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SMART ARTIFICIAL INTELLIGENCE BASED TRAFFIC PREDICTION

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Abstract

Drivers' physical and mental behaviors and decisions on the road have a direct impact on the safety of themselves, other drivers, and pedestrians. However, as distinct entities, people cannot predict the motions of surrounding vehicles and they have difficulty in performing safe reactionary driving maneuvers in a short period. This study addresses the problem of Surveillance cameras, traffic flow estimation based on the data from a video and Faster RCNN surveillance camera. The Target problem here is formulated as counting and classifying vehicles by their driving direction. This subject area is in early development, and the main focus of this work is only one of the busiest crossroads in the city of Chelyabinsk, Russia. To overcome the problem, we employed the state-of-the-art RCNN Faster two-stage detector together with the SORT tracker. A simple regions-based heuristic algorithm was used to classify vehicles movement direction. The baseline performance of the Faster RCNN was enhanced by several modifications: focal loss, adaptive feature pooling, additional mask branch, and anchors optimization. To train and evaluate the detector, we gathered 982 video frames with more than 60,000 objects presented in various conditions. The vehicle's speed will be determined using a motion detection technique if the speed is known. The speed is determined by analyzing video frames.

Keywords: RCNN, vehicle speed detection, traffic floe estimation

1. INTRODUCTION

In the ever-evolving landscape of urban infrastructure, the challenges posed by increasing vehicular density and traffic congestion demand innovative solutions. The advent of Intelligent Traffic Management Systems (ITMS) has ushered in a new era of proactive and technologically-driven traffic control. Among these, the Automated Traffic Management System (ATMS) stands out as a pioneering initiative, leveraging advanced intelligence to empower traffic police with real-time insights into road conditions.

This project harnesses the capabilities of cutting-edge camera technology to not only monitor vehicular movements but also to identify instances of speeding. By seamlessly integrating image processing algorithms, the ATMS can discern whether vehicles are surpassing predefined speed limits. The real-time data generated by the system becomes a crucial tool for traffic police, as it automates the detection of over-speeding vehicles and promptly notifies law enforcement through email alerts.

This introduction sets the stage for a comprehensive exploration of the ATMS project, delving into its key components, functionalities, and the transformative impact it promises in enhancing traffic management. The amalgamation of intelligent technology with traditional traffic control mechanisms marks a significant stride towards creating safer and more efficient roadways, underscoring the symbiosis between innovation and public safety.

2. LITERATURE REVIEW

Maryam Shaygan, Collin Meese, Wanxin Li, Xiaolong Zhao, Mark Nejad, in “Traffic Prediction Using Artificial Intelligence: Review of Recent Advances and Emerging Opportunities”, reveals the overview of the different types of prediction methodologies used for predicting Traffic using Artificial Intelligence. The data preprocessing methods were categorized with respective applications [1].

Alfonso Navarro Espinoza et.al. in “Traffic Flow Prediction for Smart Traffic Lights Using Machine Learning Algorithms”, proposed various Machine Learning and Deep Learning models for predicting the traffic flow at the intersection of vehicular traffic. It lays a groundwork for adaptive traffic control using two public datasets for training, validating and testing the proposed models [2].

Wang Y., Jia R., Dai F., Ye Y., in “Traffic flow prediction method based on seasonal characteristics and SARIMA-NAR model” a WND-LSTM model, using data preprocessing, data modelling, and model implementation, in order to compare the various travel patterns

based on seasonal changes. The proposed model combines the data mining results with the daily travel pattern of road traffic vehicles in intelligent cities [3].

Cao A., Wang F., Tao J., Liu Z., Chen Z. in "Traffic flow prediction model using an integrated framework of improved intelligent optimization algorithms and deep learning models", proposes PWOA (Probabilistic WOA algorithm) which uses an adaptive adjustment search option that was carried out on the function test and analysis of typical functions[4].

