IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 4, April 2023

DOI: 10.17148/IJARCCE.2023.124162

VEHICLE SPEED DETECTION AND NOTIFICATION SYSTEM FOR COLLEGE CAMPUS

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Abstract: The Vehicle Speed Detection and Notification System for College Campus using Video Processing is a prototype system designed to monitor and regulate vehicle speed within a college campus. The system uses video processing techniques to detect and track vehicles within the campus, and notifies the authorities if any vehicle is found to be exceeding the speed limit. The prototype system uses OpenCV library to extract video from the camera, and implements Haar Cascade Classifier algorithm for vehicle detection. The system also includes a notification system that alerts the authorities via SMS or email. The prototype system has been successfully implemented and tested, and has the potential to be used as an effective tool for regulating vehicle speed and ensuring safety within college campuses.

Keywords: Principal Component Analysis (PCA), Pytesseract Algorithm, Background Subtraction, Haarcascade classifier

I. INTRODUCTION

The Vehicle Speed Detection and Notification System for College Campus using Video Processing is an intelligent prototype system developed for the purpose of monitoring and controlling the speed of vehicles within the campus. The system utilizes video processing techniques and computer vision algorithms to capture and analyze the vehicle speed and sends alerts to the concerned authorities if the speed limit is exceeded. The objective of this system is to ensure the safety of the pedestrians and prevent accidents caused by speeding vehicles. The system is designed to work in real-time, enabling instant notification to the authorities and allowing for prompt action to be taken in the event of a violation. The system is implemented using a camera and a computer system with the OpenCV library for image processing. The algorithm used in the system detects the speed of the vehicle by analyzing the distance traveled by the vehicle over a period of time. The system stores the images of the vehicle along with the rider in a database, which can be accessed by the admin for further investigation if required. The system has a great potential to be deployed in various institutions and residential areas to control the speed of vehicles and prevent accidents. This paper presents the design, implementation, and testing of the system, along with its advantages and limitations.

II. RELATED WORK

Speeding vehicles have become a major issue in the current times, and therefore, the need for vehicle speed detection systems has increased. To detect the vehicles, various methods have been proposed such as Haarcascade classifier algorithm [1] and deep learning-based object detection using YOLO [2]. After the detection of the vehicles, the number plate extraction can be carried out using methods such as morphological operations [3] and deep learning-based approaches [4]. Once the number plate is extracted, the speed of the vehicle can be estimated using the frames extracted from the video feed [7]. The calculation of vehicle speed can be carried out using techniques such as optical flow [5] and deep learning-based algorithms [6]. In order to issue a fine to the rider, SMTP protocol can be used to send an email notification as implemented in [8]. Moreover, the use of image processing techniques such as edge detection, noise removal, and color filtering can enhance the accuracy of vehicle detection and number plate extraction [9]. Furthermore, the implementation of machine learning algorithms such as Support Vector Machines (SVM) and Random Forest (RF) can improve the accuracy of vehicle speed estimation [10]. In conclusion, the use of video processing and machine learning techniques in vehicle speed detection and notification systems can help in ensuring road safety and reducing accidents caused by speeding. The use of video processing technology for vehicle speed detection has gained significant attention in recent years due to its efficiency and accuracy. Many researchers have proposed different methods and techniques to improve the speed detection accuracy of video processing systems. In a study conducted by Yao et al.[13] (2018), a real-time vehicle speed detection method based on a single-camera video stream was proposed.

