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Detection of Vehicle Speed in the Surveillance Videos

Hemakshi[1], Parvinder Kaur[2]
[1, 2]*Department of Computer Science, SUSCET, IKGPTU*

Abstract: ***Different reports suggested that maximum accidents occurred due to over speed, wrong side over take, lane changing and red light jump. All of these conditions should be thoroughly detected and analyzed by some automatic system. In this paper, an automatic technique for speed detection of vehicles and recognizing those vehicles which are over speeded could be detected in different scenarios through webcam video is proposed. Vehicle speed detection is one of the most advanced and the most significant part of an intelligent transportation. Old traditional vehicle speed detection methodologies are using infrared rays for speed detection, use of ultrasonic rays, using radar technology for speed detection and video image speed detection systems and so on. During the last many years, various new vehicle speed detection methods in video surveillance are discovered.***
With the increase in automobile use, the highway traffic has increased. At the current rate of increasing automobiles, speed determination has become a major concern in avoiding fatal accidents. It will be impossible to provide sufficient manual labour to control traffic at all the busy areas if the on-road vehicles keep increasing at the current rate.
So there is need of some intelligent system that can detect these conditions and send detail to the local authority as well as the registered vehicle owner. The proposed vehicle speed detection system used digital image and video processing for vehicle speed detection in different illumination and weather conditions and tries to solve different issues that occurred in the past.
Keywords: Vehicle, speed, objects detection, video processing, traffic, camera.

I. INTRODUCTION

Automatic speed detection of vehicle on the highways is one of the most advanced and the most significant part of an intelligent transportation. Old traditional vehicular speed detection methodologies are either manual by utilizing infrared rays means for speed measurement, utilization of ultrasonic rays, radar speed calculation as well as images generated by speed detection systems and so on. During the last decades, various new vehicle speed detection methodologies in video surveillance are discovered [1-9]. Vehicle detection technology which is thoroughly relied on video can obtain abundant information such as the vehicle speed, vehicle flow, vehicle type and so on from video image sequences, which surely has very low cost and has effective efficiency. Vehicle motion analysis is a hot research field of computer vision. At present, the research of vehicle detection is mainly relied on moving objects detection in video. Moving target detection methodology first of all extracts the change area from the image sequence of video frames. The main algorithms for moving target detection are background difference technique, frame difference method and well known optical flow method. Highway traffic control has been a challenging and complex problem for the organizations on a global scale. According to world reports, nearly a sum of around 1 million crashes occurs all over the world in each year. Maximum of these accidents happened due to the over speeding of vehicles on highways. It will be not easy and possible to give sufficient manual labour to control traffic at all the busy areas on the road if the vehicles keep increasing at the current production rate. Utilizing radar technology for speed measurement of vehicle is not enough and so the current situation demands another better alternative [10]. As radar guns works on the principle of Doppler shift so radio waves are incident on the vehicle of which speed is to be measured and the frequency of the reflected radio waves varies which merely works on the rate at which the object is moving. This variation in frequency of reflected waves can be utilized to measure the speed of object. Though radar technology is found to be giving promising outcomes but there are also several drawbacks exist in this technology [2] as mentioned below.

A. Speed of only one object can be found at an instance. While in use, if there are any devices that generate radio waves in the near vicinity, the results are influenced.
B. Extremely expensive.
C. Radar gun must be pointed towards the direct path of the incoming traffic.

All these limitations of the Radar technology drove the researchers to look for another alternative that is better in terms of performance as well as installation cost. Image and video processing has proven to give more promising and reliable outcomes with small costs and less effort. Image processing is being utilized from the past decade for Vehicle speed detection, categorization, counting and many more functions.

II. LITERATURE REVIEW

J. Great et al. in 2017 [1] worked on the detection of speed of vehicles which was relied on the video feed. Authors suggested an improved optical low methodology by utilizing the tracking strategy of object using well known Kalman filtering that helped the problem with overlays with static foreground objects and also so speedy object attributes detection is possible. Further foreground detection with the use of Gaussian mixture prototype was combined with DBSCAN clustering so that more precise object representation could be created. This overall system composed of detection and tracking as well as speed estimation of the vehicles. Authors tested the vehicles with the predetermined speed of 15 km/h and 20 km/h utilizing different vehicles, different natures of driving and the vehicle position at the time of recording. Also the weather, illumination and other conditions were also created for algorithm strength detection. Authors proved that the proposed combination of optical flow and Kalman filter techniques delivered better results even in the case of low image quality produced by industrial camera.

