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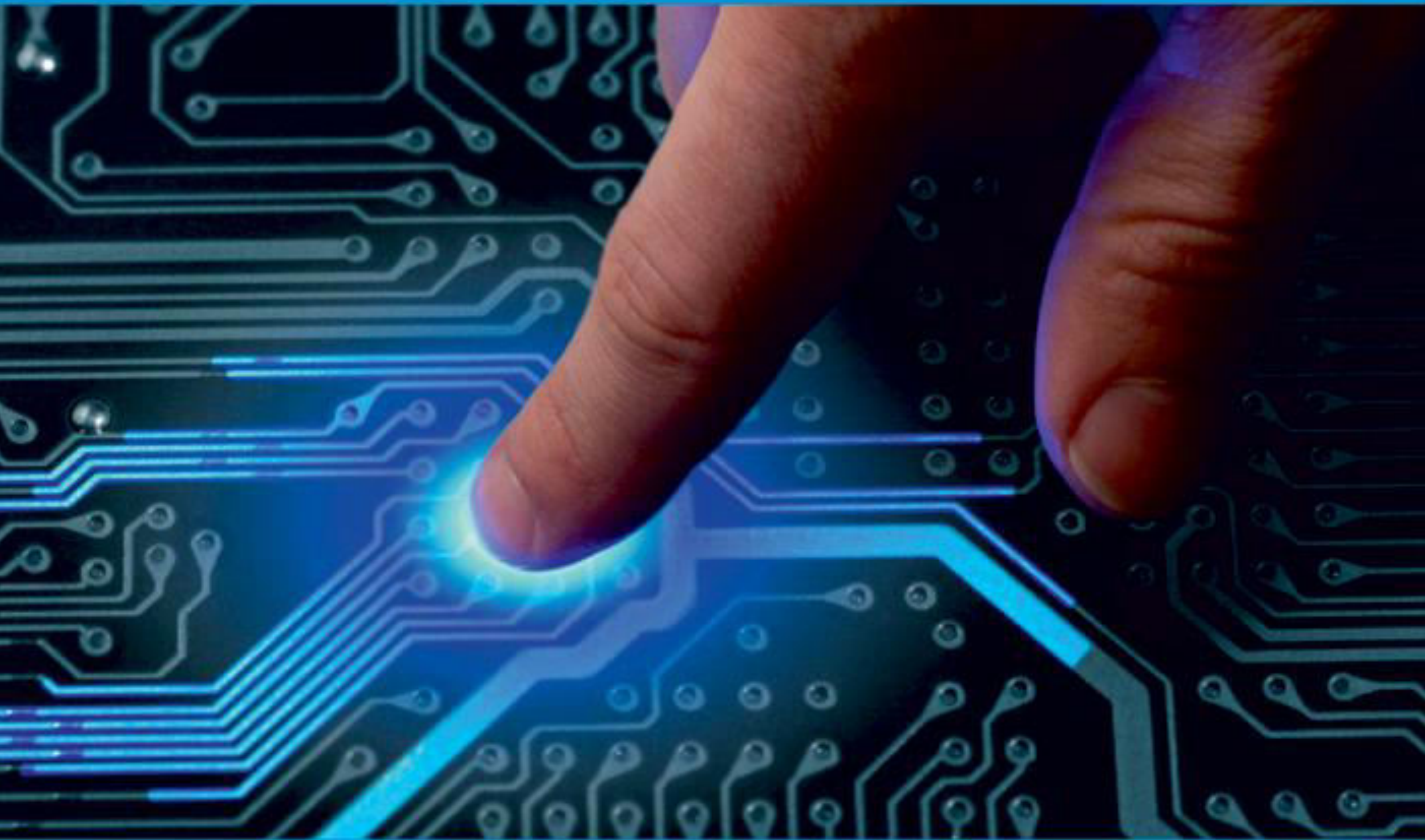

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Automatic Vehicle Detection and Tracking System Using AI (Artificial Intelligence) based Image Processing for Intelligent Transportation System

