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Velocity Measurement of Moving Object using Camera

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ABSTRACT: This paper is subjected to one main objective that is to develop a system that may be able to sight the speed of moving vehicle employing a web camera. The speed detection exploitation traditional camera are going to be terribly helpful in a lot of quite industries since its main feature is affordable or low value. This project intends to develop the vehicle speed detection system for trap system. Beside the most objective, there are numbers of sub-objectives of this project. Below square measure the sub objectives for the project: to develop a replacement approach of sleuthing speed exploitation net camera and to live the speed of moving vehicle.

KEYWORDS: Image processing, Filtering, Thresholding, Linear speed, Pixels.

I. INTRODUCTION

A lot has been same regarding Asian country topping the chart for one amongst the country with highest rate of road accidents. The authorities play their role at the best efforts so as to extend the road safety however the numbers of individuals killed or abraded on the roads stay intolerably high. One amongst the factors that contribute to road accidents is dashing. Because the speed of auto is one amongst the most factors for road accidents, it becomes a very important traffic parameter, therefore the detection of speed of auto is incredibly important for additional swish traffic management. Therefore, there are several efforts created by the govt. to scale back dashing such traffic signal and vehicle speed detection by exploitation radio detection and ranging (Radio Detection and Ranging) or measuring instrument (Laser Infrared Detection and Ranging) based mostly strategies. Though radio detection and ranging and measuring instrument based mostly strategies were high in performances, they're conjointly terribly high in worth that around RM1000 to RM 14000 per item. It's not reasonable if it meant to use for several roads around Malaysia. There was conjointly speed camera methodology accustomed sight the speed of moving vehicle, however speed camera is additionally depends on radio detection and ranging instrumentality.

Speed cameras area unit sometimes placed behind trees and road sign. It failed to want the employment of force sort of a speed guns wherever there should be a person's to work the system in any respect the time. So, at the primary look, these speed cameras appears to be the most effective methodology for trap however as long because the instrumentality remains supported the radio detection and ranging approach, this methodology are going to be at disadvantage as a result of it cannot be mounted despite however the technology has been improved to date. Therefore, the approach of exploitation image process in vehicle speed detection was introduced to interchange the employment of radio detection and ranging and measuring instrument. Image process is additionally less costly compared to radio detection and ranging approach because it solely wants one video camera and a laptop. Image process is that the technology that is predicated on the code element that doesn't need special hardware. A recording device and a traditional laptop with MATLAB code put in within will served the necessity for low value of investment for vehicle speed detection. A basic medicinal drug rate theory will be accustomed calculate the speed of moving vehicle within the video scene from the best-known distance and time. There are a unit six major elements in mensuration speed of auto by exploitation image process approach that area unit image acquisition, image sweetening, image segmentation, image analysis and speed calculation. Image process methodologies are terribly helpful in detective work speed of auto. For examples area unit image sweetening and image differentiation. The image differentiation is employed within the vehicle detection stage. First, opt for the background image and set the linear projection. The speed of the vehicle is computed once the vehicle

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passes through the linear projection. This background-updating technique is additional helpful compared to thresholding methodology because it will sight the vehicle additional accurately. While, the image sweetening like region filing and image scaling is employed in rising the form of the article or the vehicle. The image segmentation plays biggest role during this project because it acts as medium for measure of distance that the vehicle traveled through.

Detection and localization of object have invariably been the foremost attention-grabbing a part of image process. Advanced algorithms area unit developed from time to time to sight objects exploitation varied approaches. Surveys are distributed to seek out the on the market strategies for Object trailing [1]. Feature based mostly object trailing [2] conjointly gained significance in varied fields that isolate every object supported its featured look in image. variety of techniques are projected in numerous researches for providing object-centric info like orientation, space or form [3] [4] that helped in document analysis like Devnagari and Bengali font extraction projected by Bhattacharya et al [5] and Text extraction techniques comparison by Graham Leedham et al [6]. Those analytical approaches have conjointly been tested beneficiary for reality applications like medical diagnostic systems [7]. These static imaging approaches produce the bottom for object trailing for real time video analysis from live camera. Additional economical techniques area unit projected to beat the challenges in real time trailing systems [8], wherever extracted info from video area unit used for more information analysis. Johan Sommerfeld projected the techniques for trailing objects from single camera [9]. Recent researches have projected strategies for reality application with real time camera however they're conjointly restricted in their domain and application atmosphere. Some examples area unit Anomaly Detection in police work Video exploitation Color Modeling [10] and Accident bar exploitation Eye Blinking and Head Movement [11]. Moving a step more we've got tried to expand the domain wherever object properties will be mapped directly from image to globe situation. From detected object within the image we have a tendency to tried to relate the article properties i.e. displacement and rate with some provided info and constraints. The projected approach not solely tracks an object however conjointly deals with a rate calculation methodology which might be extended to alternative domain to support other systems.

