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Polychromatic Path Identification for Multiple Objects from a Video

Aparajita Datta[1], Sushmita Pramanik[2], Shubham Chatterjee[3], Debabrata Datta[4]
[1]Department of Computer Science, St. Xavier's College, Kolkata, India, aparajita.xaviers@gmail.com
[2]Department of Computer Science, St. Xavier's College, Kolkata, India, spsushmita@gmail.com
[3]Department of Computer Science, St. Xavier's College, Kolkata, India, shubham.chatterjee94@gmail.com
[4]Department of Computer Science, St. Xavier's College, Kolkata, India, debabrata.datta@sxccal.edu

ABSTRACT

In this paper an algorithm has been proposed to identify different objects in a real time video and to mark the paths of different objects individually. In this algorithm the process starts from indentifying objects using background subtraction of frames taken from the video at a certain time interval and then finds the changes in their respective positions in successive frames so that their individual paths can be accurately tracked and their motion can be identified separately. Such tracking system is very useful in various crime prone areas such as banks, departmental stores or museums to detect the exact path of the moving objects.

Key words: Object tracking, Moving objects, Reference Frames, Current frame, Inter Frame Difference, Laplacian Filter.

1. INTRODUCTION

Video tracking is the process of locating a moving object (or multiple objects) over time using a camera. It has a variety of uses, some of which are human-computer interaction, security and surveillance, video communication and compression, augmented reality, traffic control, medical imaging and video editing [6].

Video tracking can be done in different ways:- Blob Tracking, Kernel-based Tracking, Contour Tracking and Visual Feature matching. In case of kernel-based tracking it is much easier to track moving objects in slow motion and also the computation complexity is much less in this type of object tracking [2] [7]. Normally the video based object tracking method deals with non-stationary image stream that changes over time. For this dynamism in the nature of the operation, real time moving objects tracking is a challenging task in computer vision research area [4].

The algorithms that are prevalent, deal with object tracking in a predefined and well controlled environment. While a single image provides a snapshot of a scene, the different frames of a video taken over time represents the dynamics in the scene, making it possible to capture motion in the sequence [3]. Video based tracking mainly deals with non-stationary image streams, with a changing background with time. Tracking objects is performed in a sequence of video frames and its processing mainly consists of two main stages: separation of objects from background in each frame and connecting those objects in successive frames to trace them [5].

Three methods are used for object tracking viz, template-based, probabilistic and pixel-based. Pixel-based method is one of the useful methods for object tracking. This method has been proved to provide fruitful results against the background interfusion methods. This category is effective enough in the failure detection and automatic failure recovery.

In this paper the connections amongst the objects in successive frames has been found out by identifying the same objects in each frame according to their relative positions. Then according to the changes in positions of each object their path of movement has been plotted and marked separately.

The rest of this paper is organized as follows: Section 2 summarizes the review of the past work, Section 3 deals with work description and Section 4 describes detail designing of the algorithm of entire work, Section 5 presents implementation of the work, experimental results are given in Section 6 and Finally, conclusion and future work are discussed in section 7 followed by references.

2. RELATED WORK

Much research work has been done in the field of object tracking from a video. A comparative study on this aspect has been done in [1]. Some of the works have failed to remove shadows from the images to be detected, whereas some of them have failed to detect multiple objects. But most of the works have been dependent on the background subtraction method to separate objects from a video frame. The challenge remains in separately identifying the paths of movements of multiple objects from a video. The objects in a single frame can be identified using the concept that when changes in some pixels are spotted in any frame with respect to the reference frame then it can be assumed that any object has been identified and by it can be plotted with a bounding box [1]. Whenever it can identify any box or collection of pixel then it plots any centroid [1]. The work that was depicted in [1], has correctly identified multiple objects separately, but that has failed to track their paths of movements separately.

In the present paper, an algorithm has been proposed to identify the motion of different objects in a video clip with different colors by using the background subtraction method as the basic step. In this methodology, frames are captured from the video clip and the whole video is accessed as a combination of frames. Predefined methods are used for color conversion and extracting the object (or objects) from the foreground image using the initial frame as reference frame [8][9]. The objects are identified by the amount of pixels and also the relative locations of the objects in the corresponding frames and then are tracked by using the bounding box and the paths are plotted uniquely by separate color to track the path of each object separately.