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ABSTRACT: Road safety is becoming a major challenge nowadays across the world due to continuous increment in the number of vehicles on roads for various purposes such as traveling, transport, etc. There have been invented numerous kinds of vehicle detection and tracking systems and methods earlier to monitor the traffic activities over the roads in a pragmatic manner but the existing systems have various limitations these days due to the constantly increasing number of vehicles and technological advancements, and higher maintenance and costs of existing systems. In this article, the authors investigated a novel automatic vehicle detection and tracking system and method using AI (Artificial Intelligence) based image processing for the intelligent transportation system. This research offers an approach of moving traffic data utilizing a camera module that is mounted on the intersection for enhancement in the traffic detection and surveillance system for the roads to eliminate the chances of accidental situations. The present strategy utilizes a deep learning technique (YOLOv4) to process the captured pictures via an AI camera module for automobiles detection as well as classify various types of vehicles. The accuracy of vehicles classifications along with the surveillance is 96.20% and 99.10% respectively. Although multifarious researchers have proposed various methods and systems in past for vehicles detection and surveillance over the roads still there is a need for more pragmatic vehicles surveillance approaches in a more cost-effective and enhanced manner to provide additional safety to the people on the roads.

KEYWORDS: Artificial Intelligence, Surveillance, Tracking Systems, Vehicle Detection, YOLOv4.

I. INTRODUCTION

The surveillance of the traffic on roads is a major challenge and a huge issue worldwide as some of the developing and underdeveloped countries are facing several issues due to manual traffic surveillance, which is a time-consuming process and leads to inaccuracy several times. Still, multifarious traffic surveillance centers mainly depend on the people operator for tracking the traffic classification and nature to detect any incident over a road [1]–[4]. Such manual process considered in the manual traffic surveillance is becoming a huge challenge these days due to rapid increment in the vehicles on the roads. People are prone to imprecision as well as subject to tiredness, the outcome generally includes numerous inconsistencies [5]–[8]. Therefore, there is a huge need for the development of novel systems and cost-effective methods for effective traffic surveillance along with proper tracking of each fast-moving vehicle quickly. Therefore, it's not a surprise that automated traffic surveillance systems are recognized most essential research arena for intelligent transport systems worldwide [9], [10].

It is noted that maximum traffic surveillance activates at present happen on traffic administration centers with the help of multifarious vision-rooted surveillance camera systems. But few of the existing systems are still on surveillance by various people in many regions that make it a tedious task to keep a track record of all vehicles accurately in real-time [11]–[13]. The major objectives of the intelligent transportation systems are several but a few of the most important ones include improved public safety, minimum traffic congestion, enhanced access for traveling as well as transit datasets including the minimum harmful environmental impacts. In modern transport systems, various essential components are required such as sensors, communication modules as well as high-volume traffic control technologies. These kinds of technologies are assisting the states, larger cities including the towns in diverse regions of the nation to meet the rising needs pragmatically. The surveillance of the vehicles as well as tracking techniques is an integrated part of the intelligent transportation system since they collect full or parts of datasets thatare utilized in the intelligent

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transport systems globally. It has been evaluated that there is a huge need to make investments in intelligent traffic surveillance and tracking to manage and monitor the rising traffic volume more easily and cost-effectively [14]–[16]. Therefore, this paper presents a novel and automatic vehicle detection and tracking system using AI (artificial intelligence) based image processing for the intelligent transportation system. The paper organization is as follows: Section I presents the introduction of the topic, related work regarding the existing work is presented in section II. The proposed methodology is discussed in section III. Section IV presents the results and discussion and the conclusion and future scope are presented in section V.

II. RELATED WORK

In paper [17], A. Gomaa et al. presents a novel strategy for vehicles surveillance as well as tracking in the aerial images/videos through taking on the morphological operation as well as features motion investigation. There is a major challenge of automated surveillance as well as tracking of the running automobiles in real-time and in such a scenario large systems are required that leads to huge investments in the systems development and their maintenance. This work is pragmatic but has limitations in the huge traffic scenario. In a paper [18], X. Liu et al. carried research on vision-rooted target surveillance, tracking as well as positioning set of rules for the UAV (Unmanned Aerial Vehicles). The UAVs are playing a crucial role in the surveillance and secrecy field around the globe due to various reasons such as higher flexibility and efficiency. However, the maintenance charges take a huge amount along with high computation complexity. Thus, the presented work has these limitations that demand more attention towards research and development of novel systems.

