Detection of Moving Vehicle for Automated Transportation System

[*]Akarsh Baliyan, [#]Pallavi Murghai Goel

[*,#]Galgotias University, India. [*]akarsh1774@gmail.com, [#]pallavi.goel@galgotiasuniversity.edu.in

Abstract - As real-time vehicle detection is always of great interest and areas for improvement. As no. of accidents are increasing day by day, this system is always a need for society to maintain a comfortable, smooth, and safe drive for vehicles in cities. In this paper, there is an advanced and improved model for vehicle detection in which we use a video image processing algorithm to detect moving vehicles. We try to use RGB video frames and will convert them into the HSV colour domain, which will improve in differentiating colours accurately. We will also improve the application of this device. As the detection of vehicles can be identified through its colour features, we will try to manipulate frames in such a way that not only colour we can also find which type of vehicle is that. We can also use a speed recognition algorithm to check the speed of that vehicle. Not only this, we can track down vehicles and also check the number of vehicles running in each lane. By this system, we can also manage our traffic and can reduce the number of accidents. We can also contribute to the ongoing "odd-even" approach used by our government to reduce pollution. In this, we will use the raspberry pi to implement this system using c++ and python as a scripting language. Summarily, this paper is about the detection of moving vehicles and their features to maintain traffic flow and reduce the number of incidents on roads. We can conclude that this system is going to be more efficient and accurate on detection than the previous system recognized.

Keywords: ***automated, RGB video frames, vehicle detection, speed recognition, odd-even approach.***

I. INTRODUCTION

The very fast-growing industry of vehicles has led us to a very critical situation of over traffic and jams It is hard to know which vehicles is registered or which is just being used illegally. For maintaining law and order and secure the life of the people on road the vehicle detection system has become a need of our daily life. There are various laws which is needed to be kept such as speed limit and etc at some places to minimise the threat of the life. The automated vehicle system allows the traffic police to maintain a graph for study according to which the further decision can be made. There are some areas where the rods are made smooth and flowless, the speed ratio for those areas are always fixed such as 90km/hr or 100km/hr. This type of rules is made so that the traffic jams are avoided and the vehicle passes easily. Some of the people who are careless and are not aware of the rules should be given proper law treatment. Detection of speed of each vehicle and the disappearing of the same is that is why important. The most silent feature of the Detection of moving vehicle for automated transportation systems is to detect the number of vehicles passing through that route and the speed average of the same. The record of the vehicle data will help in generating the reports regarding how many vehicles pass on through that route every single day and what is the intensity of the speed they are traveling so that the researchers would be able to make a statistics of the data to make some assumptions for the betterment of the society. Mainly this type of automatic detections is performed in the area where most of the road mis happenings are reported. The report generated can further suggest the ways for stopping the accidents. Many car drivers tend to not pay the toll tax amount and take advantage of their sources. These types of fraud are also easily traceable as the number of vehicles passing through the route and the vehicles listed in the tax payment list will generate the data to give adequate results. If the mis happenings are occurring due to the reason of over speeding then the speed limit for that particular region will be fixed and anyone found rash driving will have to suffer the consequences of the law. This type of application will reduce the number of road accidents happening and the lives of many will be saved. During the day time, the motion of the vehicle can be easily monitored and the ratio of four-wheelers and two-wheelers traveling by the road can be made but while at night the problem arises such as the camera is unable to capture the image of the traffic clearly so the object detection was a problem. Thanks to the night mode image detection where a numerous paper has been made and the authors have suggested various techniques for maintaining the number. At night the number of vehicles is counted by citing their headlights and from the front and the pattern of red light at the back.

With the increasing demand in the metropolitan city of the vehicles, the record of vehicle activity in each area is important according to which the pollution ratio and accident control measures are taken into play. In this paper, a brief description of the traffic analysis is given using the algorithm for the detection of the vehicle. Also, speed

 DOI : 10.35291/2454-9150.2020.0499

recognition of the vehicle and the type of vehicle recognition is briefly explained. There are multiple sensors in use for the development of this model but the number of sensors being used is minimized by the approach of using raspberry pi which is discussed later.

There has been four parts of discussion among the algorithms. The first one starting with classification, it will help in the vehicle and its type recognition. Then background subtraction where the maximum noise from the picture will be removed and only the image of the vehicle will be left for further process of traffic analysis. Later, Image processing module is explained which will help in detection and tracking of the vehicle. Finally, raspberry pi will help in sorting of the speed recognition algorithm.

