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Segmentation of Moving Object with Uncovered Background, Temporary Poses and GMOB

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Abstract

Video has to be segmented into objects for content-based processing. A number of video object segmentation algorithms have been proposed such as semiautomatic and automatic. Semiautomatic methods adds burden to users and also not suitable for some applications. Automatic segmentation systems are still a challenge, although they are required by many applications. The proposed work aims at contributing to identify the gaps that are present in the current segmentation system and also to give the possible solutions to overcome those gaps so that the accurate and efficient video segmentation system can be developed. The proposed system aims to resolve the issue of uncovered background, Temporary poses and Global motion of background.

*Keywords:*Global Motion of Background(GMOB);Semiautomatic method;Affine model

1. Introduction

Moving object segmentation is a process used to separate object from the background. In digital video processing technology video segmentation generated by objects is an important application domain. Segmentation of foreground objects from background has a lot of applications in human-computer interaction, video compression, multimedia content editing and manipulation. The extraction of the moving foreground from a stationary background from a general video sequence has various applications such as compression of videos and also in the cinematographic effects. One of its important applications is digital composition, in which the object of interest is extracted from a video clip and pasted to a new background [1].

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Object can be segmented based on the motion information called as temporal methods .When camera is stationary, the problem of moving object segmentation becomes identifying the set of pixels which represent objects from a scene in stationary background. In camera in motion sequences, the task of identifying video object is difficult, since object motions are disturbed by camera motion. This undesired motion should be first removed before segmentation of moving object is done.

Temporary poses or slow movements are also one of the issue in moving object segmentation. When part of the object stops moving temporarily or it is moving very slowly then it becomes very difficult to detect such type of movements. The present work aims at solving this problem by tracking the object.

2. Review of Literature

A number of video segmentation algorithms have been proposed. This section provides a critical review of the various approaches available for video segmentation.

Dong Zhang proposed a method for video object segmentation through spatially accurate and temporally dense extraction of primary object regions. In this method the author has extracted the object proposal and used DAG approach which gives good segmentation performance. To find out which image regions are objects vs. background, it makes these methods very slow [2]. Camille Courier proposed a method for Causal Graph based video segmentation. This method uses the graph based matching method, It is more robust to large camera displacements but spanning trees method takes more computation time[3] .MacFralane N.J.B. proposed a method for segmentation and tracking of piglets in images. This paper uses approximate median method which employs frame difference with constantly updated background model. Storage requirements of median filtering are alleviated by this technique but it requires continuous updating of background model. [4].Ricardo proposed a Mixture of Gaussian model in this Background model is parametric instead of being a frame of values. Performance of this method depends on the modelling of background [5]. Efficient moving object segmentation algorithm using background registration technique is proposed by Shao-Yi Chien.This method uses Frame difference, Background Registration, Object detection and Post Processing. Computational complexity of this method is low but slow movements/temporary movements are not identified and works only for fixed camera [6]. In Background subtraction scheme, the basic step is the selection of GMOB (RF) or background to be subtracted. In some approaches, accumulated frame difference pictures are analyzed to reconstruct stationary scene component to compare with frames to detect change. In these approaches, there is a strong assumption of stationary background. Other approaches align consecutive frames to construct a reference background image before applying change detection. Whenever there is a big deviation of the background, it is updated as necessary. Changes between two frames can also be identified by using two consecutive frames instead of using a reference background frame.

An algorithm based on change detection is proposed by Neri which separates potential foreground regions employing a higher order statistics (HOS) significance test to inter-frame differences. The earliest methods were comparing successive frames by relying pixels. Comparison could be performed on a global level, so methods based on histograms were also proposed [7]. Automatic segmentation is simplified by approaches based on change detection as compared to GMOB approaches; they also have their own problems. Specifically, the complexity of background generation and updating requires more attention in these methods. If there is a static reference background frame, the problem will be easier and accurate results may be obtained. However, when the background itself is in motion, and when no initial background reference (a frame prior to appearance of any moving foreground object in the video sequence) is present, the problem will be more complex, and the results of segmentation may not be accurate. This shows that there is still a lot to be done to obtain better segmentation system.

3. Proposed work

On the backdrop of the afore-mentioned review of literature and subsequent gaps identified from the findings of the literature review, the proposed work aims at contributing to develop a system to segment video objects automatically from the background given a sequence of video frames. The proposed work aims to resolve the issue of “moving camera/Global motion of background”, “uncovered background” and “Temporary poses”.

3.1 Global motion of background

Object motions are disturbed by camera motion. This undesired motion should be removed first before actually segmenting the moving object. This is done in three steps as motion vector estimation, Removal of motion vectors of background and finally frames warping. To find the motion vectors frame is divided in to blocks of n*n (8*8/16*16).Then motion vectors are found by searching for the best match in the reference or previous frame. To find best match criteria is used to minimize a measure of matching error between current block and blocks in previous frame.

$$MAD (m, n) = 1/n*m (\sum gl(I)-gl(I-1)) \quad (1)$$

$$(u,v)=min(MAD(m,n)) \quad (2)$$

Where MAD is mean absolute difference, gl is grey level and (u,v) is motion vector.
After finding motion vectors, motion vectors that greatly differ from their neighbours are rejected. The mean of 3*3 group of motion vector is calculated and compared with motion vector under test.Then frame warping is used to align the previous or next frame to current frame. New frame is calculated from previous frame by transforming the co-ordinates of previous frame into new position defined as

$$X'=a1*X + a2* Y+ a3 \quad \text{and } Y'= a4*X + a5* Y+ a6 \quad (3)$$

Where a1 to a6 represents to transformations, 2 scaling and 2 rotation camera parameters.