In another study [19], K. Priyadharshini et al. presented another approach for vehicles surveillance and tracking based on the DBN (Dynamic Bayesian Network) as well as the Graph cutting model. In this work,the authors explored another automated surveillance strategy for the vehicles by using feature extraction and color transformation along with post-processing. However, the present approach is not suitable as it takes higher vehicles classification time in the huge traffic volumes. In the paper [20], X. Zhao *et al.* presented another method for the geolocation of running automobiles along with real-time surveillance with the help of UAVs installed with the monocular image capturing module. During the last decade, various researchers have developed numerous pragmatic systems and methods for automatic vehicles surveillance. But all these methods and systems have huge computation complexity and higher cost and maintenance. Therefore novel cost-effective systems are required for the development and installation. In a paper [21], R. Rishi *et al.* presents an automated message system for automobiles surveillance as well as accident detection. In this work, the author seeks to eliminate the chances of the deaths by the decay of reaching the assistance to the concerned individual regarding the mishappening of the automobiles on the roads. However, the presented model accuracy rate is low in a huge traffic volume scenario.

III. PROPOSED METHODOLOGY

A. *Design of Proposed System:*

Vehicle detection and tracking are becoming a major challenge these days globally due to the rapid increment in the number of vehicles. The existing systems designs for the vehicle's surveillance have certain limitations such as computation complexity, higher costs and maintenance, and many more that demands more attention towards novel and cost-effective systems that monitors the vehicles in a pragmatic and faster manner as demanded in the modern world for the increasing number of automobiles around the world. The effective and accurate surveillance of moving automobiles is of utmost importance these days to provide accurate locations and tracking of the vehicles. Figure 1 illustrates the model of our proposed automatic vehicle detection and tracking for an intelligent transportation system. Our proposed system comprises mainly five elements i.e. an AI (Artificial Intelligence) based image capturing module, proximity sensor, data center, communication unit on-road, and onboard unit installed inside the vehicle. In this paper, the image capturing module is preferably an AI camera that is mounted on the road intersections.

The AI camera as well as proximity sensor gathers the real-time data of the moving vehicles and sends it to the server database within the traffic surveillance center. After the collection of a real-time dataset, the center determines the vehicle's surveillance task via the image processing method. The dataset collected from the proximity sensor as well as camera module, utilized for the extraction as well as prediction of automobiles trajectories. After that, trajectory datasets go through for the HD-maps match job for enhancement in prediction accurateness. The locations of various vehicles detected on the roads via the camera module as well as proximity sensor along with corresponding trajectories go through the onboard unit within the respective vehicle via the communication unit. Whenever any notification is obtained, the collision risk of the automobile can be measured depending on expected trajectories as well as

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demonstrated to the vehicle surveillance system via a display panel. The position, as well as status of each of the vehicle after proper tracing, can be directed back to the traffic surveillance center via the communication unit.

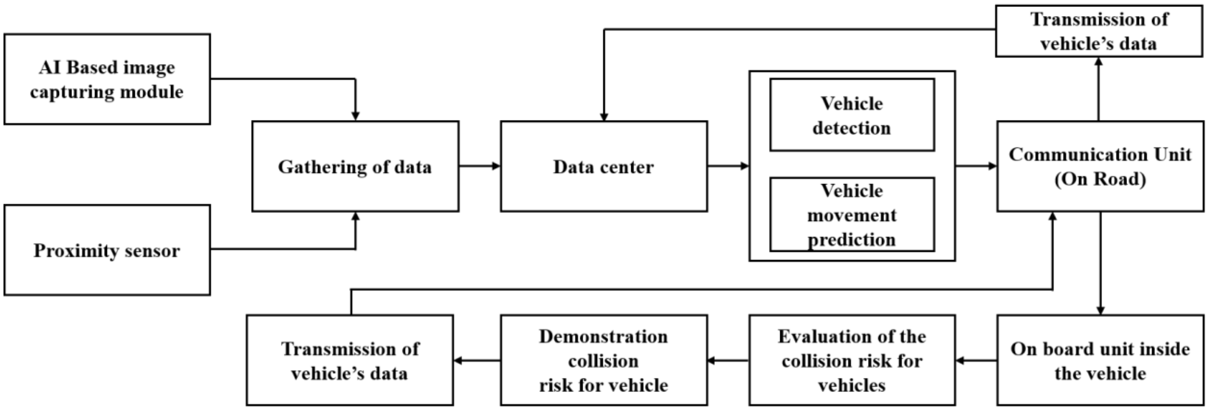

Figure 1: Illustrates the model of our proposed automatic vehicle detection and tracking for an intelligent transportation system.