Various field of the computer science is analysed to complete this research process:

- Computer Vision
- Artificial intelligence
- Internet of Things
- Machine Learning
- Computeronics
- Data analysis
- Sorting methods etc.

II. LITERATURE SURVEY

"Vehicle Detection and Speed Estimation for Automated Traffic Surveillance Systems at Nighttime" by HyungJun KIM

This paper gives a brief about the vehicle and speed detection at minimum light. At night reading the presence of vehicle is quite a tough job but in this paper the headlights are detected to measure a car's presence. The automatic vanishing points of a vehicle can be detected by a single camera during daytime while those surveillance pre-processing can be used to monitor the traffic at night. The experiment result shows that even during night time the efficiency of the automated system is very good as compared by the preliminary results during day and night. The model is efficient to study the vehicle's movement at both the day and night. It can efficiently measure the lane in which the vehicle is moving and also track the distance between them. Foreground and background extraction can be made as, if the camera is installed at the top of the road them background image is quite stable and the foreground image changes using the tail lights of the vehicle the image is detected at night. The background image is filtered to give the foreground extraction. The background extraction is important to detect the vehicle's vanishing point. For experiment a stable background image is used as a stationary pint and then the movement of the vehicle is calculated according to the gaussian method. Further lane wise detection of the vehicle and their movement is monitored. The method uses the technique of measuring the headlights in pairs also individually to detect the presence of the vehicle in the lane.

Fig: Example of vehicles detected in terms of pair

The experimental research lacks the point of explanation when the algorithm detects false reflection and counts it as a vehicle. It uses CCTV system for capturing the image of the vehicle which has a limited range of the image processing.

"Motion-based Vehicle Speed Measurement for Intelligent Transportation Systems" by Ali Tourani, Asadollah Shahbahrami, Alireza Akoushideh, Saeed Khazaee, Ching. Y Suen.

This paper is based on three main regions vehicle detection, speed measuring and tracking. The system works on the gaussian model of the experiment and helps in detection of the vehicle by the shape of it. After detection of the vehicle the speed is tested. Instead of detecting the vehicle by its name plate and windshield the new approach of the motion detection has been used in this experiment. By gaussian background subtraction method the image is firstly filtered, then only the image of the vehicle moving on with the next step filtration is obtained elimination all the noises in the picture. Blob tracking algorithm is used to detect vehicles and their displacement among the frames. The further discussion of the paper describes about the proposed model of the experiment where the brief description about pre-processing, vehicle detection, vehicle tracking, speed measurement and final output of the image is given. Pre-processing includes the RGB correction and greyscale measurement and changing the subject to the interest. The vehicle detection includes subtraction using gaussian background elimination and filling the holes terminology. Vehicle tracking includes blob tracking and detection. Speed measurement is all about calculation of displacement of vehicle and pixels conversion. Violation detection detects the speed violation rule by comparing the speed of the vehicle with the speed limit. Finally, the detected vehicle with their corresponding speed is given.

 DOI : 10.35291/2454-9150.2020.0499

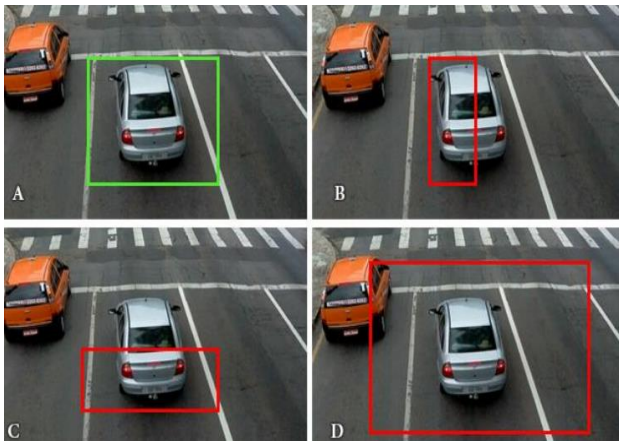

Fig: ROI sample for image processing.

III. PROPOSED SYSTEM

The whole algorithm consists of following steps:

- Traffic analysis
- Detection and tracking of vehicle
- Speed recognition of vehicle

Following is the flow chart for our approach.