Su X., Fan M., Zhang M., Liang Y., Guo L in "An innovative approach for the short-term traffic flow prediction" proposes a light weight tensor-based traffic flow prediction approach. This approach is effective and accurate in predicting the short-term traffic flow with continuous traffic flow data for a limited period of time [5].

3. PROPOSED METHODOLOGY

A methodology is proposed for Traffic Prediction using Artificial Intelligence as shown in Fig.1. A simple regions-based heuristic algorithm was used to classify vehicles movement direction. The method comprises of a CCTV through which video footage of the traffic is captured, converted, vehicles are counted and speed is predicted. An alert is given to the authorities once the vehicle is detected with high speed.

3.1 VIDEO STREAMING

Video streaming is a type of media streaming in which data from a video file is continually provided to a remote user over the Internet. It allows one to watch a video online without having to download it on a host computer or device. Here the CCTV video will be processed in an online stream where the video will be taken for further processing by the system.

The video can be created using an efficient handling method that captures all objects. Video stream prediction for use in services such as video on-demand, video conferencing, video streaming, and so on. The aim is to predict the video stream for an efficient bandwidth allocation of the video signal. Efficient prediction of traffic generated by multimedia sources is an important key component of traffic [6].

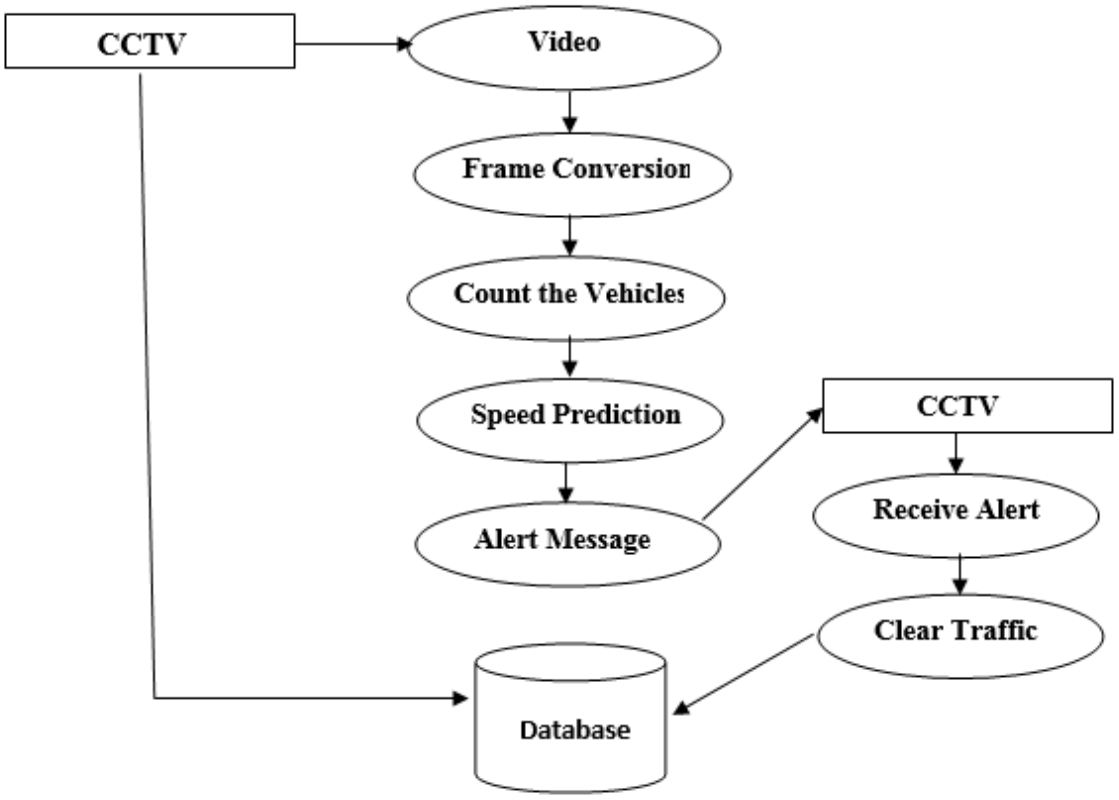

Fig 1 Proposed Methodology

3.2 PRE-PROCESSING

Contrast enhancement is the process of changing the pixel intensity of the video frame and extracting image to utilize the maximum possible bins. Generally, the "contrast" term refers to the separation of dark and bright areas present in an image. The advantage of contrast enhancement is that it removes the ambiguity that may otherwise arise between different regions. The unwanted noise pixels blur events are eliminated with the given video preprocessing technique [7].