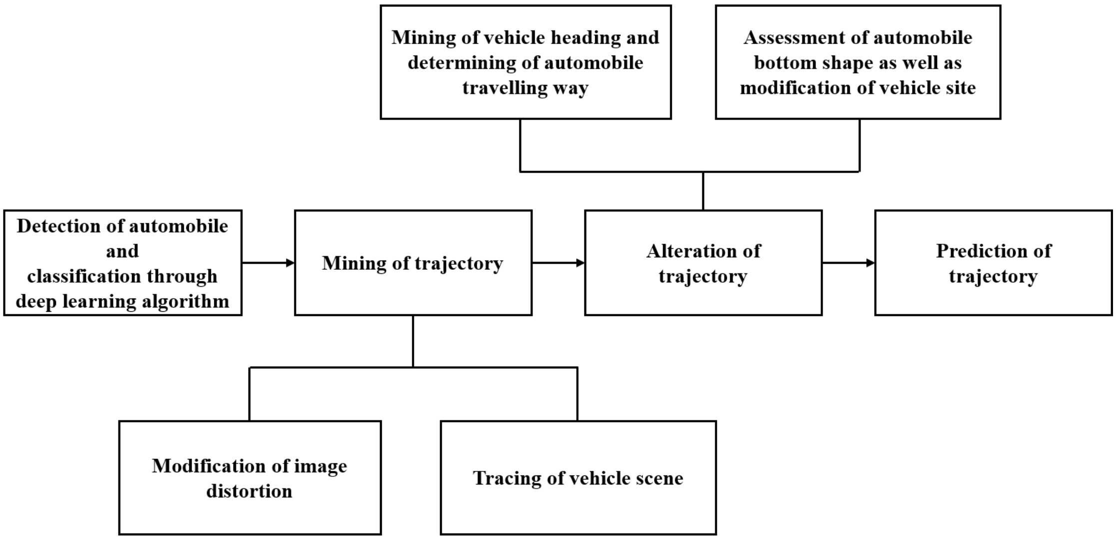

Figure 2: Illustrates the algorithm for automobile recognition as well as trajectory prediction using the deep learning technique.

B. *Instrument:*

This experiment was carried out using a personal computer (PC) having the following system configuration: 64-bit operating system, 16 GB RAM (Random Access Memory), CPU: processor Intel core i5 (Sixth Generation), installed with the MATLAB R2020a version. The suggested algorithm for automobile recognition as well as trajectory prediction using the deep learning technique has been verified in the MATLAB toolbox of image processing to validate the outcome of the proposed system in a pragmatic manner.

C. *Vehicle Detection System Using AI:*

For this system design, a deep learning technique was opted using the AI-based camera module to extract the datasets of the vehicle's position, moving activities as well as speeds on the intersections of the roads along with the nearby region. Furthermore, the essential traffic situation and real-time information namely the traffic situation as well as queue length is continuously determined efficiently. The suggested technique is rooted in a real-time vision dataset that is transferred from the AI-based image capturing module to the dataset collection server placed in the traffic surveillance center as well as predicted datasets are kept in the server database for communication purposes when required based on the real-time vehicle's surveillance. As depicted in Figure 2, our suggested algorithm comprising,

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detection of the automobile as well as sorting via deep learning technique, mining of the trajectory, alteration of the trajectory, and the last one is the prediction of the trajectory.

