ABSTRACT: In this paper, we proposed a method to estimate the vehicle speed in accident prone areas using the video frames captured from the camera fixed on the road. To calculate the absolute difference between two frames, one frame is taken as the reference frame and then two different frames are taken to calculate correct distance between those two frames, giving us the motion in the frame. After this, we perform the thresholding and morphological operations to calculate the vehicle mask. This mask is used as a basis to calculate the centroid in the two images. The difference between the centroid of the two images gives us the displacement of the vehicle with respect to the two frames through which we calculate the velocity. Finally, results show that the proposed method exhibits well and consistent performance.

Keywords: Frame Differencing, Thresholding Operation, Morphological, centroid.

1. INTRODUCTION

Now days, traffic management is one of the serious problem of our society as well as economy. With increasing traffic, there are chances of bundle of problems like traffic jams, accidents and traffic rule violations. One of the modes of transportation is road and if we do not follow the rules of driving, then it can increase accidents. The expected increase of cars from 2005 to 2035 is 13 times i.e. 35.8 million to 236.4 million vehicles and with two wheelers the increase is 6.6 times i.e. 35.8 million to 236.4 million vehicles. Finance minister P. Chidambaram in budget 2014-15 has given relief to the automobile industry by reducing the excise duty on SUVs from 30% to 24% and for small cars, motorcycles, scooters and commercial vehicles from 12% to 8%. In the fiscal year, decrease in excise duty will also increase the number of vehicles on road by a large number. There are certain areas that are highly prone to accidents and those areas are converted into speed restricted areas, where one is allowed to drive within a certain speed limit.

In 2011 37.1% people are killed on national highways in India of the total road accidents. The major reasons that contribute to the potency of road accident causation drivers, indecisiveness, fatigue, distraction, and confusion. In addition, in most of the cases the drivers are found to be inexperienced, risk takers, impulsive, aggressive, casual and unaware of the road signals.

Vehicle speed estimation is therefore becoming more important due to their advantages of saving lives, money and time. Acquiring traffic information, such as the number of travelling vehicles per time period through a position in a lane, the number of total vehicles in a given area at a given time and vehicle speed, these are the key part of vehicle speed estimation, and such information is used to manage and control traffic. It concentrates on vehicle speed since reducing speed can help to reduce accidents.

2. Vision Based System

The most convenient methods available in speed detection are vision based vehicle speed measurement. A novel algorithm is given for estimating vehicle speed from two consecutive images. Its principles are both images are transformed from the image plane to the 3D world coordinates based on thee calibrated camera parameters. Second, the difference of the two transformed images is calculated, resulting in the background being eliminated and vehicles in the two images are mapped onto one image. Finally, a block feature of the vehicle closest to the ground is matched to estimate vehicle distance and speed. Vehicle speed measurement for accident scene investigation shows the characteristics of accident scene by including the information of lane marks and background model is estimated and used for motion detection.

Vehicle speed detection based on video at urban intersection in calculates the vehicle velocity by the width of the detection zone and the time it takes for the target vehicles to drive into and depart from the detection zone. Vehicle velocity estimation for traffic surveillance system in calculated the speed of the vehicle based on the displacement of the vehicle’s centroid.
Most vision-based speed estimation methods estimate average traffic speed over a period of time with error rate of over 10% compare with the reference value. Such error rate is considered large for any practical use. The errors due to day-night transition or general weather changes could be large unless updating is frequent enough, which needs to trade-off with computational complexity.

Flow Chart of Vision based System

3. PROPOSED WORK

a. Algorithm
i. Read and access the video and find information like number of frames, width and height of the video captured.
ii. Create a structure to capture all the frames from the video.
iii. From the list of frames, select two frames and a background frame.
iv. Perform frame differencing of the two frames with the background frame and a Grayscale image is created.
v. Convert the grayscale image into binary image using thresholding operation.
vi. Remove lane marking and others non-disk shaped structures using morphological Processing.
vii. Perform morphological closing to join the vehicle disconnected components together.
viii. Get the centroid of the maximum area in both the images.
ix. Calculate the change in horizontal distance by subtracting the x value of both the centroid.

\[
\text{Delta}_x = \text{abs}(x_2 - x_1)
\]
x. Convert the distance in pixels measuring white lane distance measured using tape.

