International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169
Volume: 3 Issue: 3 1558 - 1561

Survey of Various Methods used for Speed Calculation of a Vehicle

Mr. Sairaj Bhatkar [#1], , Mr. Mayuresh Shivalkar [#2], Mr. Bhushan Tandale [#3], Prof. P.S. Joshi [#4]

[#1]Student, Department of computer Engineering, Rajendra Mane college of engineering and technology, Ambav, Devrukh, Ratnagiri, Maharashtra, India

[#2]Student, Department of computer Engineering, Rajendra Mane college of engineering and technology, Ambav, Devrukh, Ratnagiri, Maharashtra, India

[#3]Student, Department of computer Engineering, Rajendra Mane college of engineering and technology, Ambav, Devrukh, Ratnagiri, Maharashtra, India

[#4]Assistant Professor, Department of computer Engineering, Rajendra Mane college of engineering and technology, Ambav, Devrukh, Ratnagiri, Maharashtra, India

[1] *srjbhatkar@gmail.com*
[2] *shivalkarmayuresh@gmail.com*
[3] *bhushantandale11@gmail.com*
[4] *parag-joshi2007@yahoo.co.in*

Abstract— It is a survey paper of various method used for speed calculation of vehicles. The major purpose of vehicle speed detection is to provide a number of ways that law enforcement agencies can enforce traffic speed laws. The most famous methods include using RADAR (Radio Detection and Ranging) and LIDAR (Light Detection and Ranging) devices to detect the speed of a vehicle. RADAR use microwaves pules and LIDAR use coherent light beam for speed calculation. The SDCS (Speed Detection Camera System) and SMBI (Single Motion Blurred Image) method are also use on high traffic area to measure speed of vehicle using video stream and single image captured by stationary camera.

Keywords— *RADAR (Radio Detection and Ranging), LIDAR (Light Detection and Ranging), SDCS (Speed Detection Camera System), SMBI (Single Motion Blur Image*

*****

I. INTRODUCTION

The major purpose of vehicle speed detection is to provide a number of ways that law enforcement agencies can enforce traffic speed laws. The most famous methods include using RADAR (Radio Detection and Ranging) and LIDAR (Light Detection and Ranging) devices to detect the speed of a vehicle. The reflected signal is picked up by a receiver of RADAR device. The receiver of traffic radar then calculates the frequency difference between the original and reflected signals, and converts it into the speed of the vehicle in motion. A LIDAR device records how long does it take for a light pulse to travel from the LIDAR gun to the vehicle and come back. Based on this information, LIDAR can suddenly calculate the distance between the gun and the vehicle. By making several calculations and comparing the distance the vehicle travelled between measurements, LIDAR can determine the speed of vehicles correctly.

Speed Detection Camera System (SDCS) that is applicable as a radar alternative. SDCS uses image processing techniques on video stream in online captured from single camera or offline mode, which makes SDCS able to measuring the speed of moving objects avoiding the radars' problems. SDCS offers an en-expensive alternative to radars with the same accuracy or even better than it.

In Single Motion Blurred Image (SMBI) method for vehicle speed detection and identification based on single image taken by a stationary camera. Because of the relative motion between the camera and the moving object for an extended period of camera exposure time, motion blur will occur in a region of the image corresponding to the moving object in the scene. For any fixed time interval, the displacement of the vehicle in the image is proportional to the amount of blur caused by the imaging process. Thus the motion blur parameter (e.g., the motion length and the orientation) and the relative position between the camera and the object can be identified; the speed of the vehicle can be estimated according to the imaging geometry. Furthermore, for the motion blurred image taken with the license plate, image restoration provides a way to identify the vehicle.

II. LITERATURE SURVEY

Various methods are used for vehicle speed detection. These method used in various area according to their function, advantages and limitation. There are various method describe which are used for speed detection of vehicle in different areas.

1. RADAR (Radio Detection and Ranging) [1]

A radar speed gun (also radar gun and speed gun) is a device used to measure the speed of moving objects. It is used in law-enforcement to measure the speed of moving vehicles and is often used in professional spectator sport, for things such as the

measurement of bowling speeds , speed of pitched baseballs, athletes and tennis serves.