D. *Deep Learning Method for Vehicles Classification and Detection:*

For the testing and validation of our proposed algorithm for vehicle detection and tracking, we used a deep learning approach for vehicles classification and surveillance because this technique offers higher applicability in a scenario where the number of vehicles is more during the real-time surveillance in comparison to existing traditional methods. In this article, the authors used YOLOv4 based deep learning algorithm for the surveillance and classifications of numerous vehicles in real-time in an efficient manner. YOLOv4 is an object detection system that may determine numerous objects within a single frame. YOLO is an abbreviation for the You Only Look Once. YOLOv4 is capable enough to determine multifarious objects in an accurate and precise way ata faster rate in comparison to the existing systems. The YOLOv4 is rooted on a single CNN (Convolutional Neural Network). CNN work by dividing a picture into regions as well as then determining boundary boxes as well as likelihoods for every area. It instantaneously determines multifarious bounding boxes as well as likelihood for the classes. YOLOv4 is capable to watch the full picture during the training as well as testing period so it implicitly decodes contextual datasets regarding the classes and their appearance. The YOLOv4 technique utilizes the deep-learning approach as well as is optimized and shows 15% enhanced performance for the surveillance accuracy index, 14% enhanced detection speed in comparison to YOLOv3. More particularly, the YOLOv4 is capable enough and offers a higher processing vision dataset along with pragmatic efficiency, improvements in its applicability within the vehicle surveillance area, wherein the preprocessing, as well as alert generation, should be done immediately to avoid the chances of the faults.

IV. RESULTS AND DISCUSSION

During the procedure of the plurality of vehicles surveillance as well as classification by using YOLOv4 approach based on the deep learning approach, our suggested approach processes vision dataset in the frames as well as initially originates required information regarding the vehicles namely, busses, bikes, cars, tractors, and trucks, etc. along with the automobile location datasets based on the detected images/videos pixels. Based on acquired vehicles datasets based on the YOLOv4, additional training has been done rooted on the acquired targeted dataset to enhance the accurateness of automobile kind information. The various automobiles location datasets were obtained rooted on data of every vertex as well as the middle point of a bounding box. After that acquired dataset was transformed in the latitude as well as longitude coordinates rooted on a middle point of the middle of the automobile via correction.

The vision datasets acquired with the help of an AI-based image capturing module i.e. AI-based camera along with the proximity center installed over the roadside intersection are distorted whenever changing the 3D real-time pictures in 2D pictures. Due to the distortion, an enormous error occurs among the real physical coordinates as well as picture coordinates which depends on the vision dataset degree whenever position datasets determined within pixel units, changed straightly in latitude as well as longitude coordinates. In our method, for eliminating such error, improved vision datasets were originated employing distorted vision datasets via inverse application of the AI-based image capturing module intrinsic parameters that are mined via its calibration. The intrinsic parameters herein basically refer to the focal length, distortion as well as the main point. The amounts of the intrinsic factors were obtained via projecting a 2D picture in 3D space. The equation for the correction in the real-time vision datasets distortion is given as.

$$\begin{bmatrix} a_v \\ b_v \\ 1 \end{bmatrix} = \begin{bmatrix} g_x & skew & c_x \\ 0 & g_y & c_y \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} c_{pu} \\ d_{pu} \\ 1 \end{bmatrix}$$
$$r_u^2 = a_v^2 + b_v^2,$$
$$\begin{bmatrix} a_n \\ b_n \end{bmatrix} = (1 + k_1 r_u^2 + k_2 r_u^4 + k_3 r_u^6) \begin{bmatrix} a_v \\ b_v \end{bmatrix} + \begin{bmatrix} 2p_1 a_v b_v + p_2(r_u^2 + 2a_v^2) \\ p_1(r_u^2 + 2b_v^2) + 2p_2 a_v b_v \end{bmatrix} \quad (1)$$
$$\begin{bmatrix} a_p \\ b_p \\ 1 \end{bmatrix} = \begin{bmatrix} g_x & skew & c_x \\ 0 & g_y & c_y \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} a_n \\ b_n \\ 1 \end{bmatrix}$$

In the above equation 1, a_p and b_p denotes the coordinates of the picture and c_{pu}, d_{pu}represents the picture pixel coordinates after correction for the distortion, a_n, b_n represents here normalized planner coordinates along with the enhanced distortion. Table 1 illustrates various parameters values.