3. WORK DESCRIPTION

The algorithm starts with taking the frames and converting the RGB image to a grey scale image as the latter is easy to use and is less complex. Moreover for identification of objects, it is quiet fruitful but does not create any kind of ambiguity like binary images. Then a morphological filter is done using Laplacian filter to remove the small regions and isolated bunch of pixels as the basic function of this filter is to highlight the region of high intensity. After that the background subtraction is done to identify the object. Background subtraction or foreground subtraction is an efficient tool to identify any object from a sequence of frames of a video clip. This function computes the absolute difference between the frames of any video and a reference frame by comparing the pixel to a threshold. Pixel which belongs to the same object must be same in all the frames of the video where it arises. This completes the part where object identification is done by the background subtraction method where any current frame has significant change from the reference frame. If any object is identified then it is pointed by a rectangle. And the centroids of such rectangles are stored in a location. After that the centroids are picked up and are plotted in a graph where path of a unique object is identified using a unique color. The process of identifying any object and plotting the path consists of certain steps which are depicted below:

Step1: To get the first frame of the video as reference frame (stationary)

Step2: To compare every frame of the video clip with the reference frame to get the changes in the frames of the video clip.

Step3: To observe whether there is any significant change to identify any new object.

Step 4: To conclude about observation of any new object arising in the frame on the basis of step three.

Step5: To mark every object with unique color when any new object is entering. This is done using the process of inter frame difference.

Step 6: To distinguish the objects in step 5 using the fact that there is any bunch of pixels arising which is above a threshold value and also the distance between the old object and the bunch of pixel.

Step 7: To continue the tracking process by calculating and storing the co-ordinates of the location and the area of the already existing object (or objects).

Step 8: To track any object by using a bounding box of different colors for each object to identify the objects separately.

Step 9: To calculate the co-ordinate of the centroid of each and every rectangle of every frame of the video clip and store them in a vector.

Step 10: To calculate the number of objects arising in the whole video frame while doing step 5 to step 9.

Step 11: To identify the path of the objects separately with the help of the conclusion of step 10.

4. DESIGN OF THE ALGORITHM

The entire algorithm is divided into different modules. The whole algorithm is based on some basic methods which give very fruitful results for moving object tracking and identification. The methods are as follow:

4.1 Image acquisition:

This is the initial step of any computer or digital vision system. This is the way of retrieving image from the video input file (or any hardware device from where the video can be taken). More specifically, a real time image acquisition is done to capture the stream of images from the video (source) so that it can be accessed afterwards. This is basically conversion of a scene to a digital image. In this algorithm the speed has been fixed at 25 frames per second.

4.2 RGB image to gray scale image conversion:

The image that is obtained from image acquisition is an RGB image. But RGB image is more complex to handle and on the other hand gray scale image is easy to handle and also does not create any kind of ambiguity like any binary image and hence conversion from RGB image to gray scale image is done using NTSC format [10][11]. The following expression has been used for the conversion process:

$$\begin{bmatrix} Y \\ I \\ Q \end{bmatrix} = \begin{bmatrix} 0.299 & 0.587 & 0.114 \\ 0.596 & -0.274 & -0.322 \\ 0.211 & -0.523 & 0.312 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

Where **Y** = Luminance, **I** = Hue and **Q** = Saturation.

4.3 Image enhancement:

The video that is supposed to use in such surveillance system must be with a lot of noise and also the light may not be proper [12] and there may be other problems as well because naturally any video footage of any close circuit camera contains such errors. Hence, a Laplacian filter has been used in the work. This filter is a 2-dimentional isotropic measure or second order derivative of an image which highlights the area of rapid intensity. The Laplacian

L(x,y) of an image with pixel intensity values I(x,y) is as follows:

$$L(x,y) = \frac{\partial^2 I}{\partial x^2} + \frac{\partial^2 I}{\partial y^2}$$

4.4 Object identification and path plotting:

Algorithm: Object detection and path plotting.

Step 1: Let $\mathbf{I_{REF}}$ be the reference frame where moving object is not present and $\mathbf{I_{CURR}}$ be any other image of that video clip where the moving object is present but the background image is same that is the reference image is the background image.

Step 2 The base image, $\mathbf{I_{REF}}$ is converted from RGB to grayscale.

Step 3 Laplacian filter is applied on that grayscale image to enhance the image. The result is stored as $\mathbf{I_1}$.