Aiming to the effect of more noise and data loss in section traffic detection data, a data preprocessing method based on SVR (Support Vector Regression) is put forward. Using the linear regression theory, the selected and recombined data of the adjacent sections is added to the data set of SVR.

RGB is the common one when we talk about video frame extracting the image. This color space is comprised of three components Red, Green, and Blue. As a result, monochromatic

segmentation requires examining these three channels, and we cannot guarantee a decent outcome for this color space. As a result, the next alternative is to use color spaces with a distinct channel for brightness measurement. HSV and LAB are the two most popular color spaces satisfying this criterion.

The linear and non-linear filtering techniques are used here to filter the video sequences for noise removal. Image filtering algorithms are used on videos to remove the various types of noise that are either present in during capture or injected into the video during transmission. In this work, the various filtering algorithms are used and their performances of the filters are compared using Peak Signal Noise Ratio (PSNR) and Mean Square Error (MSE).

Pre-processing is required for any kind of data to be refine for further processing due to poor captured quality. The following reasons justify why the pre-processing is necessary.

I. Image degradation is due to specific transmission properties of light like absorption and scattering.

II. Specificity of environment like light changing, Weather conditions, and hue is predominant when vehicles move.

III. Specificity of video captures like unknown rigid scenes and unknown colors or low light sensitivity.

As a result, an attempt was made to select the best filter for preprocessing the video sequence frames. The quantitative comparison findings are also tabulated, with the PSNR and MSE of the output vehicle video frame calculated. It also provides a future scope.

3.2.1 2D- FRAME CONVERSION

Frame extraction plays an essential role in many video processing applications such as content-based video retrieval, shot detection, segmentation, CCTV cameras etc. The frame conversion can be got with the seconds of the video which gets with the video (Fig.2). Each frame will be analyzed to know the variations of the vehicles. Frame conversion is the process of extracting the images from the video where the sequences of images can be delivered as frames with the given video. Traffic is represented as images, and it accurately anticipates large-scale, network-wide traffic speeds. A two-dimensional time-space matrix is used to translate spatial-temporal traffic dynamics to visuals that describe the time and space relations of traffic flow [8].