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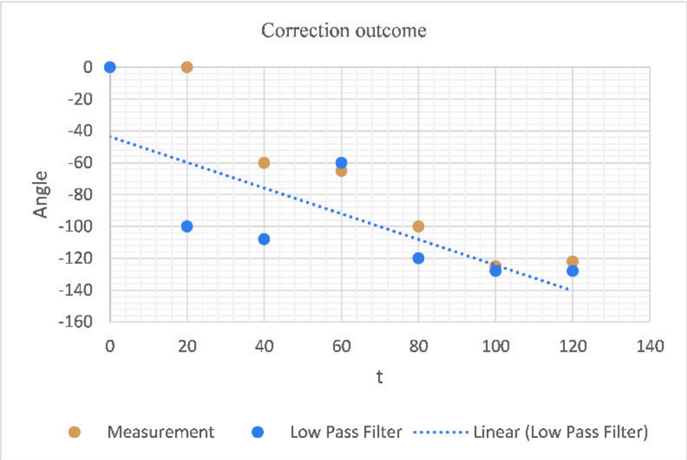
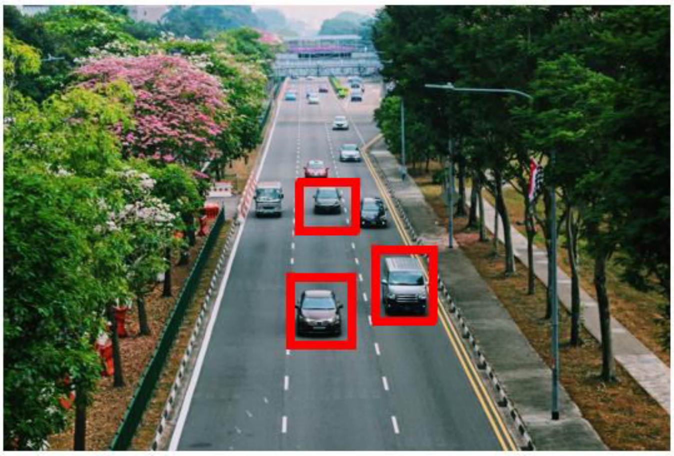
Table 1: Illustrates various parameters values.

S. No.	Parameter	Values
1	Focal Length g_x	667.251
2	Focal Length g_y	668.345
3	Main point c_x	355.378
4	Main point c_x	352.450
5	Distortion k_1	0.306534
6	Distortion k_2	0.352134
7	Distortion p_1	0.000247
8	Distortion p_2	-0.0012022



(a)



(b)

Figure 3: Illustrates the instances of the vehicle heading evaluation (a) represent correction outcome and (b) represents example picture taken.

Generally, the deep-learning rooted vehicle surveillance is capable to extract the required datasets in a bounding box form. The middle point of the bounding box showcase the overall detected automobile position datasets. Whenever the automobile position datasets are acquired concerningthe middle point of the bounding box, outcomes differentiate commencing position aboutthe middle point of automobile bottom side that is necessary datasets for traffic surveillance. In the present research, to eliminate the errors in middle point evaluation instance, the alteration of

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automobile position has been done via the following stages: (i) extraction of heading as well as determining movement position of the automobile, and (ii) evaluation of automobile bottom as well as location correction.

Initially,at the beginning of a task, automobile heading has been evaluated utilizing pixel coordinates determined in vision datasets obtained employing road i.e. bounding box middle point values including the images/videos pixel coordinates of the last frame. The automobile heading is evaluated as per the following steps: (i) the automobile location of previous picture/video frame, as well as location of current picture/video frame, are exchanged in coordinates with the help of transformation matrix, (ii) angle that is formulated via two locations is evaluated utilizing Pythagorean Theorem, as well as space among two locations is evaluated utilizing coordinates value. A low pass filter is utilized for every frame heading extraction pragmatically. Figure 3 illustrates the instances of the vehicle heading evaluation (a) represents correction outcome and (b) represents example picture taken. Figure 4 illustrates the detection and classification of the moving cars on a road by the suggested approach through the YOLOv4.

Figure 4: Illustrates the detection and classification of the moving cars on a road by suggested approach through the YOLOv4.