Numerous researches are conducted so as to observe or estimate the speed of a moving vehicle exploitation the image process technique. Analysis like [12-15] presents numerous papers on the time period vehicle detection and speed estimation. Existing strategies applied into vehicle speed detection, together with speed detection supported digital aerial pictures [16], combination price [17] and frame differencing [18] to provide the foremost flourishing outcome. Digital aerial pictures [16, 19] or camera UltraCamd [20] is employed in image process exploitation the image extraction and detection visually and automatic extraction and detection [16, 20]. The computed result's additionally compared with one another and is bestowed in [16, 20].

The accuracy in scheming the position and orientation of remote objects could be an essential issue in robotic vision. Tao et al. [21] planned a replacement visual sense technique to search out the cause estimation of remote objects through translation and rotation matrices exploitation image feature extraction and knowledge optimization. To cut back environmental lightweight variations and succeed a more robust distinction between target and background, Tao et al. [21] used near-infrared lightweight because the source of illumination. Tao et al. [21] additionally designed a replacement feature-circle-based standardization drone to accomplish automatic camera standardization. The results of Tao et al.'s [21] experiments incontestable but 8″ and less than 0.02 millimeter within the repeatability preciseness of angles and also the repeatability preciseness for displacement, severally. Fig. 1 displays Tao et al.'s [21] vision system that is reportedly already being employed during a wheel alignment system.

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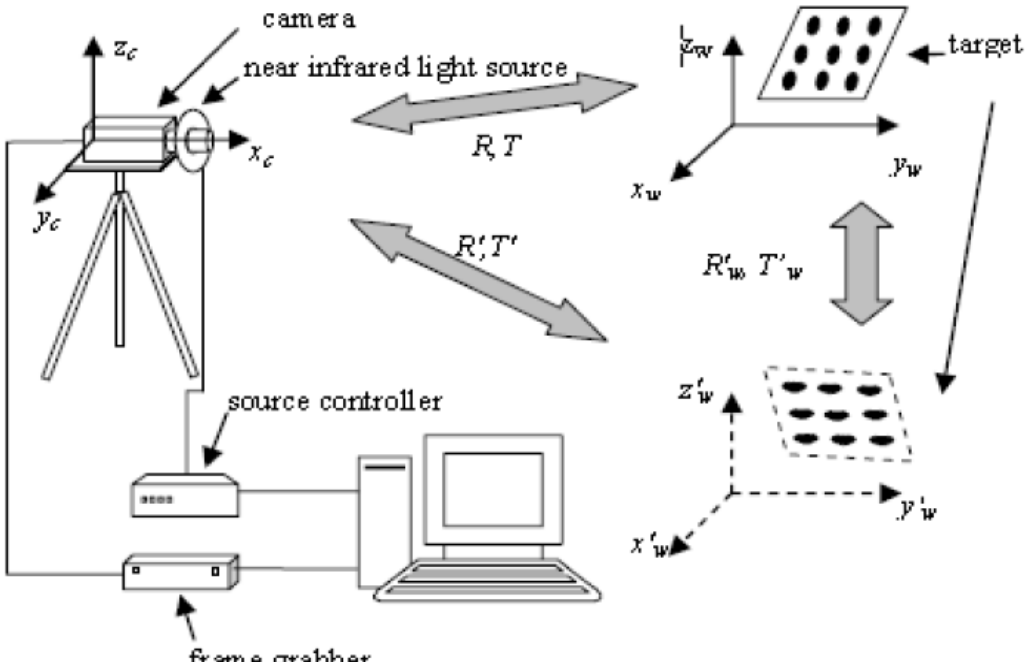