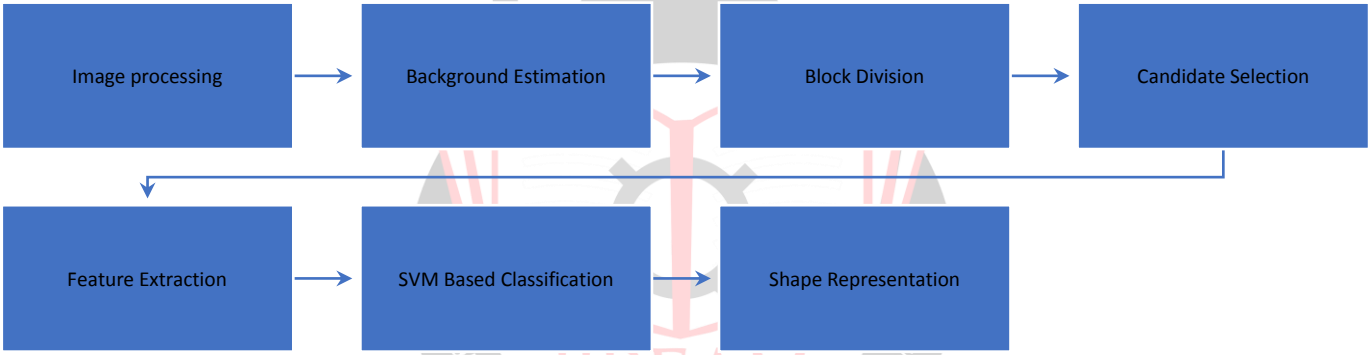

Fig: 1 Traffic Analysis process

[2] DETECTION AND TRACKING:

For detection and tracking, the first step is to frame the setup for which we used Raspberry Pi with a USB Camera to capture the traffic scene. Raspberry pi along with its camera can be kept at a remote place to capture and it can be accessed on the desktop through the android device by a static IP which is assigned to raspberry pi to connect it to a private network so that information can be accessed remotely. After this conversion and filtering take place we use a colour conversion algorithm by which we can convert collected RGB frame data to HSV format. After that noise removal is done using data association and Kalman filtering technique. In the end, detection is done which also helps in tracking data.

Fig: 2 Detection and Tracking

[3] SPEED DETERMINATION:

For speed detection, we need to follow the procedure of video extraction. A video consists of a sequence of images representing a scene in motion at one time. The first step is to transform these video sequences into static images. Now, we select two images to apply to the algorithm. Those two images undergo segmentation into 16x16 small blocks using the

- Vehicle type recognition

We will use a different approach for each algorithm and combine all.

[1] Traffic analysis:

For a traffic analysis approach, first, we will estimate the background scene properly. Then, the image is divided into many non-overlapped blocks. By taking off the current image from the background scene, blocks with change in intensity can be found as block vehicle parts. After that, by extracting a low-dimensional feature vector from each block using a principle component analysis (PCA) to two histograms of the block. Since we need to design a classifier to classify vectors as a part of a vehicle or other, we use a support vector machine (SVM) as it has high generalisation performance. Finally, all the results combined to represent a vehicle's shape. The learning of this algorithm depends on examples and does not completely rely on any a priori model of vehicle.

 DOI : 10.35291/2454-9150.2020.0499

division technique. These blocks are compared with respective blocks in the previous image and the current image. Any type of change in pixels is used to estimate the velocity of each moving vehicle.