Table 2: Illustrates the overall performance of the proposed system based on the YOLOv4 Approach.

S. No.	Evaluation item	Unit	Samples No. (frames)	Value	Sub item
1	Object Surveillance	%	7208	99.10	-
2	Classification of Object	%	7309	96.20	Car, Truck, Bus, Bikes
3	Queue Length	Meter	65012	5.07	-
4	Volume of Traffic	%	64110	2	-
5	Location of Trajectory	Meter	63305	2.5	-

The proposed system and method for the automatic vehicle surveillance as well as classification in real-time is a pragmatic approach to provide a robust as well as the cost-effective way in comparison to existing ones. Table 2 illustrates the overall performance of the proposed system based on the YOLOv4 Approach. The accuracy of vehicles classifications along with the surveillance is 96.20% and 99.10% respectively. The YOLOv4 provides good accuracy as demanded nowadays in a higher traffic volume over roads. Our system is found to be capable enough after the experiment as it determines automobiles within a specified range via an AI-based image capturing module and the proximity sensor and stores the datasets in the server database for classification. The outcomes of the automobiles classes as well as boundary box coordinates as a picture file (*.jpeg) along with dataset files (*.txt), utilizing equal files names.

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V. CONCLUSION AND FUTURE WORK

There have been investigated several systems and methods earlier for vehicles detection and surveillance across the globe in real-time. But existing methods have various limitations nowadays due to computation complexity as well as higher maintenance and installation cost on the road. To, resolve the issues of existing systems, the authors proposed a novel system and method for automatic vehicle surveillance and faster tracking efficiency. In this work, the authors selected a technique to derive the traffic datasets employing an AI-based image capturing module along with the proximity sensor mounted on the roadside or an intersection to enhance the surveillance and tracking of vehicles on roads. Our method utilizes a deep learning technique based on the YOLOv4 framework for efficient image processing to classify various vehicles detected over the roads. The AI-based image capturing module and proximity sensor sends acquired datasets to the server database with the help of the communication unit. Our method is capable to determine lane-by-lane automobiles trajectories utilizing the determined positions of the automobiles on the roads.

Depending on the evaluated automobiles trajectories, transportation volumes of every lane-by-lane movement route, as well as queue lengths of every lane, have been determined. The performance evaluation of our suggested system and method have been done by proper testing and the outcomes of the system are validated with the help of various samples and datasets. For the accurate evaluation of the proposed system, the following criteria were selected: rate of detection of the automobile, the queue length of the vehicles, prediction of the trajectory in an efficient manner, classification of the vehicles along traffic volume. The accuracy of vehicles classifications along with the surveillance is 96.20% and 99.10% respectively. However, extensive investigation has been done earlier for vehicles surveillance as well as tracking, but still, there is a need for more research in the future to explore the full potential along with pragmatic solutions and strategies for resolving the issues of existing systems cost-effectively.

REFERENCES

[1] V. Mandal and Y. Adu-Gyamfi, “Object Detection and Tracking Algorithms for Vehicle Counting: A Comparative Analysis,” *J. Big Data Anal. Transp.*, 2020, doi: 10.1007/s42421-020-00025-w.

[2] H. J. Kim, “Vehicle detection and speed estimation for automated traffic surveillance systems at nighttime,” *Teh. Vjesn.*, 2019, doi: 10.17559/TV-20170827091448.

[3] A. Gomaa, M. M. Abdelwahab, M. Abo-Zahhad, T. Minematsu, and R. I. Taniguchi, “Robust vehicle detection and counting algorithm employing a convolution neural network and optical flow,” *Sensors (Switzerland)*, 2019, doi: 10.3390/s19204588.

[4] V. Kocur and M. Ftáčnik, “Detection of 3D bounding boxes of vehicles using perspective transformation for accurate speed measurement,” *Mach. Vis. Appl.*, 2020, doi: 10.1007/s00138-020-01117-x.

[5] F. Li, R. Zhang, and F. You, “Fast pedestrian detection and dynamic tracking for intelligent vehicles within V2V cooperative environment,” *IET Image Process.*, 2017, doi: 10.1049/iet-ipr.2016.0931.