P. K. Thadagoppula et al. in 2016 [2] proposed method of utilizing image and video processing which had overcame the limitations of using radar guns. The proposed algorithm utilized the live video stream from the surveillance cameras to find vehicle speed. The system updated the speed of vehicle after every half a second so that there should be kept vigil on acceleration and retardation of vehicle in the range of view of the camera. If there occurred any violation in the speed laws, which could be easily detected and feedback could be send to local authority. So there was no need of holding a radar gun on the national highways. Also this live feed video could also be saved for future use. Authors found that the speed calculated from different experiments showed an error of only 3% in real time. J. X. Wang et al. in 2016 [3] presented a vehicle speed estimation algorithm which was relied on the moving target detection in surveillance videos. First phase in proposed algorithm was the extraction of various attributes of moving vehicles with the aid of utilizing the 3 frame difference as well as the background difference methodologies. In the second phase centroid feature extraction was utilized to track as well as positioned over the moving target. In the last phase, the vehicle speed was approximated with the help of mapping relationship amid the pixel distance with the actual distance. Experiments were conducted on various groups of videos captured outdoor, with the video image resolution of 640 × 480 with the frame rate was 18 fps and the camera utilized was static monocular camera. The method had showed sound robustness and strong practicability, but there were certain errors also. S. M. Malik et al. in 2014 [5] designed an automated electronic speed detection system which detected the speedy vehicles and if over-speeding occurred then software automatically extracted the license number of that particular vehicle and sent number via email to respective Toll collected centres to charge fine. The system was designed for Punjab state vehicle license plates. For the speed measurement the proposed strategy utilized Doppler Effect. Overall system utilized Digital Image Processing (DIP) methods and the MATLAB software which was utilized for core image processing. The output showed that the proposed system successfully detected over speeding vehicles and then efficiently extracted those vehicles license plate. Overall proposed system had high performance and could be deployed on highways for checking the over speed vehicles, but the system reliability was dependent on the electronic circuit and not entirely on web camera.

K. V. K. Kumar et al. in 2014 [6] proposed an efficient methodology which required no camera calibrations and setup for measurement of speed of vehicles in real time. The algorithms were implemented in 'C' language utilizing OpenCV for computer vision and Visual Studio for C programming. With the utilization of frame subtraction technique and other image masking ways the moving vehicles were segmented out. Vehicle speed was generated with the mathematical approximation formulas. In the final phase frame masking was utilized for differentiating amid various vehicles. Authors showed that their proposed algorithm showed small mean error of +/- 2 km/h for the speed detection for different video sequences.

III.PROBLEM FORMULATION AND METHODOLOGY

With the increase in automobile use, the highway traffic has increased. At the current rate of increasing automobiles, speed determination has become a major concern in avoiding fatal accidents. Different reports suggested that maximum accidents occurred due to over speed, wrong side over take, lane changing and red light jump. All of these conditions should be thoroughly detected and analysed by some automatic system. From the literature survey it is cleared that a new robust and reliable as well as automatic methodology should be created for detection of vehicle information with various properties like speed, color, number of plate and other things. So there is need of some intelligent system that can detect these conditions and send detail to the local authority as well as the registered vehicle owner.

After having a deep study into literature survey, the various research gaps that were identified are

1) Vehicle speed should be detected with high accuracy even in low light.

2) The process should be automatic so that license plate of the vehicle with high speed should be extracted without any manual intervention.

3) In the acquisitions process of video, it may possible to introduce a certain amount of noise in the image or video signal so it is not easy to detect vehicle and its speed.
4) Moving vehicle may be present behind some other vehicle in the current scene.

