Real Time Movable Object Detection, Tracking and Velocity Estimation Using Image Processing

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Abstract— Moving object detection and tracking is often the first step in applications such as video surveillance, Trajectory Prediction,etc. The main aim of this research is moving object detection and tracking system with a static camera has been developed to estimate velocity, distance parameters. We propose a general moving object detection and tracking based on vision system using image processing algorithm. This paper focus on detect and track the moving object in the scene and estimate the velocity of moving object. In this paper an algorithm is implemented on track the movable object in different video frames using the color feature extraction. This is done by using Matlab software and we could calculate Distance travelled by the object in different frames and estimate the velocity using simple image processing algorithm.

Index Terms— Vision System, Movable Object Detection and Tracking, Features Extraction, Distance Measurment, Velocity Estimation.

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1 INTRODUCTION

Tracking can be defined as the problem of estimating the trajectory of an object in the image plane as it moves around a scene. The need for high power computers, the availability of high quality and inexpensive video cameras, and the increasing need for automated video analysis has generated a great deal of interest in object tracking algorithms. Our main aim is to track the real-time moving objects in different video frames with the help of a implemented algorithm and estimate the velocity. In this paper we present a simplified object detection method based on features subtraction method and a blob matching tracking algorithm that relies only on blob matching information. A moving object detection and tracking system with a static camera has been developed to estimate velocity, distance etc. parameters.For that application we presented features subtraction algorithm which contain Region of interest is the region in which we locate the required object in different video frames. To locate the required object in different video frames, we have to first detect the motion of that object with the help of motion estimation features, such as Centroid, Boundingbox. The tracking methodology discussed in this paper is focussed on locating and tracking an object on the basis of colour.

2 SYSTEM OVERVIEW

2.1 Object Detection and Tracking For Movable Object[1]

Issues related to object tracking involves choosing good tracking algorithms, measuring their performance and understanding their impact on image analysis system. One of the main challenges in object tracking is that of noise, complex object shape/motion, partial and full object occlusions, scene illumination changes, real-time processing requirements. Tracking methodology used in this paper is focused on locating red object in the different video frames.

May, the implemented algorithm discussed in this paper will be helpful in developing better and efficient algorithms in the field of tracking. A basic block diagram for the proposed algorithm is shown below:
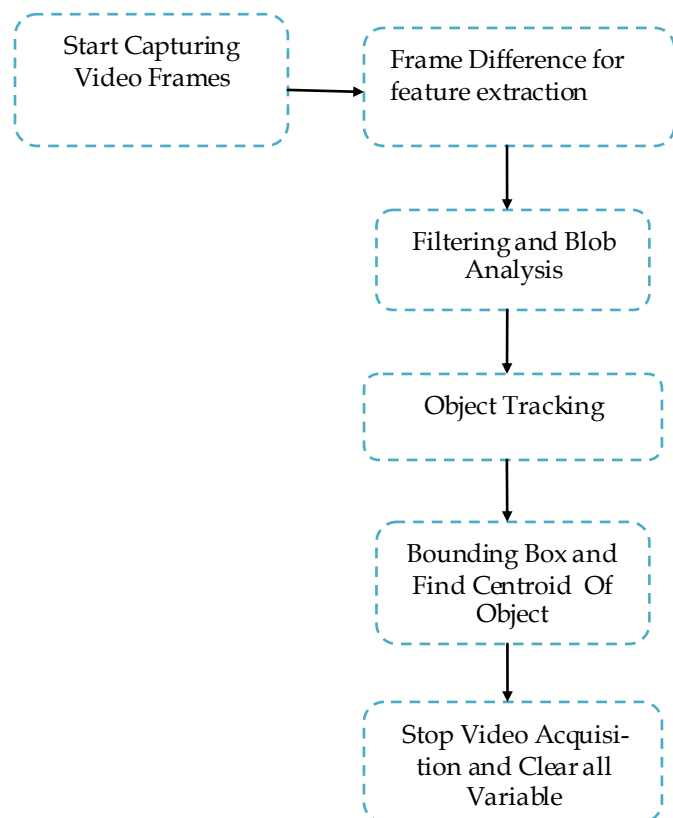

Fig.1 Block Diagram Of Detection and Tracking System

The blocks present in the fig.1 are being explained below in the following steps:

Step1: Capture the video frames using the video input function.