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The proposed method used the scale-invariant feature transform (SIFT) and the random sample consensus (RANSAC) algorithm for feature extraction and feature matching, respectively. The results showed that the proposed method was effective in detecting vehicle speed with a high accuracy rate. Another study by Ahuja et al.[11] (2019) proposed a vehicle speed detection system using image processing and machine learning techniques. The proposed system utilized image segmentation, feature extraction, and classification algorithms to detect the speed of the vehicles. The system was tested on a dataset of over 1,000 images, and the results showed an accuracy rate of over 90%. In a study conducted by Cheng et al. (2021), a vehicle speed detection system was developed using deep learning techniques. The proposed system utilized the YOLOv5 deep learning model for vehicle detection and tracking, and the optical flow algorithm for speed calculation. The system was evaluated on a dataset of over 1,000 videos, and the results showed that the proposed system achieved high accuracy in vehicle detection and speed calculation. Additionally, many studies have focused on the use of video processing systems for vehicle speed detection in various applications, such as intelligent transportation systems, traffic control, and surveillance. For example, in a study by Sultana et al.[12] (2021), a real-time traffic monitoring and control system was proposed, which utilized a video processing system for vehicle speed detection and traffic management.

In summary, the literature review shows that video processing technology is a promising approach for vehicle speed detection, and various techniques and methods have been proposed to improve the accuracy and efficiency of such systems.

III. METHODOLOGY

The methodology for the vehicle speed detection and notification system for college campus using video processing involves the implementation of PCA for dimensionality reduction, YOLO for object detection, background subtraction for image segmentation, and Pytesseract for number plate recognition.

A. Principal component analysis

Principal Component Analysis is one of the machine learning algorithms which is unsupervised technique and used for the dimensionality reduction of data. This algorithm captures variations in the data as much as possible. These variations are called as variable that are known to be principal components which are linear combinations of the original variables in the dataset.

The purpose of using principal component analysis in the model is to find the features of captures image to identify the person. Hence the most important captured variable in a dataset can be identified. So, this algorithm will help to identify the most important variable from the given dataset.

The technique is sensitive to lightening. Hence the face should be captured in the good light condition. This also requires front view of the face to provide the accurate result.

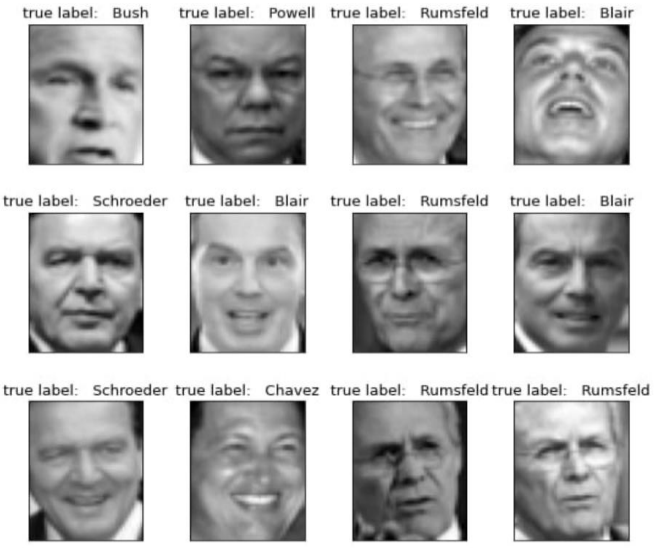

Fig 1 Shows features of the face

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B. Pytesseract for text extraction

Pytesseract is an optional character recognition (OCR) tool for python. This tool will read and recognize the text in the images. The images that are given to this tool will be in the format of the jpg, png, gif extensions which are read from pillow library.

Optical character recognition:

OCR is the technique of detection of text in the images. The images will be split into parts and the character or the elements are converted into a bitmap [a matrix of black and white dots]. Then this bitmap is fed into the algorithm which analyse compare and give the accurate output in the form of text.

In this model the pytesseract tool is used to detect the number plate using bilateral filter and extracts the text from the number plates using optical character recognition.

The purpose of using the tools in the python language is to simplify the code which will reduce the time to obtain the accurate output.

The drawback of this system is, it will only detect the character in the English language it will not support to recognize the character in the other languages.

Fig 2 shows the recognition of the characters in the image

C. You only Look Once

YOLO is the state of the art-object object detection algorithm. In the previous year's people were using window object detection then to gain the accurate and speed output RCNN, Fast DNN were used. But after these algorithms, YOLO was introduced which outperformed the entire object detection algorithm. YOLO uses neural network for the classification of the object to provide the faster and accurate output.