A. *Objectives*

This research work will be focused to achieve the following objectives:-

1) To design, study and implement a high-speed vehicle detection framework.
2) The framework should be fast and reliable
3) The proposed framework depends on the image processing
4) Main focus on improving the accuracy of vehicle speed detection, while providing state-of-the-art detection quality.
5) To learn from the design process, identify and solve possible bottlenecks in detection speed and recognize important factors contributing to the overall detection quality.

B. *Methodology*

The following steps will be performed to complete this research work:-

1) Create an object detection system that detects all the vehicles in the field view of camera.
2) Find the speed of each vehicle by using some intelligent mathematical mapping approximation algorithm
3) Detect those vehicles which are moving with approved speed limit.
4) Segment the license plate of those vehicles and send email to Toll authorities for vehicle over speed fine purposes.

C. *Proposed Algorithm*

The proposed algorithm includes various steps which are listed here

1) Create an object detection system that can detect all vehicles in the field view of camera.
2) Find the speed of vehicle using mapping function of segmented image of each frame in 5 consecutive frames.
3) Extract segmented vehicles which have speed greater than 25 km/h.
4) Extract licence plate numbers of those vehicles which are over speeding and display on the screen
5) Perform testing in various illumination conditions.

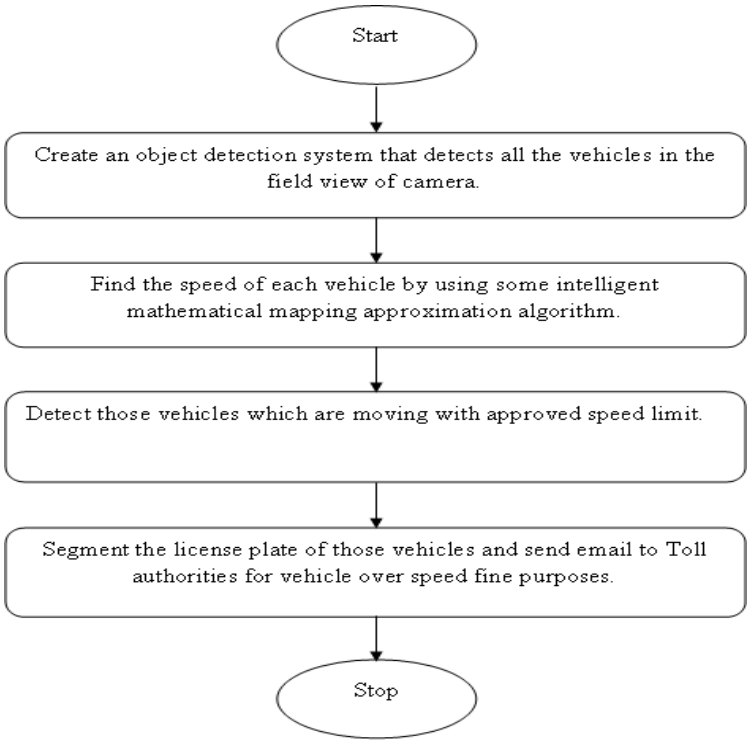


Fig. 1 Flowchart of proposed algorithm

IV. RESULTS

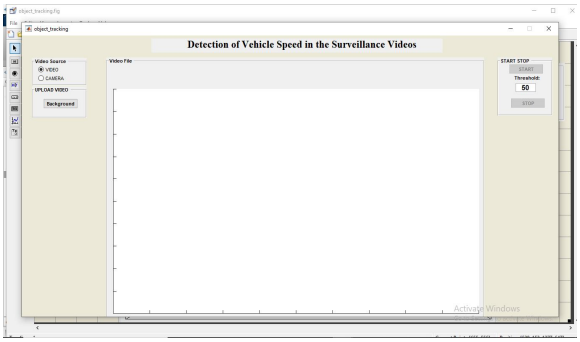


Fig. 2 Vehicle speed detection interface

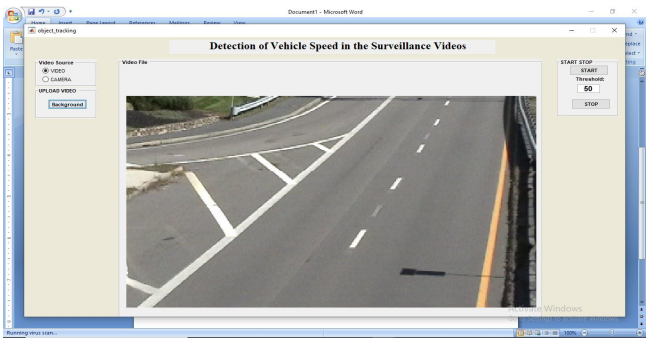


Fig. 3 Input video loaded to the interface

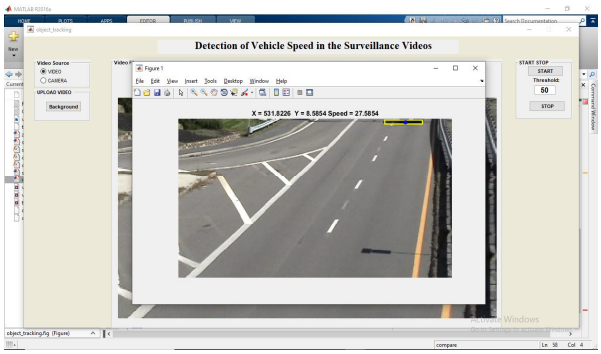


Fig. 4 First vehicle detected by the interface with speed

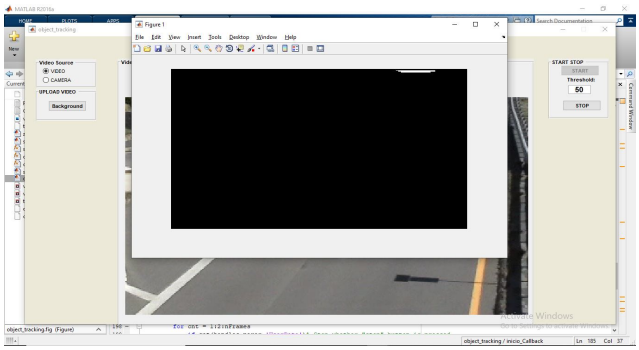


Fig. 5 Background subtraction of the vehicle no. 1

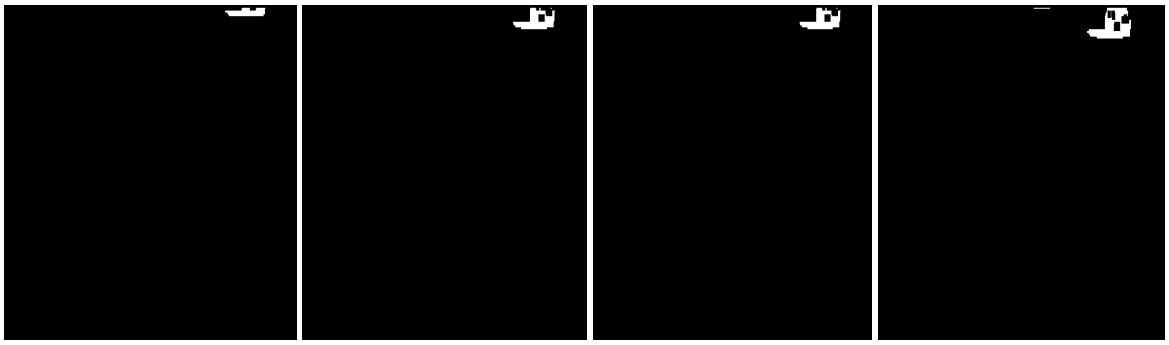


Fig. 6(a,b,c,d) Sequence of background subtraction of vehicle no. 1