Step2: Set the properties of video object.

Step3: Start the video acquisition.

Step4: Set a loop that starts after 50 frames of acquisition. This loop contains the following steps:

1) Get the snapshot of the current frame.
2) Now to track the red objects in real time we have to subtract the red component from the gray scale image to extract the red components in the image.
3) Use a median filter to filter out noise.
4) Convert the resulting gray scale image into a binary image.
5) Remove all those pixels which are less than 300 pixels.
6) Label all the connected components in the image to perform image blob analysis, here we get a set of properties for each labelled region.
7) Display the image.
8) Again a loop is used to bound the red objects in a rectangular box.
9)

Step5: Stop the video acquisition.

Step6: Flush all the image data stored in the memory buffer.

Step7: Clear all the variables.

2.2 Image Filtering[2]

Another common problem which arises during the object tracking is that of light illumination and background which acts as a noise and is the main problem which arises during the tracking of the object which can be removed by filtering the noise[2]. Median filtering is a non-linear operation often used in image processing to reduce noise. A median filter is more effective than convolution when the goal is simultaneously reduce noiseThe recorded video may have some noise due to bad weather (light, wind, etc. or due to problems in sensors). Few algorithms are tested to improve the image quality, to detect moving object, calculation of distance and velocity of the moving object.[2]

Median filter: The median filter is a classical noise removal filter. Noise is removed by calculating the median from all its box elements and stores the value to the central element. The median filter sorts the elements in a given matrix and median value is assigned to the central pixel. Sorted elements 1, 2, 3, 4, 5, 6, 7, 8, 9 and median 5 will assign to the central element. Similar box scan is performed over the whole image and reduces noise. Execution time is more compared to mean filter, since the algorithm involves with sorting techniques. But it removes the small pixel noise.

2.3 Finding Centroid[1]

If the segmentation is performed using frame difference, the residual image is visualized with rectangular bounding box with the dimensions of the object produced from residual image. For a given image, a scan is performed where the intensity values of the image are more than limit (depends on the assigned value, for accurate assign maximum).

In this Features is extracted by colour and here the intensity value describes the colour. The pixel values from the first hit of the intensity values from top, bottom, left and right are stored. By using this dimension values a rectangular bounding box is plotted within the limits of the values produced. The boundary box is drawn using the dimension Height and Width as calculated below.

$$Hight = (bottom\ value - top\ value)/2$$
$$Width = (right\ value - left\ value)/2 \qquad (1)$$

Initially the Centroid of the object is extracted and then by calculating Height and Width a bounding box is drawn around the object[1].

3 FIND VELOCITY FOR MOVING OBJECT IN DIFFERENT FRAMES[2]

3.1 Velocity Estimation[2]

The velocity of moving object is calculated by the distance it travelled with respect to the time. Distance formula is used to calculate the distance between the sequences of frames. By using the values of distance with respect to frame rate, the velocity of the object is defined. The defined velocity is of 2-dimension (since camera is static). Velocity of moving object is determined using the distance travelled by the Centroid to the frame rate of the video.

Algorithm for calculating velocity is explained as follow:

1. Make a Video of movable object with take a reference distance (0.5m)

2. Find meter/pixels ratio. (with a logic how much pixels in width and how much pixels in height with reference height & width).

3. Read the distance travelled by the object and time taken of 1 frame from frame rate.(29 f/s)

4. Velocity = distance travelled/frame rate

$$V = d/t \quad \text{(m/s)} \qquad (2)$$

5. Save the value in an array

6. The velocity of moving object in the sequence frames is defined in meter / second.

3.2 Distance Measurment

The distance travelled by the object is determined by using the Centroid. The variables for this are the pixel positions of the moving object at initial stage to the final stage.