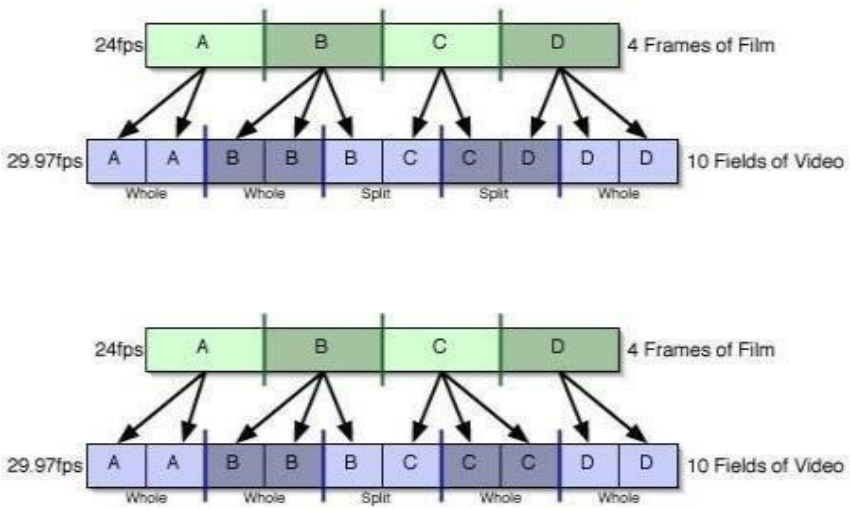

Fig 2 Frame conversion of the given video file

3.2.2 OBJECT DETECTION

Object detection is achieved by the Region of Interest (ROI) system where the object that present in the video frames will be known for the object. Thus, the object detection can be identified with the Artificial Neural Network (ANN). Region-based Artificial Neural Network combines region proposal network with ANN, achieving better performance. Then, the region proposals are fed into an ANN to extract features, to detect each vehicle which is passing through the CCTV video.

Automatically detecting various objects (such as vehicles and pedestrians) in images or videos taken from traffic scenes is a basic premise for many intelligent traffic scenes is a basic premise for many intelligent transportation systems. Reasonable traffic management and control based on vehicle and pedestrian movement can reduce traffic accidents and road congestion.

4. ALGORITHM

4.1.1 Artificial Neural Network

The main challenge of the proposed intelligent agent scheme is the prediction of the forthcoming speed on the road as an indicator of the road traffic congestion. For this purpose, the agent has to process large amounts of data in a short period. Based on these requirements, a General Regression Neural Network(GRNN) is considered more appropriate for the prediction process.

GRNN is a one-pass neural network used for estimating continuous variables. Its main advantages are the fast-learning ability and the convergence to the optimal surface, and thus it has been widely used for forecasting purposes. Assuming that the input data consists of pairs of (x,y), where x is a vector random variable and y a scalar random variable , the resulting estimation is given [9]. It is reasonable to expect that there should be certain periodicities int the road traffic pattern which corresponds to the habitual behavior of the rivers to the habitual behavior of the drivers, i.e., using the same road every day. In order to specify such periodicities, the Fourier transformation has been employed [10].

4.1.2 Speed Analysis and Traffic Analysis

Proposed method to calculate traffic volume and vehicle speed after vehicle detection. There are various works related to this study for analysing traffic data using CCTV image data. Target problem here is formulated as counting and classifying vehicles by their driving direction.

4.1.3 Intimation

The above module will analyze the traffic and speed of the given process where the user will be made intimation. The intimation will be added with the email system where the email will be given. The intimation will be made only when the threshold value get exceeds in the video an, intimation will be sent to the control room. An Email will also be sent to the control room as an alert message. Thus, after the intimation the police man take a further action.

5. RESULT AND DISCUSSION

The proposed methodology, provides an efficient method of traffic prediction using artificial intelligence. The GRNN Algorithm facilitates the prediction of the forthcoming speed of the vehicle on the road by analyzing the traffic, detecting the high speed vehicle in the highly traffic area by using segmentation methods. This provides an efficient and accurate technique with detailed information about how traffic surveillance systems use Image Processing Methods and analysis tools to detect, segment, and track vehicles using GRNN.

6. CONCLUSION

Even though there are various techniques for predicting the traffic and high-speed vehicles, it is great challenge to identify the vehicle due to the complex relationships between the data, external factors, non-linearity, inherent spatial and temporal dependencies. The proposed methodology, provides an efficient method of traffic prediction using artificial intelligence. It

focuses on these areas, namely Traffic Analysis and Incident Detection, Segmentation Methods and Vehicle Tracking Methods. These types provide detailed information about how traffic surveillance systems use Image Processing Methods and analysis tools to detect, segment, and track vehicles using GRNN.

More specifically, this review gives a better understanding and highlights the issues and their solutions for traffic surveillance. We rely on temporal information of features and their motion behaviors for vehicle identification, which compensates for the complexity in detecting vehicle shapes, colors, and types. The paper work can be extended using the optical flow method and Background Subtraction technique which aid in determining the vehicle's speed from the video sequence. In optical flow, approach the distance traveled by the vehicle is calculated using the movement of the centroid over the frames.

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