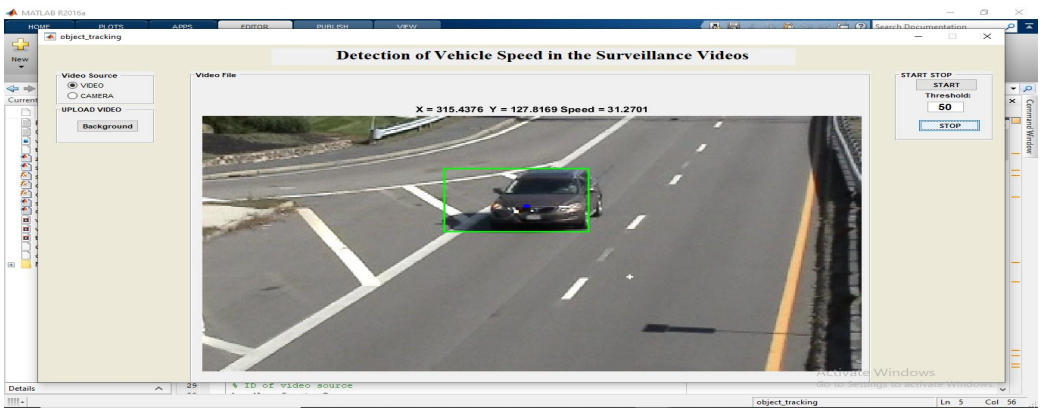


Fig. 7 Second vehicle detected by the interface with speed

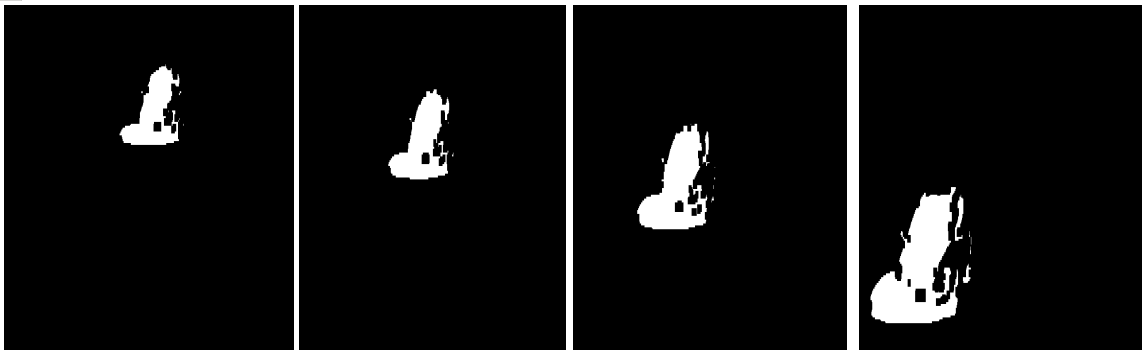
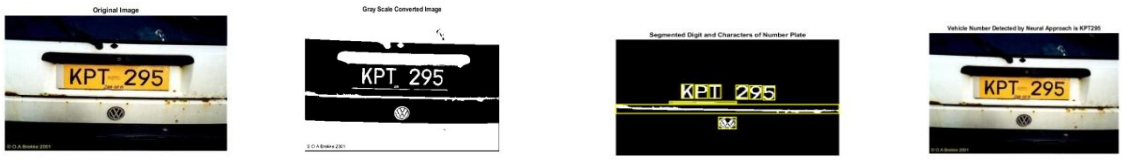
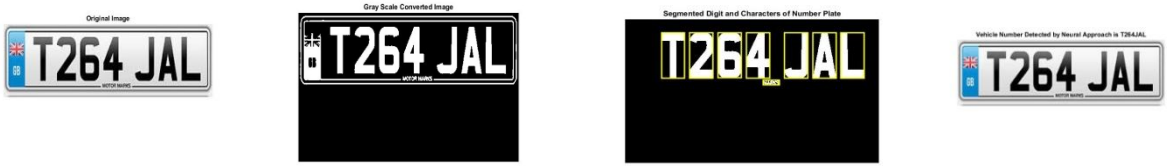


Fig. 8 (a,b,c,d) Background subtraction of vehicle no. 2



(a) (b) (c) (d)

Fig 9 (a-d): Vehicle no. 1 extraction of license plate as speed is more than 25km/hr



(a) (b) (c) (d)

Fig 10 (a-d): Vehicle no. 2 extraction of license plate as speed is more than 25km/hr

By performing the different test on different videos the average accuracy of the proposed system is found to be 87% which show the effectiveness of the proposed system.

V. CONCLUSIONS

From the results it is cleared that proposed algorithm wins the game fairly as it finds the clear images of background subtraction of all the vehicles and if the speed of vehicle is more than 25km/h it extracts the number plate fairly well. Overall effectiveness of the proposed system depends on the clear extraction of background from the foreground.