Fig. 1:Diagram of the Tao et al. measurement system [21]

Some researchers, such as Krishnan et al. [22], proposed an object-to-camera distance based on a complex log mapping method. This method has the advantage of measuring the distance between the camera and an object's surface with an arbitrary texture pattern. The idea behind this technique is to use two images taken at two different camera positions to measure the object-to-camera distance. The object-to-camera distance, in this technique, is calculated through the ratio between the object's sizes projected on the two images that are moved on the camera's optical axis.
Kendal [23] suggested a general method of horizontal and vertical object distance calculations, where the object plane was parallel to the image plane or was tilted in the vertical plane using digital images. The size, density, and spatial distribution of a sample (shrubs) were also investigated in the Kendal [23] method. The experimental results showed a strong relationship between calculated distances and actual distances for different cameras, focal lengths, distances, and vertical tilt angles.

II. METHODOLOGY

The idea of this project is to calculate the vehicle speed from known distance and time when the first vehicle passes the starting point and the time the vehicle finally reaches end point.
Below figure is the flow chart of the vehicle speed detection. It is to provide a deeper understanding of the details of operation of the vehicle speed detection. Based on flow chart below, the process consists of five major components which are image acquisition, image segmentation, image enhancement, image analysis, and speed calculation.

(a) Image Acquisition
To use the Image Acquisition Toolbox to acquire image data, you must perform the following basic steps:
Step 1: Install and configure your image acquisition device
Step 2: Retrieve information that uniquely identifies your image acquisition device to the Image Acquisition Toolbox
Step 3: Create a video input object
Step 4: Preview the video stream
Step 5: Configure image acquisition object properties
Step 6: Acquire image data

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Step 7: Clean up

Fig. 2:Methodology of Proposed System

(b) Image Enhancement

Image improvement draw back are going to be developed as follows: given academic degree input calibre image and additionally the output top of the range image for specific applications. It is well-known that image improvement as an active topic in medical imaging has received plethoric attention in recent years. The aim is to spice up the visual look of the image, or to provide a better work illustration for future automatic image method, like analysis, detection, segmentation and recognition. Moreover, it helps analyses background information that is essential to grasp object behaviour whereas not requiring pricey human visual examination. Finishing image improvement beneath standing beneath calibre image is also a tough draw back because of these reasons. As results of low distinction, we have a tendency to tend to cannot clearly extract objects from the dark background. Most colour based ways will fail on this matter if the colour of the objects that of the background square measure similar. The survey of accessible techniques depends on the current techniques of image improvement, which can be classified into a pair of broad categories: spatial domain image improvement and Frequency primarily based domain image improvement. Spatial based domain image improvement operates directly on pixels. The foremost advantage of spatial based domain technique is that they conceptually simple to grasp and additionally the complexity of these techniques is low that favours real time implementations. But these techniques generally lack in providing adequate robustness and property wants. Frequency based domain image improvement is also a term accustomed describe the analysis of mathematical functions or signals with relevance frequency and operate directly on the work coefficients of the image, like Fourier work, separate wave work (DWT), and separate work (DCT). The elemental set up in using this methodology is to spice up the image by manipulating the work coefficients. The advantages of frequency based image improvement include low complexity of computations, simple viewing and manipulating the frequency composition of the image and additionally the easy pertinence of special reworked domain properties.

(c) Image Segmentation

Unsupervised image segmentation algorithms have matured to the aim that they provide segmentations that adjust to associate degree outsize extent with human intuition. The time has arrived for these segmentations to play an even bigger role in seeing. It's clear that image segmentation is also accustomed facilitate cue and refine various recognition algorithms. However, one in all the obstacles that keep is that it's unknown specifically but well these segmentation algorithms perform from degree objective posture. Most shows of segmentation algorithms contain superficial analysis that simply show footage of the segmentation results and charm to the reader's intuition for analysis. There's an even lack of numerical results, thus it's powerful to know that segmentation algorithms gift useful results and at intervals that things they're doing so. Appealing to human intuition is convenient, however if the formula goes to be used in associate degree automatic system then objective results on huge datasets are to be desired. Throughout this paper we tend to tend to gift the results of degree objective analysis of two image segmentation techniques: mean shift segmentation [35], and additionally the economical graph-based segmentation formula bestowed in [37]. As well, we tend to look at a hybrid variant that mixes these algorithms. For each that algorithm, we tend to tend to look at three characteristics:

1) Correctness: the pliability to supply segmentations that settle for as true with human intuition. That is, segmentations that properly establish structure at intervals the image at neither too fine nor too coarse grade of detail.

2) Stability with respect to parameter choice: the pliability to supply segmentations of consistent correctness for a diffusion of parameter selections.

3) Stability with respect to image alternative: the pliability to supply segmentations of consistent correctness exploitation an analogous parameter selection on a decent varies of varied footage. If a segmentation theme satisfies

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these three characteristics, then it's going to give useful and inevitable results which can be reliably incorporated into an even bigger system.

III. IMPLEMENTATION OF PROPOSED SYSTEM

(a) Hardware Implementation

Complete hardware assembly is shown in figures 4.1. The main part of the hardware is web camera which is located on a stand of height 45cm. Another part is white board which is used to locate position of object. Size of hard white board is 50x50cm. Camera is placed on a height of 45cm so that it can cover 40x40cm of hard board area.Hardware used in this project includes having three parts

1- Processor
2- Camera
3- Hard Board

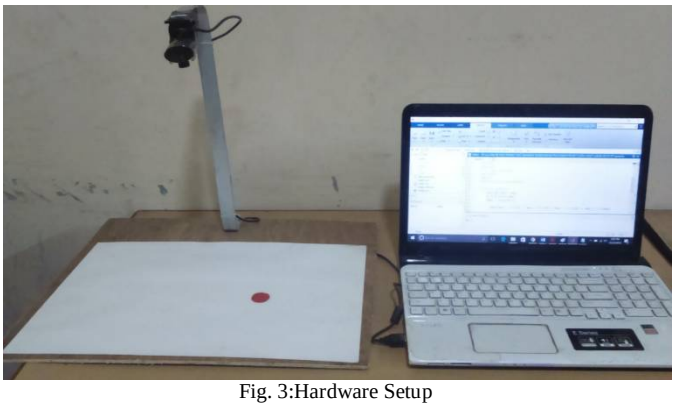

Fig. 3:Hardware Setup

A processor (computer) is used for processing data received by image acquisition device. Camera is used for image acquisition with captures frame from video and provide to computer. Computer have inbuilt MATLAB tool to process the information received, and displays angular speed of DC motor. Processor specifications are Intel Core i3 processor, 2.4GHz CPU frequency, 4GB RAM, 64-bit operating system has been used.

(b) Software Implementation

Software of proposed work is developed on MATLAB. Initial step of program is to capture image form video. Commands used in this process are as follows

```
vidobj=videoinput('winvideo',1,'YUY2_320x240');
set(vidobj, 'ReturnedColorspace', 'RGB');
vid=vidobj;
preview(vid)
pause(4)
s=getsnapshot(vid);
```

The captured image shown in fig. 4(a) and second captured image is shown in fig. 4(b). Second image is capture on a delay of 5 seconds after first image has captured.