Here 1.57 meter is the measured distance of the white lane and 160 is the pixel distance of white lane.

\[
\text{Pixel}_\text{metre} = \frac{1.57}{160} \\
\text{distance}_{\text{travel}} = \text{Delta}_x \times \text{Pixel}_\text{metre}
\]

xi. Calculate the velocity by dividing the distance to the time elapsed calculated using the frame rate.

\[
\text{time}_{\text{elapsed}} = \frac{\text{frame}\_\text{difference}}{\text{frame}\_\text{rate}} \\
\text{Velocity} = \frac{\text{distance}_{\text{travel}}}{\text{time}_{\text{elapsed}}}
\]

b. Frame Differencing Operations
In the frame differencing operation we first select a reference background frame. We then select two different frames of the video and calculate the absolute difference between those two frames with the reference background frame. The result of this operation shows the actual movement in the frame as seen in Fig.

![Figure 1: Frame X](image1.png)

![Figure 2: Frame Y](image2.png)

Figure 2: Result of Frame differencing being performed on (a) Frame X and (b) Frame Y with background frame.

C. Thresholding Operations
Image Thresholding is a simple, yet, effective way of partitioning an image into a foreground and background. [8] This image analysis technique is a type of image segmentation that isolates objects by converting grayscale images into binary images. Image thresholding is most effective in images with high level of contrast. After performing the frame differencing operation we perform the thresholding operation to convert the image into the binary image as seen in Fig 4. It is easy to perform the motion operations on the binary image than the grayscale image.
Threshold follows the same concept as in basic electronics, here it is used to convert the grayscale image to black and white (binary image, consisting of 0's and 1's as pixel values.) We select the same frame X and frame Y from the last operation and perform thresholding on it.

Figure 3: Frame X

Figure 4: Frame Y

Figure shows the Thresholding is performed on (a) Frame X and (b) Frame Y to convert it into binary images.

d. Morphological Operation

After thresholding operation we observed that we are left with lots of isolated points which add to the complexity. Morphological operations are performed to remove all the isolated points that are observed in the thresholding as seen in Fig 5. We are removing the isolated points so that we are left with clear points that belong to the vehicle.

Figure 5: Frame X

Figure 6: Frame Y

Figure 4: Morphological operations are performed on (a) Frame X and (b) Frame Y to clean up all the isolated points.

Now after removing the isolated points we are left with some disconnected components. If we calculate the centroid of all these disconnected components than it will become difficult for us to calculate the displacement of the vehicle because of large number of centroid. We will not able to judge that which centroid we need to pick to calculate displacement. Therefore we will connect all these disconnected components together. So we will now perform morphological closing to connect the vehicle disconnected components together as shown in Fig 6 for Frame X and Frame Y.

Figure 7: Frame X

Figure 8: Frame Y

Fig. Morphological closing is performed on (a) Frame X and (b) Frame Y to join the disconnected vehicle components together. The centroid of the maximum area in both the frames is calculated. Then the displacement is calculated by the difference in the x position of their respective centroid.

4. EXPERIMENTAL RESULTS

<table>
<thead>
<tr>
<th>S. No</th>
<th>Original Velocity</th>
<th>Velocity Calculated</th>
<th>Percentage Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>34</td>
<td>37.12</td>
<td>2.31 %</td>
</tr>
<tr>
<td>2</td>
<td>38</td>
<td>32.90</td>
<td>3.23 %</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>29.04</td>
<td>3.20 %</td>
</tr>
<tr>
<td>4</td>
<td>26</td>
<td>25.28</td>
<td>2.76 %</td>
</tr>
</tbody>
</table>
5. ADVANTAGES

i. It is simple & fast method.
ii. Accident level is reduced.

6. SOFTWARE TOOLS

In our paper we use MATLAB software having a version 7.10.0499(R2010a). MATLAB software provide best simulation platform. MATLAB (matrix laboratory) is a multi-paradigm numerical computing environment and fourth–generation programming language. Developed by MathWorks, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, JAVA, and FORTRAN. Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic engine, allowing access to symbolic computing capabilities. An additional package, Simulink, adds graphical multi-domain simulation and Model-Based Design for dynamic and embedded systems. In 2004, MATLAB had around one million users across industry and academia. MATLAB users come from various backgrounds of engineering, science, and economics. MATLAB is widely used in academic and research institutions as well as industrial enterprises.

7. CONCLUSION

In this paper a method to calculate the velocity of the vehicle is explained. First of all frame differencing is performed to get the motion in the image. Then thresholding is performed to convert the grayscale image into binary image. Isolated points are removed using the morphological operations. Morphological closing is performed to join the disconnected vehicle components together. Then the centroid is calculated and the difference in horizontal distance is the displacement of the vehicle. Through this method we calculate the velocity with percentage error less than 4%. Future work will be focused on reducing the percentage error and developing the method that work in night time also.

8. REFERENCES

[3] Manisha Ruikar “National Statistics of road traffic accidents in India” Department of Community and Family Medicine, All India Institute of Medical Sciences (AIIMS), Raipur, Chhattisgarh, India, Jan–April 2013.