A radar speed gun is based on a Doppler radar unit that may be hand-held, vehicle-mounted or static. It calculate the speed of the objects at which it is pointed by detecting a change in frequency of the returned radar signal caused by the Doppler Effect, whereby the frequency of the returned signal is increased in proportion to the object's speed of approach if the object is approaching, and lowered if the object is receding. Such devices are frequently used for speed limit enforcement, although more modern LIDAR speed gun instruments, which use pulsed laser light instead of radar, began to replace radar guns during the first decade of the twenty-first century, because of limitations associated with small radar systems.

Radar speed guns, like other types of radar, consist of a radio transmitter and receiver. They send out a radio signal in a narrow beam, and then receive the same signal back after it bounces off the target object. Due to a phenomenon called the Doppler Effect, if the object is moving toward or away from the gun, the frequency of the reflected radio waves when they come back is different from the transmitted waves. From that difference, the radar speed gun can calculate the speed of the object from which the waves have been bounced.

Limitation of radar

Traffic radar comes in many models. Hand-held units are mostly battery powered, and for the most part are used as stationary speed enforcement tools. Stationary radar can be mounted in police vehicles and may have one or two antennae. Moving radar is employed, as the name implies, when a police vehicle is in motion and can be very sophisticated, able to track vehicles approaching and receding, both in front of and behind the patrol vehicle. It can also track the fastest vehicle in the selected radar beam, front or rear.

However, there are a number of limitations to the use of radar speed guns. For example, user training and certification are required so that a radar operator can use the equipment effectively. Stationary traffic enforcement radar must occupy a location above or to the side of the road, so the user must understand trigonometry to "guess" vehicle speed as the direction changes while a single vehicle moves within the field of view. Vehicle speed and radar measurement are rarely the same for this reason. Radar speed guns do not work reliably in traffic, and significant vehicle separation is essential for proper operation when used for speed monitoring.

Size

The primary limitation of hand held and mobile radar devices are size. An antenna diameter of less than several feet limits directionality, which can only partly be compensated for by increasing the frequency of the wave. Size limitations can cause hand-held and mobile radar devices to produce measurements from multiple objects within the field of view of the user.

Distance

A second limitation for hand-held devices is that they have to use continuous-wave radar to make them light enough to be mobile. Speed measurements are only reliable when the distance at which a specific measurement has been recorded is known. Distance measurements require pulsed operation or cameras when more than one moving object is within the field of view. Continuous-wave radar may be aimed directly at a vehicle 100 yards away but produce a speed measurement from a second vehicle 1 mile away when pointed down a straight roadway. Operators cannot be certain which object's speed the device has measured without distance information, which is unavailable with continuous wave radar.

Environment

The environment and locality in which a measurement is taken can also play a role. Using a hand-held radar to scan traffic on an empty road while standing in the shade of a large tree, for example, might risk detecting the motion of the leaves and branches if the wind is blowing hard (side lobe detection). There may be an unnoticed airplane overhead, particularly if there is an airport nearby. Hand-held radar is only reliable on single vehicles when the location has been certified to be free of environmental influences that will cause false readings. Site survey must be repeated periodically for reliable operation.

2. LIDAR (Light Detection and Ranging) [2]

A LIDAR speed gun is a device used by the police for speed limit enforcement which uses LIDAR to detect the speed of a vehicle. Unlike Radar speed guns, which rely on Doppler shifts to measure the speed of a vehicle, these devices allow a police officer to measure the speed of an individual vehicle within a stream of traffic. LIDAR relies on the principle of time-of-flight of two (or more) short 905 nm wavelength (near infrared - NIR) LASER pulses.

Limitation of lidar

LIDAR can be used to measure vehicles coming toward the LIDAR gun or moving away from the LIDAR gun. More often it is used to measure the target vehicle coming toward the LIDAR gun because this allows the police officer, who may be operating alone, to wave the driver down for ticketing/arrest.

The LIDAR is generally used as a stationary device and fired in clear air. There is a low probability that a police officer will try to operate it in heavy rain or through a windshield from inside his vehicle. Unlike police radar, it is able to pick a single vehicle out of a group.