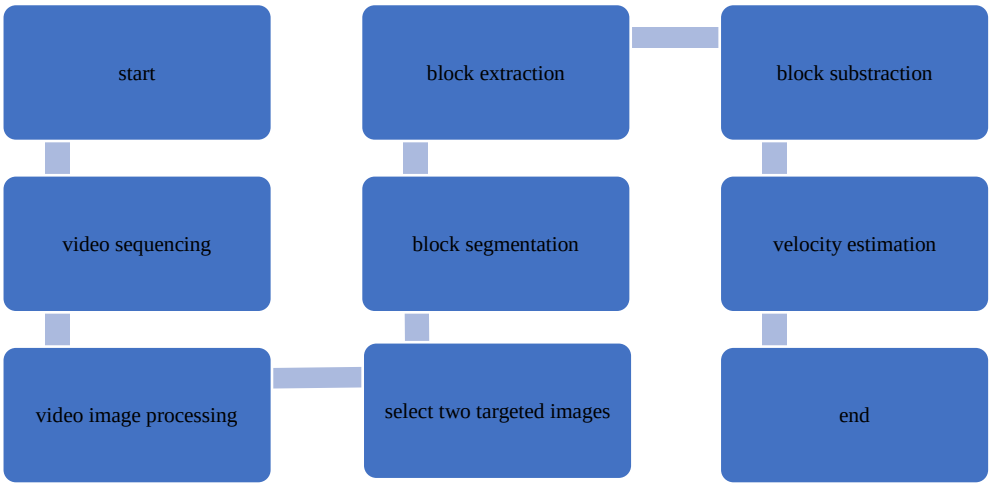

Fig:3 Speed determination of vehicle.

[4] VEHICLE TYPE RECOGNITION:

For vehicle type recognition, we have four modules work upon reading video captures and decomposing it into frames; moving vehicle detection by background estimation process; digital image processing module in which the system distinguishes important details from unimportant data; vehicle -type classification. For vehicle type classification, we use the technique of training and testing data which is to provide details of different cars and teach systems to differentiate via features. Four major features extraction is to detect vehicle type which is: the size of the vehicle; logo of the vehicle; the colour of vehicle; make and model of vehicle.

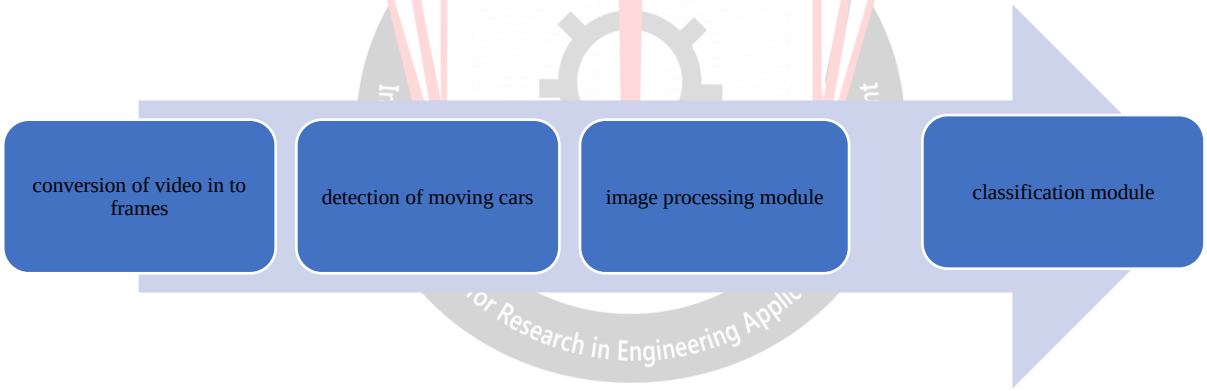

Fig:4 vehicle type recognition.

SCOPE and OUTCOME

In this system, we are trying to connect our transportation with automated technology so that to maintain peace on roads becomes reliable. For this, we replace stationary cameras to video cameras which are connected to Raspberry pi over a private network. We are trying to reduce the cost of multiple systems by replacing them with one USB camera with multiple inbuilt algorithms in it. In this system, we propose a model which can detect a vehicle, track a vehicle, recognise vehicle type, analyse its speed and calculate no. of vehicles so that we can analyse traffic as well. For this, we are trying to mix and match different estimation, extraction, classification, filtering algorithms together with some supervised learning approach. To increase the application of a single system and to make it more reliable we tried to connect four different algorithms in one system through which we can propose the idea of multitasking. For traffic analysis we used the approach of background estimation using support vector machines. For detection and tracking of vehicles, we used the approach of frames estimation and frames matching. For speed recognition we used the approach of image processing and block subtraction so that we can estimate the velocity of the vehicle. For vehicle type recognition, we used the approach of image processing with classification modules. Following is the detailed explanation of every approach and their flowcharts are also mentioned. Outcome of the system can be utilised to model the traffic system where the accidents and death rates on roads are minimised. This particular type of system considering all the parts of algorithms processing gives a dynamic approach for the automated traffic control. As discussed in the proposed system we have seen the working of four different parts of

 DOI : 10.35291/2454-9150.2020.0499

algorithm which can be further compiled together to develop a new form of system.