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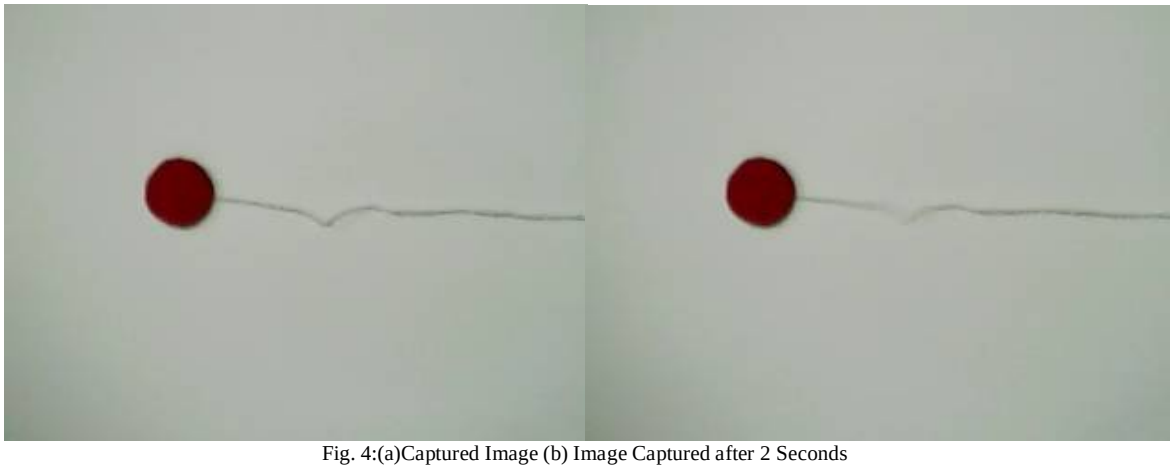

Fig. 4:(a)Captured Image (b) Image Captured after 2 Seconds

In second step captured RGB image is converted to YCBCR image using command rgb2ycbcr.
Now in third step thresholding is applied to ycbcr image and resultant binary image is shown in fig. 5.

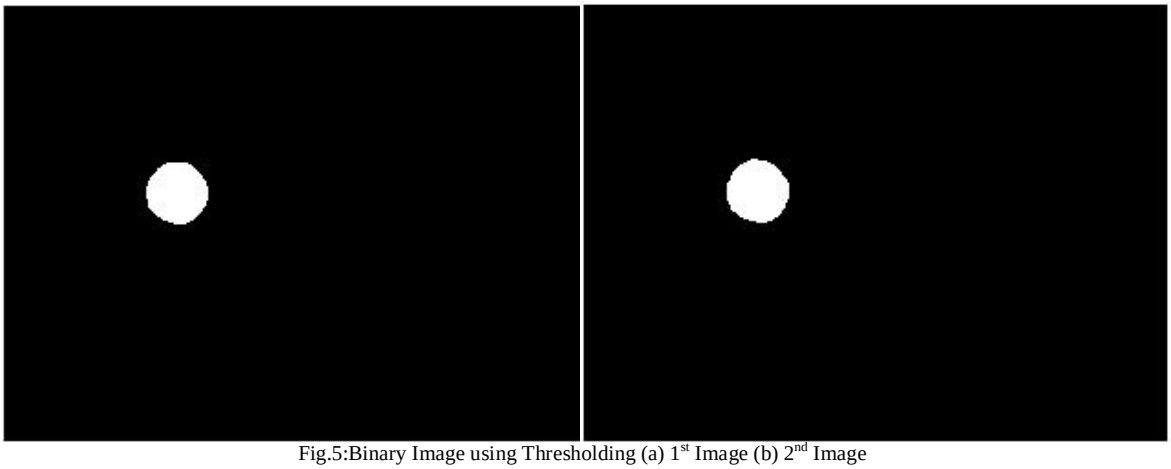

Fig.5:Binary Image using Thresholding (a) 1st Image (b) 2nd Image

In fourth step centroid of both images are calculated using connected component analysis.
Centroid of both images are (x1,y1) and (x2,y2).
Now displacement is calculate using eq (4.1)

$$r = \sqrt{(x2 - x1)^2 + (y2 - y1)^2}$$

As we know that time different in capturing both images is 5 second.
Hence $\Delta t = 2\ sec$
Linear velocity of vehicle can be calculated as

$$v = \frac{r}{\Delta t}$$

IV. SPEED MEASUREMENT

On a primary thought it looks not possible to associate a picture with the important world. How, it'll be doable to extract 3D knowledge from a 2nd image. The thought is to, because of the previous stage, to seek out points that outline the thing so as to match them with identical points of the thing within the world. When reading the documentation [14], we have a tendency to found two functions that do exactly this.