3. SDCS (Speed Detection Camera System) [3]

These methods, presents a new Speed Detection Camera System (SDCS) that is applicable as a radar alternative. SDCS uses several image processing techniques on video stream in online - captured from single camera- or offline mode, which makes SDCS capable of calculating the speed of moving objects avoiding the traditional radars' problems. SDCS offers an en-expensive alternative to traditional radars with the same accuracy or even better. SDCS processes can be divided into four successive phases; first phase is Objects detection phase. Which uses a hybrid algorithm based on combining an adaptive background subtraction technique with a three-frame differencing algorithm which ratifies the major drawback of using only adaptive background subtraction? The second phase is

Objects tracking, which consists of three successive operations, object segmentation, Object labeling, and Object canter extraction. Objects tracking operation takes into consideration the different possible scenarios of the moving object like; Simple tracking, object has left the scene, object has entered the area, object cross by another object, and object leaves and another one enters the area. Third phase is speed measurement phase, which is calculated from the number of frames captured by the camera to pass-by the scene. The final phase is Capturing Object's Picture phase, which captures the image of objects that exceeds the speed limits. SDCS is implemented and tested in many experiments; it achieved a satisfactory performance.

Requirements and Analysis

i. Supporting online and offline modes.
ii. Categorization of inputted video in offline mode into predefined extension.
iii. Categorization of the camera to provide an online video stream in online mode.
iv. Specify the distance captured.
v. Specify the limited speed for objects.
vi. Specify the folder to save the images in.
vii. Detecting moving objects.
viii. Tracking moving objects.
ix. Shadow removal.
x. Calculating speed of objects entered the scene and exit appropriately.
xi. Marking the vehicle which violates the limited speed.

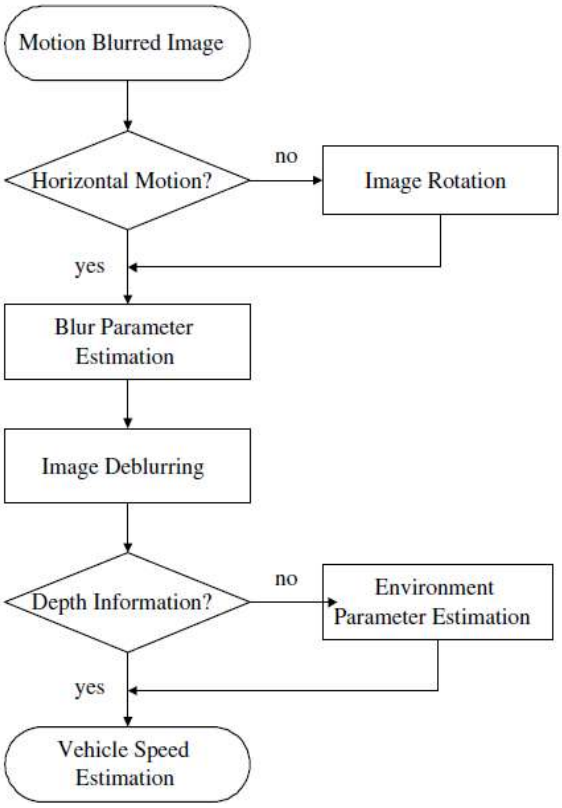
Limitations of Speed Detection Camera System method

i. Interactive User Interface (GUI)
ii. Troubleshooting for system inconsistencies
iii. Portability
iv. Performance Requirements(speed, response time)
v. Reliability of system with its functionality
vi. Manageability and Ease of Use of the system main features
vii. Scalability
viii. Extensibility
ix. Robustness

4. SMBI (Single Motion Blurred Image) [4]

In Single Motion Blurred Image (SMBI) approach for vehicle speed detection and identification based on single image taken by a stationary camera. Due to the relative motion between the camera and the moving object for an extended period of camera exposure time, motion blur will occur in a region of the image corresponding to the moving object in the scene. For any fixed time interval, the displacement of the vehicle in the image is proportional to the amount of blur caused by the imaging process. Thus, if the parameters of the motion blur (e.g. the motion length and the orientation) and the relative position between the camera and the object can be identified, the speed of the vehicle can be estimated according to the imaging geometry. Furthermore, for the motion blurred image taken with the license plate, image restoration provides a way to identify the vehicle.

The feasibility of a vehicle speed detection and identification technique using a single motion blurred image. Motion blur has recently been investigated for different application areas, such as image deblurring and increasing image resolution from video sequences, depth measurement and 3D shape reconstruction, optical flow calculation, motion estimation, and the creation of computer generated images. However, to the best of the authors' knowledge, it has never been used for vehicle speed detection before. We have provided a link to establish the relationship between motions blurred images and the corresponding 3D information. In this study, we consider a common case that the optical axis of the camera is parallel to the ground. Reasonable agreement on the speeds of moving vehicles is obtained between several other speed measurement methods and the proposed approach using motion blurred images.