Step 4 For each frame $\mathbf{I_{CURR}}$, the following steps are executed until no more new frames in the video frame set is found:

a) The current frame $\mathbf{I_{CURR}}$ is read.
b) The current frame image, $\mathbf{I_{CURR}}$ is converted from RGB to grayscale.
c) Laplacian filter is applied on that grayscale image and the result is stored as $\mathbf{I_2}$.
d) After applying Laplacian filter that current frame image $\mathbf{I_2}$ is subtracted from the reference frame image $\mathbf{I_1}$ pixel by pixel i.e. the operation $(\mathbf{I_1} - \mathbf{I_2})$ is performed.
e) After subtraction, the resultant image is converted into its equivalent binary form. Let this new image is $\mathbf{I_{2B}}$.
f) Very small unnecessary structures called noise are removed from $\mathbf{I_{2B}}$ and the result is stored as $\mathbf{I_3}$.
g) The area and centroid of each remaining structure in $\mathbf{I_3}$ are computed.
h) If the area is not empty then it identifies the presence of one or more than one moving objects in that video frame. Thus, the detection process is completed.
i) On the basis of the result of 4.h) it stores the number of objects in maxobj and compares it with every $\mathbf{I_{CURR}}$ dynamically.
j) Each detected moving object is then identified and tracked separately by green bounding box.
k) The centre co-ordinate of each tracked object is computed and stored in a vector named **XY**.
l) The color of the path changes with increasing value of maxobj.

Step 5 These discrete points stored in **XY** vector are plotted at the end. So, finally the path of the moving objects from the different frames is identified and path of every object is identified with a separate color.

Step 6 Stop.

4.5. Implementation:

The entire procedure has some modules to complete the whole work. Hence the process has been divided into several stages.

4.5.1 Assumption

It has been considered that, the velocity of the object (or the objects) will be constant. The background image that is the reference frame

4.5.2 Used hardware platform and software platform

A web camera is required to capture the real time video (no need of any kind of high quality video). The proposed algorithm has been implemented using Windows 7 operating system and 2013a version of MATLAB.

4.5.3 Functional design

In this stage the details concepts of designs are done that is the input that is supposed to be given and the output that is supposed to come. In the proposed algorithm the input file is a real time video file and the output file is the sequence of images where the objects are identified with a specific color and a graph that plots the path of every object separately and separated paths are plotted with unique color for each path.

4.5.4 Algorithm development

In this stage the implementation of the algorithm is done and the steps are chosen in such a way that the complexity is much less and also each step must be taken in such a way that they should be optimistic and feasible.

4.5.5 Coding

The software that has been used to implement is MATLAB 2013a and it has given a fruitful result for every step of the algorithm with the help of different examples as given in [12].

5. Experimental Results

This work has been started from performing some operations on a number of frames where one ball is coming from left side and another one from right side. They make a collision and after that they go back in a different path. In initial frame there is no object. The first frame which is the reference frame has the background image same as the background image of the forthcoming frames and the objects that are arising in the successive frames are moving in the constant speed so that one does not cross the other one.

Figure 1, as given below, shows the output of different frames of the video clip which has 27 frames. The first part shows the first frame that is the reference frame. The next part shows the 13^{th} frame where two objects are coming from two different paths.

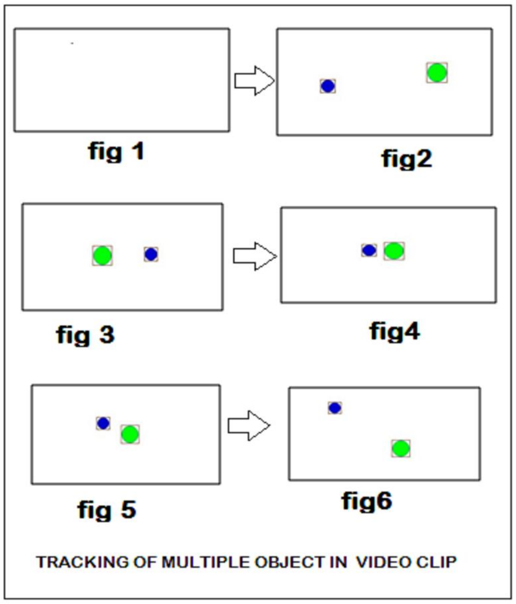

Figure 1: Tracking of multiple objects

The second last portion of the above figure shows the 20th and 21st frame and hence it has been seen that they are identifying the objects separately even when they are very much close to each other. The last row shows the 23rd and 26th frame respectively which depicts that objects are even properly identified when they are returning back.

The figure 2 shows the ultimate output of the whole algorithm where the whole path is identified and the centroids of the objects in the video frame have been plotted accurately. It has also been observed that as the maximum number of objects that was arising in the whole frame is 2 hence two paths are plotted with two different colors separately according to the motion of the corresponding objects.