As ever-growing use of this technology, increases the no. of consumers. due to its accuracy and ability to notify important details in real-time make it unique and more trending. There are many advantages due to which people use it and suggest to use it. Some of those advantages are:

- Real-time video works within the video network and the number of vehicles will be broadcasted within seconds.
- We can access the real-time video data using any remote computers, laptops, mobiles, etc.
- Portables will be placed on any roads for traffic surveillance.
- Reduces physical space and space for storing by capturing the video, only if the movement is found.
- Power efficient and cost-effective.
- Possible to attach multiple cameras and process them in parallel.
- Multitasking is to be through with one system.
- Work an efficient and accurate system when put next to previous works.

IV. FUTURE WORK

- As till now from our calculation, we can tell that we can detect the vehicle but concerning different angles of cameras and videos captured but they are not as clear or can say accurate to tell you the license plate of the vehicle if a vehicle is continuously moving so this can be our fist future work that by determining the exact frame sequence by using the stationary camera to capture traffic video, we can detect the license plate. This can be a great approach to reduce traffic or to contribute to the initiative of "ODD-EVEN" cars.
- Another future work that would make our system more accurate and trustworthy is the classification of vehicles. The classification method improves the detection and determination performance further, so it is very useful to add a classification process.
- Another work will be to store all the data which we collect via video frames. This is to be done so that we can use our previous data to compare recent data and check whether any crime pattern is similar or not. we can use that data to track as well. In this way, we can secure law and order as well.
- Another future work is going to implement this system with full accuracy and reliability. As this system is a combination of four other different algorithms. To increase multitasking in one system we proposed the idea of this system.

V. CONCLUSION

As the need for smart transportation increases, the use of real time transportation systems is increasing day by day. There are many systems which we use nowadays but there are many problems we are facing. So, the system we proposed in this paper will be the solution for all those problems. The system with the use of raspberry pi and USB camera and machine learning approach is a defined system we talked about in the paper. This system is effective yet cost-efficient according to its accuracy. The real-time detection of vehicles, their tracking, their speed analysing, their type recognition and traffic monitoring. This system is different from previous work as its combined version to create automated transportation. This approach is cost-efficient as and works efficiently from the previous system as they are pre-trained to give accurate data. Detection of vehicles is more reliable now and tracking of vehicles made by the system is more accurate. The proposed system takes only colour features and works on estimation and extraction algorithms to provide best output and this approach is to make the system accurate to replace the existing system. Counting no. of vehicle and traffic analysis is now easy and can be calculated in real-time.

REFERENCES

[1] Zhan W.; Wan Q. (2012) "Real-Time and Automatic Vehicle Type Recognition System Design and Its Application". In: *Li Z., Li X., Liu Y., Cai Z. (eds) Computational Intelligence and Intelligent Systems. ISICA 2012. Communications in Computer and Information Science, vol 316. Springer, Berlin, Heidelberg. Available:*

[2] Mallikarjun A.; Vishwanath B.(2017) "A novel approach in real-time vehicle detection and tracking using Raspberry Pi". In: *Alexandria Engineering Journal Volume 57, Issue 3, September 2018, Pages 1597-1607.*

[3] Jie Z.; Dashan G.; David Z.;(2007) "Moving Vehicle Detection for Automatic

Traffic Monitoring". In:*IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 56, NO. 1, JANUARY 2007 51*.

[4] Muhammad M. (2018); "REAL-TIME VEHICLE MAKE AND MODEL RECOGNITION SYSTEM". In: *thesis submitted under department of software system engineering in 2018 at university of Regina" copyrighted in 2018. Pages 20-48.*

[5] Tang; Yong, et al. "Vehicle detection and recognition for intelligent traffic surveillance systems." . *In: Multimedia Tools and Applications 76.4 (2017): 5817- 5832.*

[6] R. Cucchiara, M. Piccardi, and P. Mello, "Image analysis and rule-based reasoning for a traffic monitoring system," IEEE Trans. Intell. Transp. Syst., vol. 1, no. 2, pp. 119–130, Jun. 2000.