Algorithm for calculating distance is explained as follow:

1. Read the centroid position of each image.
2. Calculate the distance between two centroid images.
3. Calculate change in distance by Distance

$$d = \sqrt{(((x1 - x2)^2) + (Y1 - Y2)^2} \qquad (3)$$

Where (X1-X2) m/s and (Y1-Y2) m/s.
Where X1=previous pixel position and X2=present pixel position in width   Y1=previous pixel position and Y2=present pixel position in height.
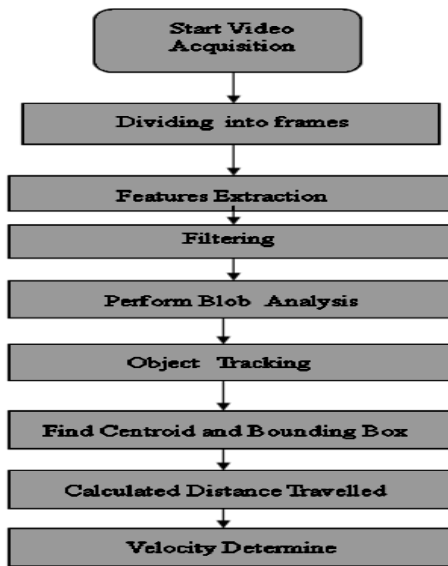Store all the distance values in an Array

Fig 2 Flow Chart of Praposed Algorithm

4 TOOL USED

I choose MATLAB after deciding the various important tasks in my work. I decided that the platform on which I am going to develop my code will be MATLAB, because MATLAB is a high level technical language and interactive environment for algorithm development, data analysis, and numeric computation. Using the MATLAB product, we can solve technical computing problems faster than with traditional programming languages, such as C, C++, and FORTRAN. We can use MATLAB in a wide range of applications, including signal and image processing, communications, the MATLAB environment to solve particular classes of problems in these application areas. MATLAB provides a number of features for documenting and sharing our work, we can integrate our MATLAB code with other languages and applications, and distribute our MATLAB algorithms and applications.
In MATLAB various video acquisition and analysis functions are pre-defined in MATLAB that would make the development of my work much easier.

5 RESULTS

I have worked on real time object detection and tracking . The praposed algorithm explained above is applied on the video frames to achieve the required tracking.[1] After tracking moving object we calculated time Per Frame of video than with the help of centroid of moving object and reference point we calculate distance of moving object .we also calculate velocity.
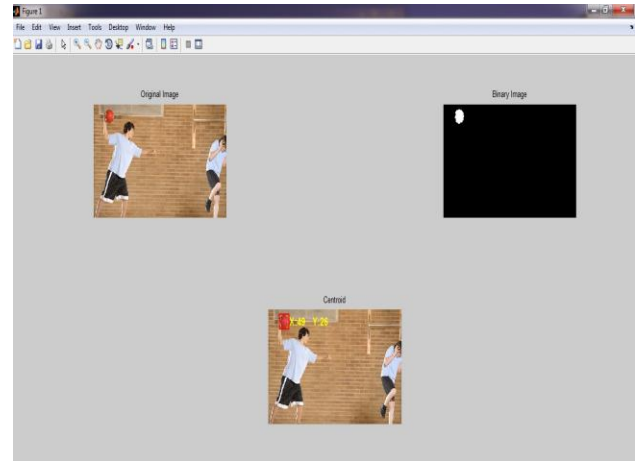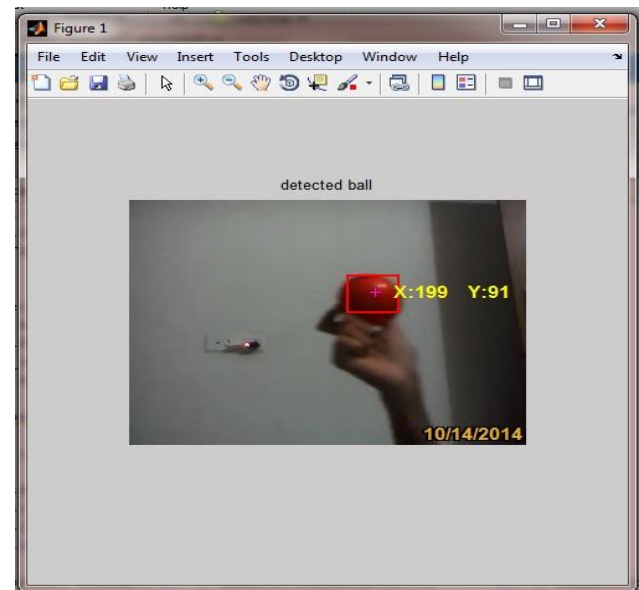