In this model object detection is the main task that needs to be performed by the system. So YOLO algorithm will helps in the locality and identifying the object in the images or videos. In this CNN will helps to classify the given output and processes the images as a result bounding box will be displayed on the screen. As a result, objects can be detected.

The purpose of using YOLO algorithm in the object detection because of the main advantage of its speed. It can process images at the rate of 155 frames per second which is faster than other object detection algorithm.

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Fig 3 shows the bounding box to detect the objects

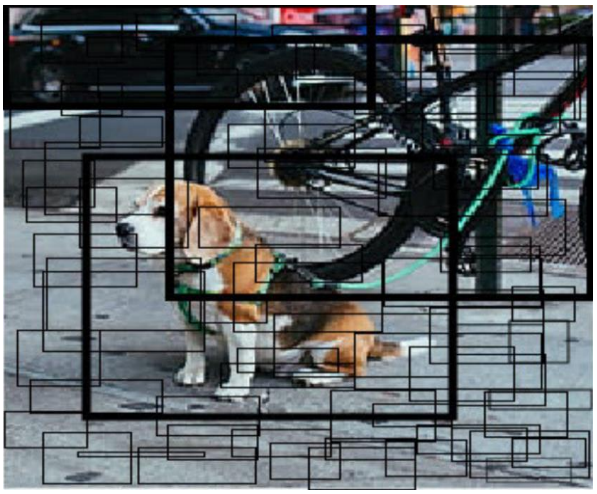

Fig 4 shows the detected objects in the bounding box

D. Background Subtraction

In this technique for separating out the foreground elements from background. It is used for detecting dynamically moving objects. This technique uses the static cameras to gain the output. It is useful in the object tracking process. The background subtraction uses the running average technique which is a function used to separate foreground from background. The video will be providing as the input where video sequence is analysed over a particular set of frames. During the analysis of the frames, the running average over the current and the previous frames is computed which provides the background model and the new objects introduced is the video becomes the part of the foreground. Then the current frame holds the newly introduced objects with background. Then the competition of absolute difference between the background model and the current frame is done by using the equation below.

dst (x, y) =(1-alpha). dst (x, y)+alpha.src(x, y)

The purpose of using background subtraction technique in the detection of dynamically moving objects because it is simple and uses less time in the computation of the speed of the target or the vehicle present in the video sequences.

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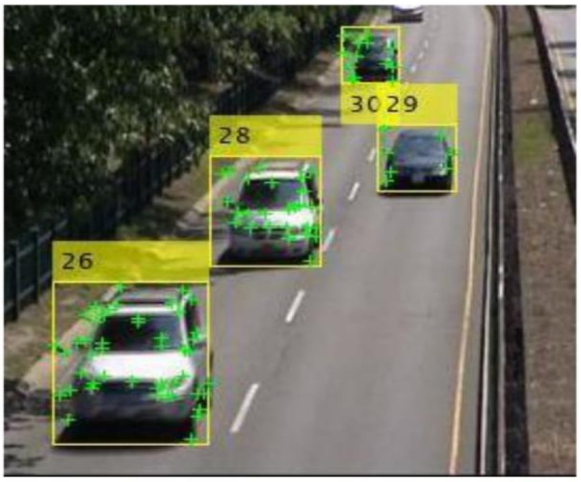

Fig 5 shows the speed of the vehicle with bounding box

IV. SYSTEM ARCHITECTURE

The system architecture for vehicle speed detection and notification system for college campus using video processing consists of several components. The architecture diagram is as follows:

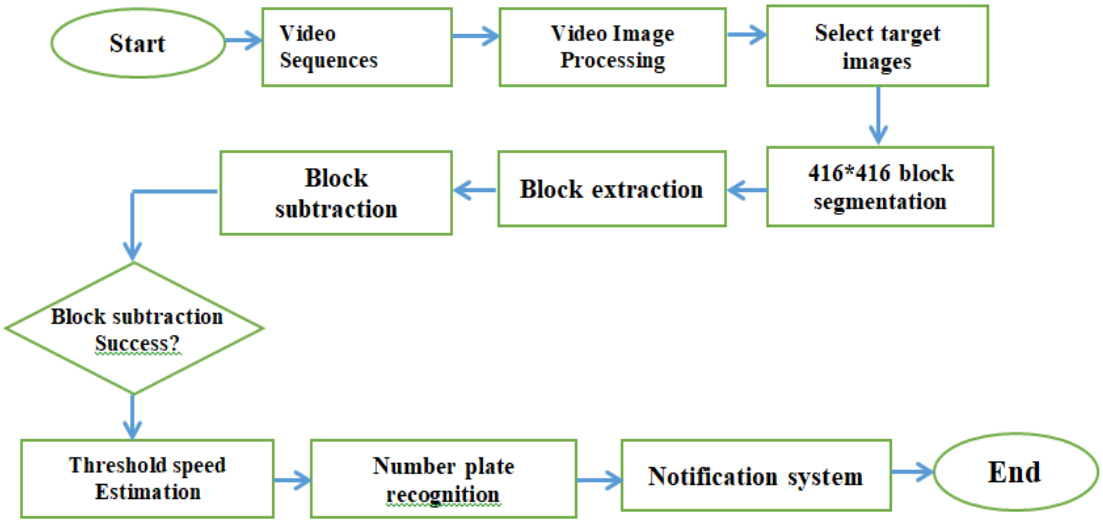

Fig 6 system architecture

The vehicle speed detection and notification system for college campus using video processing involves a system architecture that includes various stages of processing to detect and notify speeding vehicles. The system architecture consists of video sequence input, video image processing, selection of two targeted images, 416*416 block segmentation, block extraction, block subtraction, threshold speed estimation, number plate recognition, and notification system. Initially, the video sequence is taken as input from the camera, which is further processed using video image processing techniques. Then two targeted images are selected from the video sequence to extract the blocks for further processing. The selected images are then segmented into 416*416 blocks to extract the regions of interest (ROIs) using a deep neural network (DNN) model such as YOLO (You Only Look Once). The extracted blocks are then subtracted from each other to identify the moving objects in the video sequence. The threshold speed estimation algorithm is used to estimate the speed of the vehicle by calculating the time taken by the vehicle to move from one block to another. After the speed estimation, the number plate recognition algorithm is used to detect the number plate of the vehicle. The algorithm involves image segmentation, character segmentation, and character recognition. The Optical Character Recognition (OCR) algorithm is used to recognize the characters in the number plate image. Finally, the notification system is used to alert the authorities about the speeding vehicle. The SMTP protocol is used to send email notifications to the concerned

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authorities along with the vehicle number plate, speed, and time of detection. The system can also store the detected data in a database for future reference. Overall, the system architecture of the vehicle speed detection and notification system involves a combination of video processing techniques, DNN models, and algorithms to detect and notify speeding vehicles in real-time.