In the future work more accurate speed detection of different class of vehicles can be detected. Also the intelligent system can also be created to detect other types of road crimes due to vehicles.

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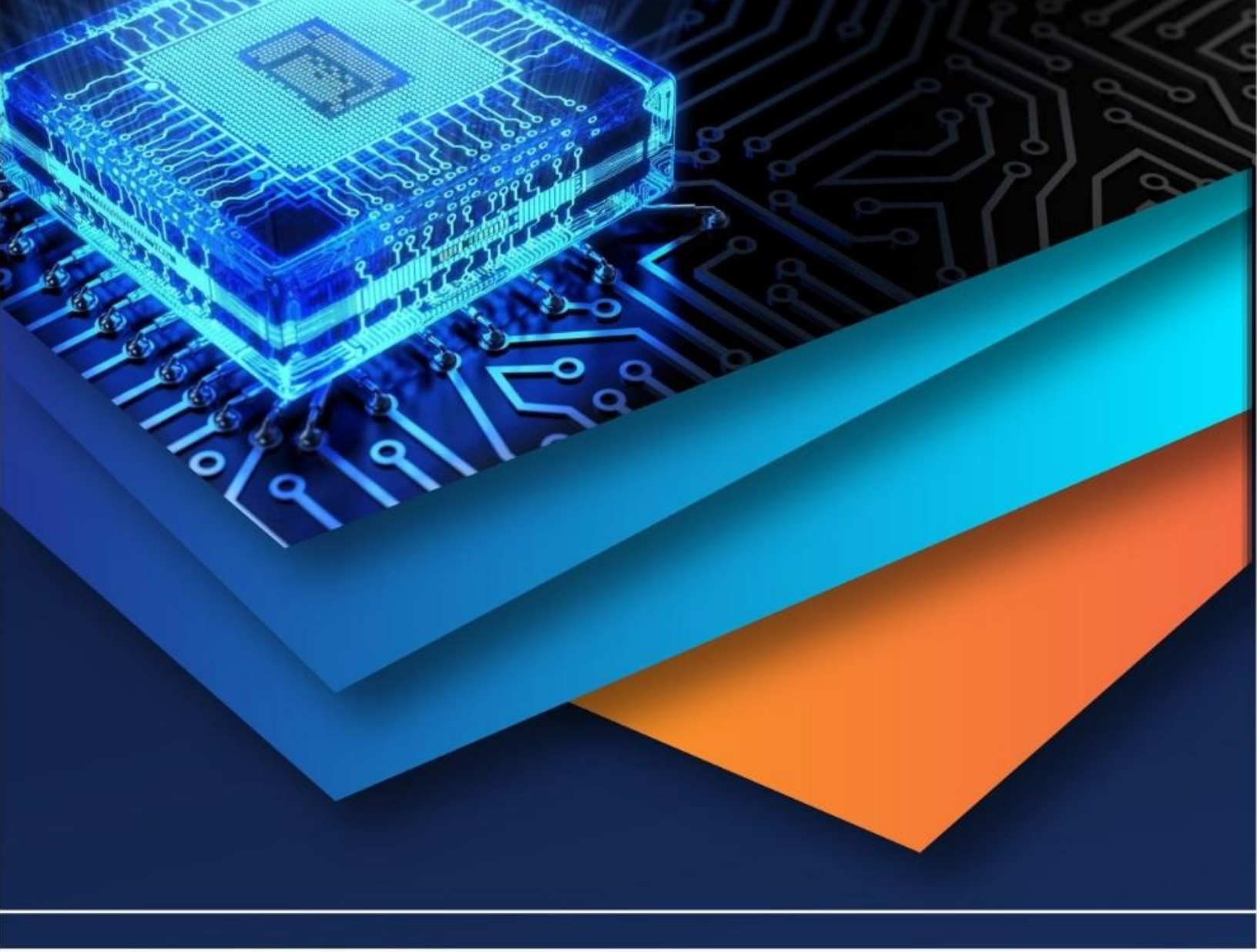

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