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These functions square measure ready to get the rotation matrix and translation vector of anantecedent outlined object, and describe the connection between the things coordinates system in relation with the one among the camera. To outline the thing means that as same, to explain, as an instance, the position during which the corners of our brick on the three axes square measure. The functions calculate the position by the association of every object 3D purpose with same points found within the 2nd image. However, to try and do this it's necessary to calibrate antecedent the camera. The standardisation is finished by capturing pictures of a chess board with proverbial dimensions for, after this, a particular perform calculates the intrinsic parameters and distortion coefficients of the camera.
This is to correct image distortions created by the optical lens and obtain the parameters that relate the pixels with the units of measuring of the important world.

Calculation of Angle Traced on Centre by Curved Image
Radius of circle is predefined and is considered as r. An example is considered as shown in Fig. 6.

Fig. 6:Moving Object Image

Let co-ordinate of first point I1 of image is (x1, y1) and co-ordinate of second point I2 of image is (x2, y2).
Then distance between two points $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
A command bwconncomp is applied on binary image to get pixel information in image in the form of pixels.
Number of pixel for zero component are assigned to
n1= 594 & n2=454
A command regionprops is applied to binary image to measure the centroid of black spots
x = (114.7946,96.4579)
y = (269.6035, 101.7225)
The x and y are two coordinates of center of wheel and object at perimeter.
Now displacement between centroids can be calculated as

$$\Delta s = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1{}^2)}$$

Δs= 154.8984
Now, angular displacement in radian can be calculated as

$$v = \frac{\Delta s}{\Delta t}$$

= 77.45 cm/s

V. RESULTS

Image of moving disc is captured using a webcam and stored. And images are first filtered and then applying thresholding to convert them in binary image. These captured images are shown in below fig. 7

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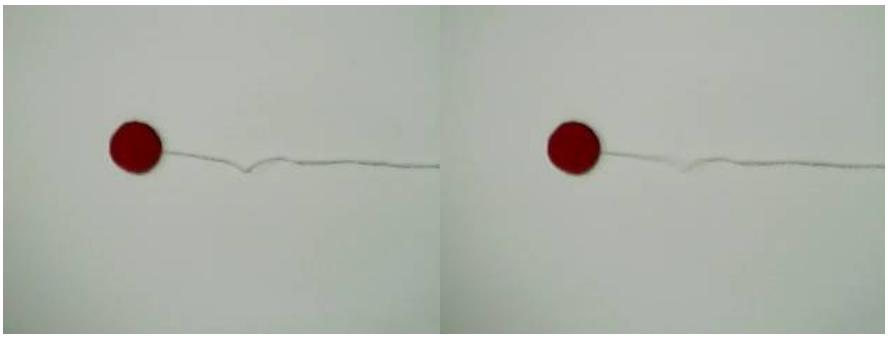
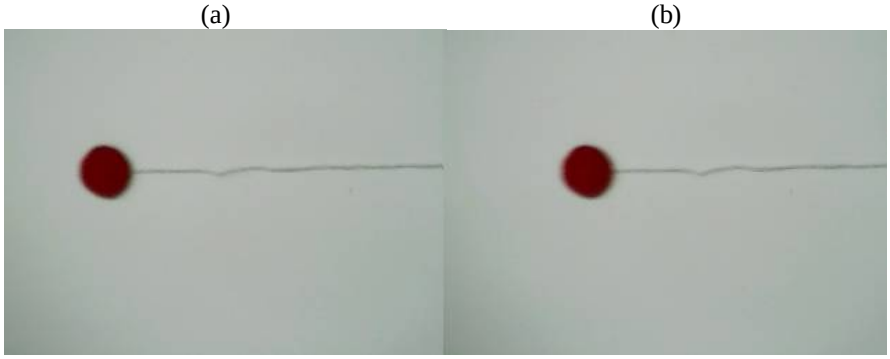
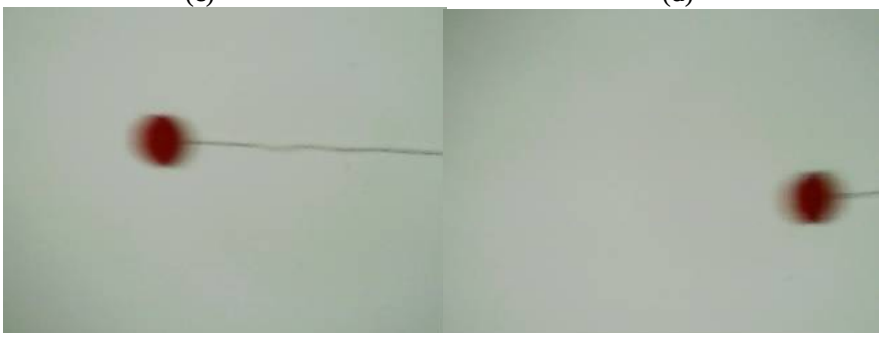