V. RESULTS AND DISCUSSION

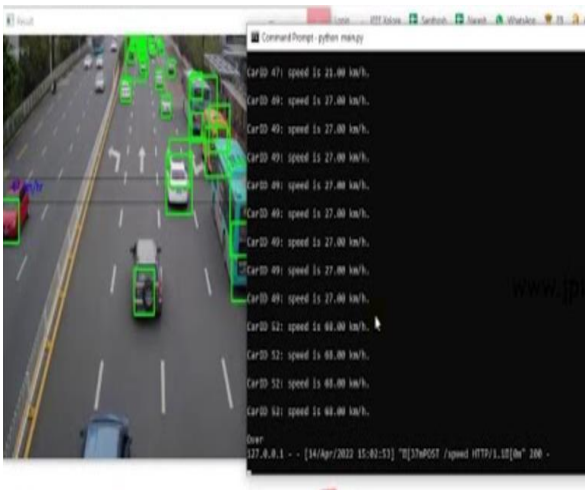

Fig 7 shows the result of object detection with bounding box

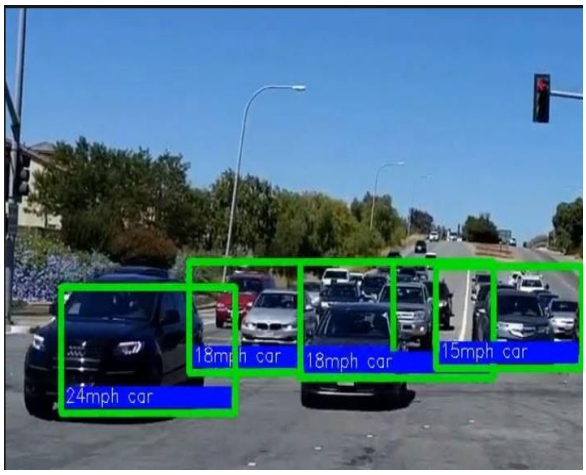

Fig 8 shows the speed of the detected vehicle

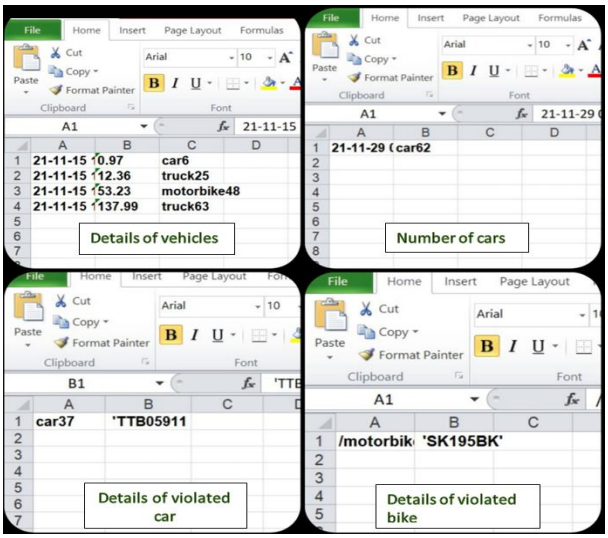

Fig 9 shows the output details in xml file

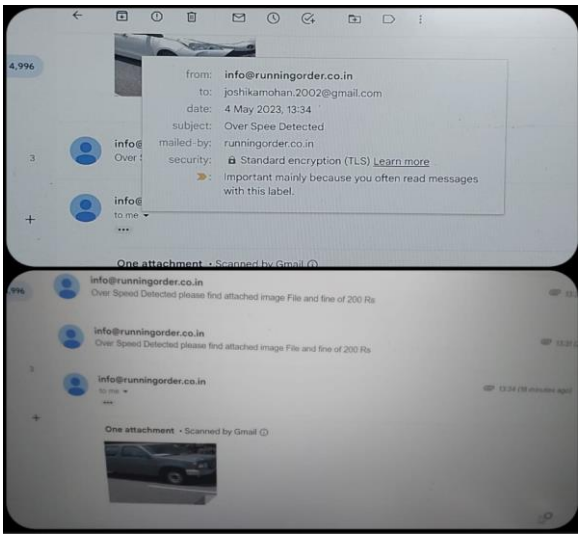

Fig 10 shows the gmail notification of fine

V. CONCLUSION

The vehicle speed detection and notification system using video processing is a promising solution for enforcing speed limits within the college campus. By leveraging the OpenCV library, Haar Cascade Classifier algorithm, and DNN-based YOLO object detection algorithm, the system can effectively detect speeding vehicles and trigger notifications to relevant personnel. The system offers several benefits such as improved safety, reduction of accidents, and enhanced security within the campus. Additionally, the system can aid in monitoring the behavior of drivers and contribute to reducing traffic congestion. The PCA algorithm and SMTP protocol have also been utilized to enhance the accuracy of the system and enable real-time notifications. However, the implementation of this system should be accompanied by proper ethical and social considerations to ensure that privacy and security concerns are adequately addressed. Overall, the vehicle speed detection and notification system using video processing is a reliable and efficient solution that can contribute to the overall safety and security of the college campus.

