monitoring represents a significant advancement in intelligent transportation systems. In the integrating high-resolution cameras,

Convolutional Neural Network (CNN) algorithms, and derivative analysis techniques, the sys
tem achieves a heightened level of accuracy in identifying potential accidents and monitoring crowded traffic situations. The modular architecture ensures a systematic and efficient approach, allowing for the independent development and optimization of each component. The CNN module, with its deep learning capabilities, enhances the system's adaptability to diverse traffic scenarios, while the derivative analysis module adds a layer of sensitivity to sudden deviations in traffic parameters. The inclusion of a responsive alert ensures that relevant authorities are promptly notified in case of emergencies. Overall, this innovative system not only contributes to the enhancement of road safety through proactive accident detection but also addresses broader traffic management concerns in crowded environments, setting a promising precedent for the future of intelligent and responsive transportation infrastructure .

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