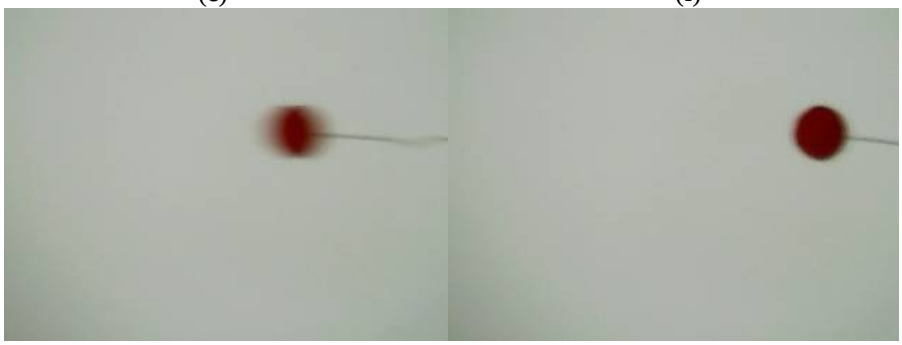
(a) (b)



(c) (d)



(e) (f)



(g) (h)

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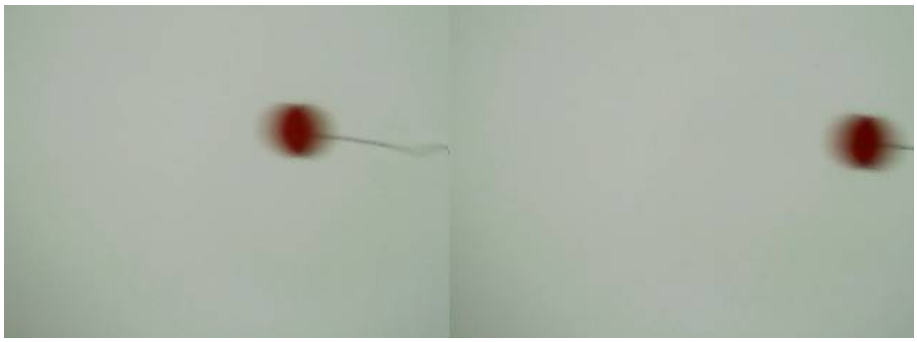

(i) (j)

(k) (l)

Fig. 7: Captured Images (at 2 seconds interval)

Using image processing technique images are processed and used to calculate angular speed of rotating wheel and results are listed in below table1. Error is also calculated for individual images. Mean error and standard deviation of nine images are calculated: mean error is 0.4412 and standard deviation is 0.5916.

Table1: Measured Velocity of different tests,

S. No. (Images)	Velocity of Object (cm/s)
a-b	0.50
c-d	16.03
e-f	77.45
g-h	27.21
i-j	39.69
k-l	56.65

VI. CONCLUSION

Measurement of velocity for any moving object from a single camera is a very challenging problem for the real time video system. In this project two snapshot from a video object is captured at two second time interval. Image captured are blurred. Different levels of noise and blurred images have been experimented successfully with this proposed algorithm. This proposed technique can be extended to vehicle speed detection system on road on a pole using a fixed camera speed placed on. This proposed algorithm is ableto measure speed from grayscale image capturing cameras as our base computation is on grayscale image. In this algorithm time between two capture is already fixed that is two seconds. After capturing image it is converted to binary image and centroid is found first and then displacement is calculated. Calculated velocity of different experiments are shown in table1. Minimum speed captured is 0.5 cm/second and maximum calculated speed is 77.45 cm/s.

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BIOGRAPHY

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