[6] R. S. Zhuk, “Automatic detection and tracking the moving objects observed by an unmanned aerial vehicles video camera,” *Informatics*, 2021, doi: 10.37661/1816-0301-2021-18-2-83-97.

[7] H. Zhou, H. Kong, L. Wei, D. Creighton, and S. Nahavandi, “Efficient road detection and tracking for unmanned aerial vehicle,” *IEEE Trans. Intell. Transp. Syst.*, 2015, doi: 10.1109/TITS.2014.2331353.

[8] P. S. Pratama, A. V. Gulakari, Y. D. Setiawan, D. H. Kim, H. K. Kim, and S. B. Kim, “Trajectory tracking and fault detection algorithm for automatic guided vehicle based on multiple positioning modules,” *Int. J. Control. Autom. Syst.*, 2016, doi: 10.1007/s12555-014-0294-y.

[9] D. Avola, L. Cinque, G. L. Foresti, N. Martinel, D. Pannone, and C. Piciarelli, “A UAV Video Dataset for Mosaicking and Change Detection from Low-Altitude Flights,” *IEEE Trans. Syst. Man, Cybern. Syst.*, 2020, doi: 10.1109/TSMC.2018.2804766.

[10] B. S. Shin, X. Mou, W. Mou, and H. Wang, “Vision-based navigation of an unmanned surface vehicle with object detection and tracking abilities,” *Mach. Vis. Appl.*, 2018, doi: 10.1007/s00138-017-0878-7.

[11] S. Hashemi, H. Emami, and A. Babazadeh Sangar, “A new comparison framework to survey neural networks-based vehicle detection and classification approaches,” *Int. J. Commun. Syst.*, 2021, doi: 10.1002/dac.4928.

[12] B. Xiao, J. Xia, X. Li, and Q. Gao, “An Improved Vehicle Detection Algorithm Based on Multi-Intermediate State Machine,” *Math. Probl. Eng.*, 2021, doi: 10.1155/2021/5540837.

[13] S. Tak, J. D. Lee, J. Song, and S. Kim, “Development of AI-Based Vehicle Detection and Tracking System for C-ITS Application,” *J. Adv. Transp.*, 2021, doi: 10.1155/2021/4438861.

[14] H. Nguyen, “Multiscale Feature Learning Based on Enhanced Feature Pyramid for Vehicle Detection,” *Complexity*, 2021, doi: 10.1155/2021/5555121.

[15] W. Al Okaishi, A. Zaarane, I. Slimani, I. Atouf, and M. Benrabh, “A vehicular queue length measurement

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system in real-time based on SSD network," *Transp. Telecommun.*, 2021, doi: 10.2478/ttj-2021-0003.

[16] J. Chen *et al.*, "Dual-modality vehicle anomaly detection via bilateral trajectory tracing," 2021, doi: 10.1109/CVPRW53098.2021.00453.

[17] A. Gomaa, M. M. Abdelwahab, and M. Abo-Zahhad, "Efficient vehicle detection and tracking strategy in aerial videos by employing morphological operations and feature points motion analysis," *Multimed. Tools Appl.*, 2020, doi: 10.1007/s11042-020-09242-5.

[18] X. Liu and Z. Zhang, "A Vision-Based Target Detection, Tracking, and Positioning Algorithm for Unmanned Aerial Vehicle," *Wirel. Commun. Mob. Comput.*, 2021, doi: 10.1155/2021/5565589.

[19] K. Priyadharshini, S. Vishnupriya, and P. Saranya, "Automatic vehicle detection and tracking in aerial surveillance using DBN and Graph cut model," 2013, doi: 10.1109/ICE-CCN.2013.6528482.

[20] X. Zhao, F. Pu, Z. Wang, H. Chen, and Z. Xu, "Detection, tracking, and geolocation of moving vehicle from UAV using monocular camera," *IEEE Access*, 2019, doi: 10.1109/ACCESS.2019.2929760.

[21] R. Rishi, S. Yede, K. Kunal, and N. V. Bansode, "Automatic Messaging System for Vehicle Tracking and Accident Detection," 2020, doi: 10.1109/ICESC48915.2020.9155836.

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