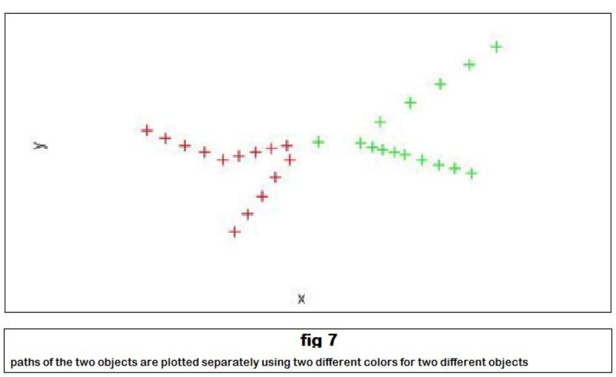

Figure 2: Paths of different objects with different colours

6. Conclusion And Future Prospect

The paper addresses a multi-chromatic path plotting algorithm to identify different objects and plot their correspond path separately from a real time video. The methods which are used in this algorithm is less complex and also effective in identifying proper path of any moving object in video. Using background subtraction is the simplest way to identify an object and using gray scale image also reduces complexity and also does not create any kind of ambiguity and hence we get a productive result.

There is a scope to extend this work in future so that it can identify the objects from a moving reference frame also. According to this algorithm the initial frame should not contain the object that is supposed to be identified. Algorithm can be further modified in such a way so that it can consider that aspect as well.

References

1. Rupali Naha, Antariksha Ray, Priteem Sarkar, Debabrata Datta," **Moving Objects Tracking in Real Time Video and Plotting Their Path of Movement",** International Journal of Advanced Computer Research, (ISSN (print): 2249-7277 ISSN (online): 2277-7970), Vol 4, No 1 Issue-14 March, 2014.

2. Tushar S. Waykole and Yogendra Kumar Jain**, "Detecting and Tracking of Moving Objects from Video"**, International Journal of Computer Applications (0975 – 8887), Volume 81 – No 18, November 2013.

3. Md. Zahidul Islam, Chi-Min Oh and Chil-Woo Lee, **"Video Based Moving Object Tracking by Particle Filter"** International Journal of Signal Processing, Image Processing and Pattern Vol. 2, No.1, March, 2009.

4. Priti P. Kuralkar and Prof. V.T.Gaikwad , **"Human Object Tracking using Background Subtraction and Shadow Removal Techniques",** International Journal of Advanced Research in Computer Science and Software Engineering, Volume 2, Issue 3, ISSN: 2277 128X, March 2012.

5. Seema Kumari1, Manpreet Kaur2, Birmohan Singh3, **"Detection and Tracking of moving object in visual surveillance system"**, International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 2, Issue 8, ISSN (Print) : 2320 – 3765, ISSN (Online): 2278 – 8875, August 2013.

6. Ritika, Gianetan Singh Sekhon, **"Path Estimation and Motion Detection of Moving Object in Videos"**, IOSR Journal of Computer Engineering (IOSRJCE), Volume 2, Issue 4, pp.01-04. ISSN: 2278-0661 (July-Aug 2012).

7. Hitesh A Patel and Darshak G Thakore, "**Moving Object Tracking Using Kalman Filter**", International Journal of Computer Science and Mobile Computing (IJCSMC), Vol. 2, Issue. 4, pp.326 – 332, April 2013.

8. S.Vijayalakshm and D.Christopher Duraira, **"Use of Multiple Thresholding Techniques for Moving Object Detection and Tracking"**, International Journal of Computer Applications (0975 – 8887), Volume 80 – No1, October 2013.

9. Abhishek Kumar Chauhan and Prashant Krishan, **"Moving Object Tracking using Gaussian Mixture Model and Optical Flow",** International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3, Issue 4, ISSN: 2277 128X, April 2013.

10. Alsaqre F.E., Baomng Y., **"Multiple Moving Objects Tracking For Video Surveillance Systems",** ICSP'O4 Proceedings, Volume 13 no.04, pp.1301-1305, 2004.

11. Dhar P.K., Khan M.I., Gupta A.K.S., Hasan D.M.H. and Kim J.M., **"An Efficient Real Time Moving Object Detection Method for Video Surveillance System",** International Journal of Signal Processing, Image Processing and Pattern Recognition, Volume 5, no. 3, pp. 93-110, 2012.

12. Rafael C. Gonzalez **"Digital Image Processing using MATLAB"**, Tata McGraw-Hill Education Private Limited, India, pp.74-78, 2010, ISBN: 13:978-0-07-070262-2.