Fig 3 Red object detection

Fig 4 (a) Track object in one video frame

In fig 4 (a) and (b) it shown the object detect in different position. Object tracking in different video frames continuously.
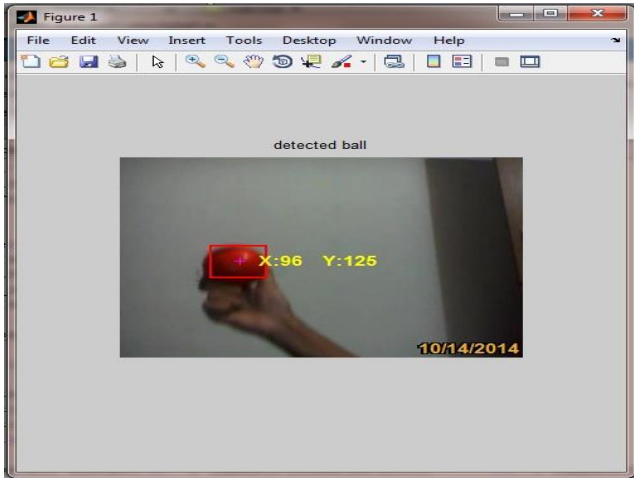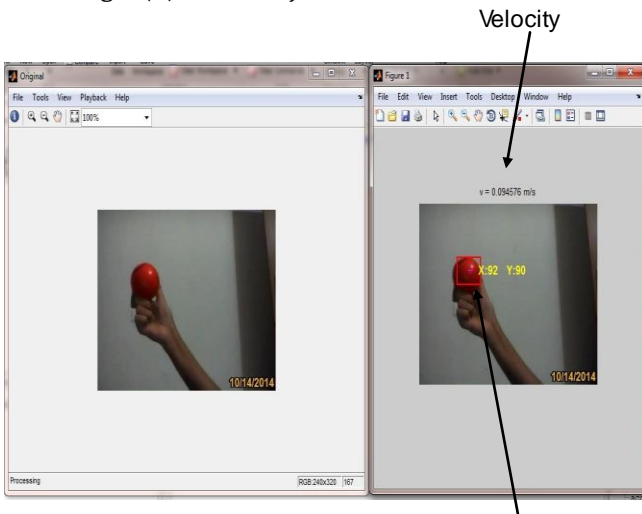
Fig 4 (b) Track object in different video frame

Fig 5 Finding velocity of movable object

6 APPLICATION DOMAIN

Some of the applications of object tracking are:

Automated video surveillieance: In these applications computer vision systems is designed to monitor the movements in an area, identify the moving objects and report any doubtful situation [1]. The system needs to discriminate between natural entities and humans, which requires a good object tracking system.

Robot Vision: In robot navigation, the steering system needs to identify different obstacles in the path to avoid collision. If the obstacles themselves are other moving objects then it calls for a real-time object tracking system.

Traffic Monitoring: In some countries highway traffic is continuously monitored using cameras [3]. Any vehicle that breaks the traffic rules or is involved in other illegal act can be tracked down easily if the surveillance system is supported by an object tracking system

7 CONCLUSION AND FUTURE WORK

Tracking of moving object is evaluated of moving object is evaluated on MATLAB/SIMULATION which is a major application in security, surveillance and vision analysis. The MATLAB/SIMULATION external memory is used to store the imported images on board and the implementation is done. The implementation is performed by removing noise in image and separating foreground and background objects. The object is visualized and its centroid is calculated. The distance it moved between frame to frame is stored and using this velocity is calculated with the frame rate of video. The velocity of moving object in 2-dimension (since the camera is static) is determined. Hence we have traced a moving object by proposed algorithm and velocity of the object is also determined. In future, algorithms can be implemented on other hardware devices. These algorithms can also be extended for the use of real-time applications and object classifications.

8 REFERENCES

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