Image Correlation Based Tracking in Video Frames

[1]K.J. Deopujari, [2]K. S. Tiwari

[1,2]Department of Electronics and Tele-Communication, M.E.S.C.O.E., Pune University
Email : [1]kjdeopujari@gmail.com, [2]kanchan.tiwari@mescoepune.org

Abstract— Single or multi target tracking is one of the extensively studied areas in the field of computer vision. Object detection between successive frames a key step in tracking algorithm. This paper proposes a method which uses image correlation between two images for target detection in the consecutive frames. This Image tracking method focuses on a frequency domain based approach using two dimensional Fourier transforms for image correlation. It implements phase correlation which is subclass of correlation. It is based on the Fourier shift property of Fourier transform. This technique identifies the position of a template image within the larger picture. This approach allows accurate image placement and the subsequent path of the image through a video scene can be followed. The solution can be implemented to provide results to provide the path of the image tracked.

Keywords—Object tracking, phase correlation, cross power spectrum.

I. INTRODUCTION

Video Tracking and analysis is one of the most talked and researched area in the field of Computer Vision. It has wide range of applications such as human computer interaction, traffic management surveillance, medical imaging, military applications, video editing, video communication and compression. Object detection involves locating objects in the frame of a video sequence. Every tracking method requires an object detection mechanism either in every frame or when the object first appears in the video. The high powered 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. The tasks of detecting the object and establishing a correspondence between the object instances across frames can either be performed separately or jointly. In the first case, possible object region in every frame is obtained by means of an object detection algorithm, and then the tracker corresponds objects across frames. In the latter case, the object region and correspondence is jointly estimated by iteratively updating object location and region information obtained from previous frames[1]. Matching identically sized and oriented images is useful, but a more widely applicable approach, particularly for defense and security, allows for identification of a matching image within a larger image[2] This allows for accurate image placement, and is utilized widely in digital camera applications and recognizing facial features. Image correlation can be implemented to determine whether two images match and it can be applied to wide variety of situations where automatic intelligent visual identification or classification of objects, conditions, or people is important [2].Image correlation applied to tracking can also find application in defense and security, manufacturing, and autonomous control and robotics.

Section 2 of the paper gives the literature survey. Section 3 explains the methodology proposed. In Section 4 we have discussed the experimental results. Section 5 summarizes the conclusion

II. LITERATURE SURVEY

In [2] a moving object is tracked that varies in size over time . This technique identifies the position of a template image within the larger picture. This approach requires the dynamic resizing of the template image in the video as it grows and shrinks in size. This approach allows for accurate image placement and the path of the image through a video can be followed. The solution can be used to provide real time results to provide the path of the image tracked.

In [4] the algorithm computes the object prediction position by constructing Kalman predictor, and then an adaptive optimized matching is performed in a neighborhood of this prediction position. This helps to get the real object position rapidly. Here correlation between images is used to perform optimum matching.

In [5] a method has been described for tracking the camera motion of a flexible endoscope, specifically a bronchoscope, using epipolar geometry analysis and intensity-based image registration. The correlation coefficient and the mean square intensity difference are the two parameters used for measuring image similarity. This method successfully tracked camera motion for about 600 consecutive frame. But this method requires 20s to process a single frame.

III. METHODOLOGY

3.1 Image Correlation

In this paper we track an object through a sequence of frames using a template image chosen to be the image of the object from the first frame of interest. We define a single region of the image, R[x, y], that is small enough to include only the object of interest but large enough to encompass the object's position within all frames. To find the target in frame n, we take the region R from frame 0 to be our template image and cross-correlate this with search image .In this paper we are implementing phase correlation which gives the estimation of translational motion of the target. Phase correlation uses frequency domain approach and is based on the Fourier shift property of Fourier transform. It is a subset of cross correlation techniques.

- Consider two input images g_a (template image) and g_b (Background image/search image)
- Calculate 2D Fourier transform G_a and G_b
- Calculate Cross Power Spectrum

$$R = \frac{G_a \circ G_b^*}{|G_a \circ G_b|}$$

- Normalized cross correlation by applying IFT

$$r = F^{-1}\{R\}$$

- Determine peak: The location of peak in r

$$(\Delta x \, \Delta y) = \arg \max_{(x,y)} (r)$$

The centre of the correlation peak is the cross-correlation result.

3.2 Video Tracking

Object detection and tracking remains an open research problem even after extensive research being carried out over the years. A robust, accurate and approach is still a great challenge today. The main challenges of Video tracking are Loss of information caused by projection of the 3D world on a 2D image, noise in images, complex object motion, non-rigid or articulated nature of objects, Partial and full object occlusions, complex object shapes, scene illumination change The proposed Algorithm for video tracking is shown in fig.1

Using this approach, the image search is done to identify a “template image” inside a larger search image which is our search image. Because the technique requires the two images to be matrices of the same dimensions, zero-padding is done to increase the size of the smaller template image which allows a matrix multiplication with the larger search image. Image is padded with zeros instead of ones. This is because if the log operation is performed at any point its value reaches to infinity. Once the template image is sufficiently zero-padded, then the 2-D Fast Fourier Transform of both matrices is implemented, and then correlation can be performed.