Flowchart of SMBI method

III. EXPERIMENTAL RESULT

In this survey we compare various methods of vehicle speed detection considering theirs accuracy, sensitivity, portability, complexity and cost.

1. Accuracy

Accuracy of calculating speed is very important issue in vehicle speed detection. RADAR has lower accuracy than LIDAR and SDCS have quite low accuracy than both RADAR and LIDAR.

LIDAR have better accuracy than RADAR and SDCS. Error occurred in SDCS is less than 2% because it used video cameras. In single motion blurred image (SMBI) it was difficult to obtain an accurate speed estimate using a video camera since the vehicle was moving fast and very close to the camera. Thus, the recorded images were deblurred first to find a few reference features and then used for speed computation. An approximation was found to be 110.22 km/h, which is within 2%.

2. Sensitivity

Sensitivity it is another important issue in speed detection. In RADAR large targets close to radar gun can saturate receiver. Extreme sunlight cannot damage. In LIDAR Rounded surfaces, the colours black, blue, and violet are poor reflectors. In SDCS and SMBI method heavy rain can create problem when capture video or image.

3. Portability

Portability it is important for speed calculation. Sometimes on heavy traffic we used cameras to detect high speed vehicles but it is limited for that area only for that we can use RADAR or LIDAR gun which are portable. We can easily move this gun from one location to another location.

4. Complexity

Complexity of system is very important factor consider selecting any method for speed detection. RADAR and LIDAR method used small database as compared with SDCS and SMBI method. RADAR and LIDAR does not need professional persons to deal with it as it has a simple interface and good design but SDCS need professional person. SDCS and SMBI method need large component compare with RADAR and LIDAR.

5. Time

Time required for vehicle detection and speed calculation is very important factor of speed detection methods. The system which required less time to calculate speed of vehicle is very useful method. Radar can take up to 2 second to lock on whereas lidar can take up to less than 1/3 second. SDCS can take up to 2.6 second for bike and 2.4 second for car. In SMBI method speed detection is depends upon cameras shutter speed.

6. Cost

Cost of System used for speed calculation of vehicle is important factor. SDCS method require large database for storing video, therefor cost of SDCS method is higher than RADAR and LIDAR methods because these two methods require only gun to detect speed. SMBI method capture only one image therefor database require is less than SDCS method therefor cost is low compare with SDCS method.

IV. CONCLUSION

Vehicle speed detection for the purpose of traffic speed Law enforcement is currently achieved by radar or laser based methods. Compared to passive camera systems, those methods use more expensive active devices and can be discovered by radar or laser detectors. SDCS method require large database its cost is high. In SMBI the motion blur parameters and the relative position between the vehicle and the camera are estimated and then used to detect the speed of the moving vehicle according to the imaging geometry. For the motion blurred image taken with the license plate, image restoration provides a way to identify the vehicle. We have established a link between the motion blur information of a 2D image and the speed information of a moving object. Database requires is small therefor cost is low. Thus SMBI better method for speed calculation.

V. REFERENCE

[1] D. Sawicki, Traffic Radar Handbook: “A Comprehensive Guide to Speed Measuring Systems”, Author House, 2002.
[2] Daniel G¨ohring, Miao Wang, Michael Schn¨urmacher, Tinosch Ganjineh, Institute fur Informatik Freie Universit¨at Berlin, Germany:” Radar/Lidar Sensor Fusion for Car-Following on Highways”
[3] International Journal of Computer and Electrical Engineering, Vol. 3, No. 6, December 2011.
[4] Huei-Yung Lin, Kun-Jhih Li, Chia-Hong Chang, Traffic Radar Handbook: “Vehicle speed detection from a single motion blurred image”, Image and Vision Computing (2008), 1327-1337
[5] T. Schoepflin, D. Dailey, “Dynamic camera calibration of roadside traffic management cameras for vehicle speed estimation”, IEEE Transactions on Intelligent Transportation Systems 4 (2) (2003) 90–98.
[6] D. Slepian, “International Journal of the Physical Sciences” Vol. 5(17), page no. 2555-2563, 18 December, 2010.
[7] Y. Yitzhaky, N. Kopeika, “Identification of blur parameters from motion blurred images”, Graphical Models and Image Processing 59 (5) (1997) 310–320.