[7] Raad Ahmed Hadi, Ghazali Sulong and Loay Edwar George; "VEHICLE DETECTION AND TRACKING TECHNIQUES: A CONCISE REVIEW"; In: *Signal & Image Processing : An International Journal (SIPIJ) Vol.5, No.1, February 2014*

[8] Sakly, Sami. (2015). "An Automated Vehicles Detection and Counting system for Traffic Surveillance". In:

 DOI : 10.35291/2454-9150.2020.0499

[9] Gopal Manne , Neetesh Raghuwanshi; "REVIEW ON VEHICLE DETECTION TECHNIQUES"; In: *International Journal of Science, Engineering and Technology Research (IJSETR) Volume 6, Issue 4, April 2017, ISSN: 2278 -7798*

[10] R.Sindoori, K.S .Ravichandran, B. Santhi; "Adaboost Technique For Vehicle Detection In Aerial Surveillance"; In: *International Journal Of Engineering And Technology (Ijet), Vol.5 No. 2, Pp 765-769, Apr-May 2013*

[11] Margrit Betke, Esin Haritaoglu, Larry S. Davis; "Real-time multiple vehicle detection and tracking from a moving vehicle"; In: *Machine Vision and Applications (2000) 12: 69–83, Springer-Verlag 2000*

[12] Sayanan Sivaraman · Mohan M. Trivedi; "Active learning for on-road vehicle detection: a comparative study"; In: *Machine Vision and Applications DOI 10.1007/s00138-011-0388-y, Springer-Verlag 2011*

[13] H. M. Abdelbaki, K. Hussain, and E. Gelenbe. 2001. "A laser intensity image based automatic vehicle classification system". In: *Proceedings of the IEEE Conference on Intelligent Transportation Systems, 2001. 460--465. DOI:http://dx.doi.org/10.1109/ITSC.2001.948701*

[14] AZZEDINE BOUKERCHE, ABDUL JABBAR SIDDIQUI, and ABDELHAMID MAMMERI; "Automated Vehicle Detection and Classification: Models, Methods, and Techniques"; In: *ACM Computing Surveys, Vol. 50, No. 5, Article 62. Publication date: October 2017.*

[15] Poonam A. Kandalkar , Gajanan P. Dhok; "Image Processing Based Vehicle Detection And Tracking System"; In: *IARJSET International Advanced Research Journal in Science, Engineering and Technology ISO 3297:2007 Certified Vol. 4, Issue 11, November 2017, ISSN (Online) 2393-8021 ISSN (Print) 2394-1588.*

[16] N. K. Kanhere; "Vision-based detection, tracking and classification of vehicles using stable features with automatic camera calibration," In: *ed, 2008, p. 105*

[17] "Vehicle Detection and Tracking using Machine Learning and HOG" by Harman Singh Chadda on march 2018. Available at: https://towardsdatascience.com/vehicle-detection-and-tracking-using-machine-learning-and-hog-f4a8995fc30a

[18] "Vehicle Detection and Tracking" by Ivan Kazavok in May 2017. Available at: https://towardsdatascience.com/vehicle-detection-and-tracking-44b851d70508

[19] "OpenCV Vehicle Detection, Tracking, and Speed Estimation" *by* Adrian Rosebrock *on* December 2, 2019; Available at: https://www.pyimagesearch.com/2019/12/02/opencv-vehicle-detection-tracking-and-speed-estimation/

[20] K. V. Arya, S. Tiwari and S. Behwalc, "Real-time vehicle detection and tracking," 2016 13th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON), Chiang Mai, 2016, pp. 1-6.

[21] Xuezhi Xiang, Mingliang Zhai, Ning Lv, Abdulmotaleb El Saddik; "Vehicle Counting Based on Vehicle Detection and Tracking from Aerial Videos"; In: *Sensors (Basel) 2018 Aug; 18(8): 2560. Published online 2018 Aug 4. doi: 10.3390/s18082560, PMCID: PMC6111533*

[22] Tourani, Ali & Shahbahrami, Asadollah & Akoushideh, Alireza & Khazaee, Saeed & Suen, Ching. (2019). Motion-based Vehicle Speed Measurement for Intelligent Transportation Systems. International Journal of Image, Graphics and Signal Processing. 11. 42-54. 10.5815/ijigsp.2019.04.04.

[23] Kim, HyungJun. (2019). Vehicle Detection and Speed Estimation for Automated Traffic Surveillance Systems at Nighttime. Tehnicki Vjesnik. 26. 87-94. 10.17559/TV-20170827091448.

 DOI : 10.35291/2454-9150.2020.0499