In the first step video is read. The counter counts the number of frames and displays the frame of interest. We create a template which has our target of interest from frame of the video. Phase Correlation is performed on each coming frame which is our search image with the template image. Peak value of correlation is then found out. Maximum value i.e. peak in correlation plot corresponds to the best match of template image found in search image. This is the simplest method with which one can detect the moving target between the frames.

IV. EXPERIMENTAL RESULTS

Figure 2 shows a template image used in the experimentation and the objective is to track the template image as it moves in a video. Figure 3 shows a screen shot from a video with the required target tracked in the next frame..

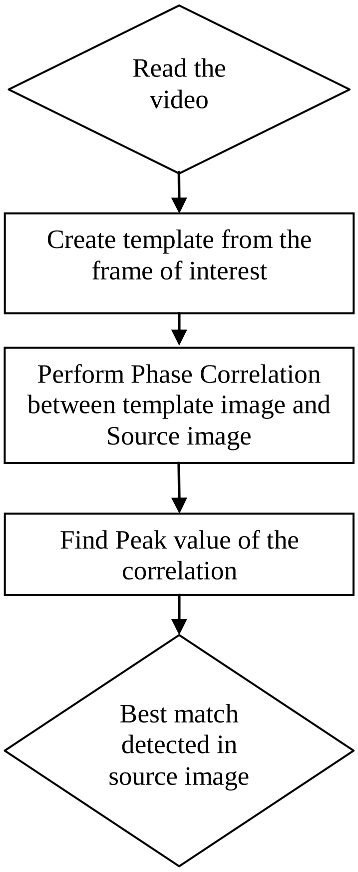

Figure 1: Flowchart of the Proposed Methodology

Figure 2: Template Image

Figure 3: Detected Target

This algorithm accurately tracked the object till next 35 to 40 frames. But when the object was partially occluded the correlation algorithm couldn't give significant result. In the test video used for the experiment there was not remarkable change in the size of the target.

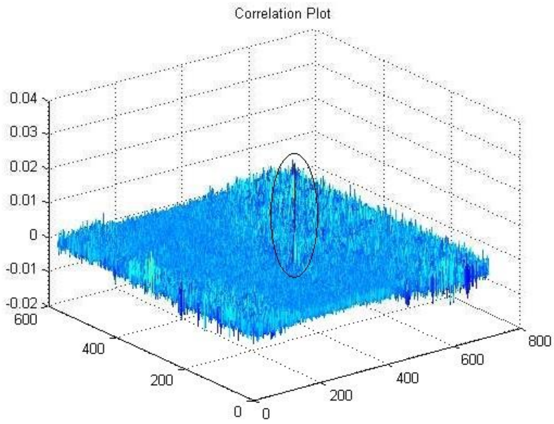

Figure 4: Correlation Plot

The camera was also fixed. But if the distance from the camera to the object changes during the video, and the image also grows in size the template of a fixed size may not detect target accurately. The solution in this case can be to change the template image after each iteration.

Figure 4 shows the Correlation plot. The visible peak in the correlation plot corresponds to the best match of the template found in the search image.

V. CONCLUSION

Image tracking is an important tool which can be implemented in various fields, and will continue to become more important in 21st century technologies. The suggested method allows for accurate image correlation and uses frequency domain transformations The simple tracking solution presented could be tested in the application of simple surveillance cameras implemented in academic campuses. If the results are robust, the tracking solution presented could easily be implemented as an autonomous robot control system with the use of the Matlab compiler. This method will be utilized as a primary way for autonomous systems to interact with their surroundings in a simplest manner. The size of template can be updated after each iteration for target of varying sizes. Kalman filter based techniques may be utilized in the implementation of the solution tracking the template image through its entire trajectory. The method can be refined to add target path prediction into the algorithm. While phase correlation was used in this effort, the use of filtering based correlation may also prove to be advantageous in the area of image tracking. The phase correlation based image correlation is less mathematically intensive and therefore it result in faster tracking times.

REFERANCES

[1] Alper Yilmaz, Omar Javed, and Mubarak Shah. Object tracking: A survey. Acm Computing surveys (CSUR), 38(4):13, 2006.

[2] Stubberud, S.C.; Kramer, K.A., " Image Correlation Based Video Tracking," Proceedings of International Conference on Systems Engineering, pp.18-23, May 2011

[3] B.V.K.V. Kumar, A. Mahalanobis, and R.D. Juday, Correlation Pattern Recognition, Cambridge University Press, Cambridge, UK, 2005.

[4] Guangzhi Cao; Jingping Jiang; Jiaqian Chen, "An improved object tracking algorithm based on image correlation," Proceedings of the 2003 IEEE International Symposium on Industrial Electronics, pp. 598- 601, June 2003

[5] K.Mori , D.Deguchi," racking of a bronchoscope using epipolar geometry analysis and intensity-based image registration of real and virtual endoscopic images" Medical Image Analysis 6 (2002) 321–336

◈◈◈