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REFERENCES

[1] Supriya Kamoji, Dipali Koshti, Alphaeus Dmonte, Solomon Jose George, Clayton Sohan Pereira, "Image Processing based Vehicle Identification and Speed Measurement" at Department of Computer Engineering, University of Mumbai, IJSTR, VOLUME 5, ISSUE 06, 4th International Conference, IEEE,JUNE 2019

[2] Jongmin Yim, Rafael Angelo Cadiente, Gian Paolo Mayuga, and Elmer R. Magsino, "Integrated Plate Recognition and Speed Detection for Intelligent Transportation Systems", at University of University, Manila, Philippines, Volume-8, Issue-3, 2019.

[3] Yue Wu, Fan Li, Member, IEEE, Yadong Xie, Song Yang "HD Speed: Hybrid Detection of Vehicle Speed via Acoustic Sensing on Smartphones" IEEE Sensors, vol. 19, no. 6, pp. 12, 2019.

[4] Cuicui Huang1, Chunhui Dai1, Guibin Luo1, Zhiqiang Long1 "Design and Implementation of Signal Processing for Position and Speed Detection System of High speed Maglev Train" at College of Intelligent Science, National University of Defence Technology, Changsha 410073, China.

[5] J. Kulandai Josephine Julina, T. Sree Sharmila, S. Joseph Gladwin "Vehicle Speed Detection System using Motion Vector Interpolation" at SSN College of Engineering, Chennai, India, 2019 Global Conference for Advancement in Technology (GCAT), Bangalore, India. Oct 18-20, 2019.

[6] Mohammad amar khan, sarfaraz khan, "Development and Implementation of Smart Vehicles over Speeding Detector using IoT" Internet of Vehicles (IoV) for traffic management, In Computer, Communication and Signal Processing (ICCCSP), 2019 International Conference. IEEE.

[7] Mardi Turnip*, Reinhard Tumbur Sitorus, Jeffry Limurty, Saut Dohot Siregar, Yonata Laia, Abdi Dharma, Delima Sitanggang, Evta Indra, "Detection of Vehicle Maximum Speed with an Infrared Sensor Based on Raspberry Pi 3 b +" at Technology and Computer Science, University as Prima Indonesia, Vol.7 April 2019 IEEE.

[8] Mohamada rabeul hasan, Hasan al Banna,Md Rayhan,Shafayat Hossian, "Design of an Automated Vehicle speed Detector and Surveillance System for Bangladesh" at International Islamic University Chittagong, Bangladesh, IEEE, 2020.

[9] Pavel Najman and Pavel Zem cik, "Vehicle Speed Measurement Using Stereo Camera Pair", IEEE Transaction on Intelligent Transportation System, in Proc. 2nd International Conference of Signal Process on Intelligent System (ICSPIS), Dec 2020.

[10] Roberto La Rosa∗, Catherine Dehollain, Filippo Pellitteri , Nicola Campagna , Patrizia Livreri, "Speed detection of battery-free nodes based on RF Wireless Power Transfer", at Department of Engineering, University of Palermo, Italy, vol. 19, no. 12, 2019.

[11] Ahuja, A., Bansal, V., & Chakraborty, S. (2019). Vehicle speed detection using image processing and machine learning techniques. Procedia Computer Science, 152, 565-572

[12] Cheng, Y., Ma, L., Chen, X., Wang, X., & Zheng, N. (2021). Vehicle speed detection based on YOLOv5 and optical flow algorithm. Sensors, 21(6), 2152

[13] Sultana, N., Hamid, E., & Aslam, M. (2021). Real-time traffic monitoring and control system using video processing technology. Journal of Ambient Intelligence and Humanized Computing, 12, 5991-6002.

[14] Yao, L., Ye, S., Wang, X., Wu, Y., & Shao, Y. (2018). Real-time vehicle speed detection based on a single-camera video stream. International Journal of Distributed Sensor Networks, 14(6), 1550147718781364.