3.2 Uncovered Background

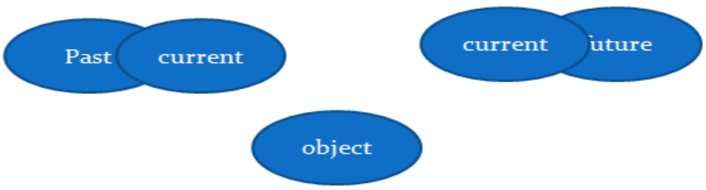

Fig.1. Removal of Uncovered Background

In this system uses three consecutive frames as past, current and future. The past frame is normalized with respect to current frame and future frame is normalized with respect to current frame .This two are combined by a logical AND operator. The operator removes all areas except the foreground object detected which is the region that overlaps in two masks.

3.3 Temporary Poses/Slow Movements

Block Matching algorithm is more tolerant to slow movements so we have used this method to calculate the motion vectors. To resolve the issue of temporary poses we have integrated region based segmentation with our system. Region based segmentation partitions the frame in to regions which are uniform with respect to some characteristics such as colour and intensity. Result of region based segmentation is “OR” with the object detection result to give final output.

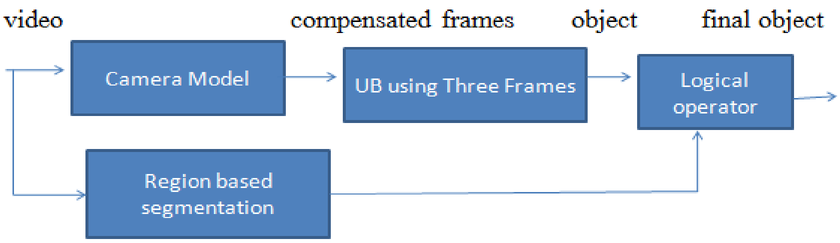

Fig.2. Block Diagram of the Proposed System

4. Experimental Results

The system is tested on a Segtrack standard dataset. It consists of 14 videos some of which are having interacting objects, slow movements, deformation, motion blur, and occlusion. Algorithm is applied on a humming bird sequence. First video is given as an input to Global Motion and estimation, here motion vectors and camera parameters are calculated. Then Frame warping is done to compensate the motion of background. In the next step compensated frames are given to uncovered background step. In this object is detected and uncovered background is removed. The result of this step is 'OR' with the result of region based segmentation to give final output. The experimental results includes detected object and performance analysis.

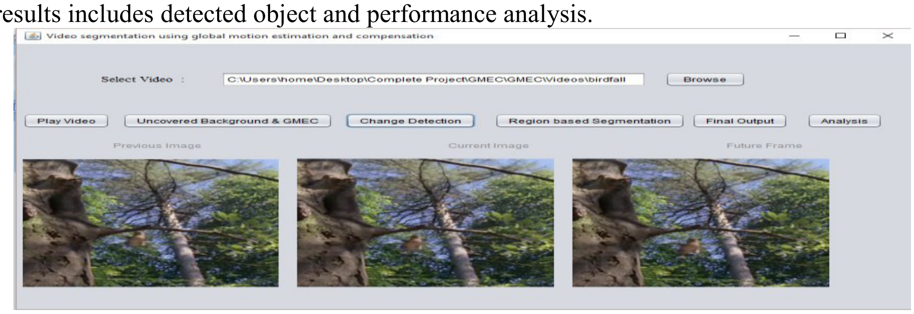

Fig.3. Input Video

(a) (b) (c)

Fig. 4.Result of (a) Detected object (b) Region based segmentation output (c) Final output

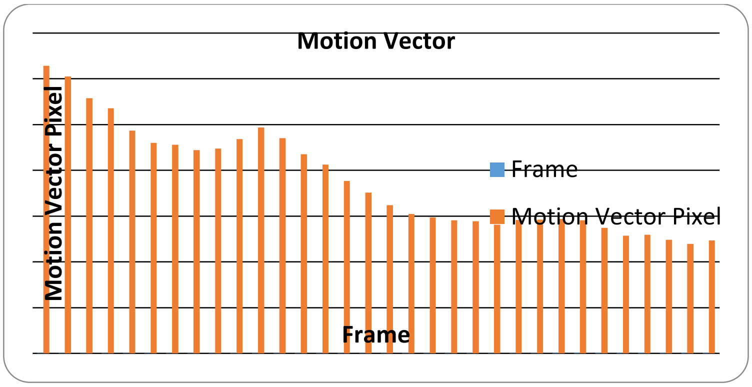

Fig.5. Graphical Representation of Motion Vector

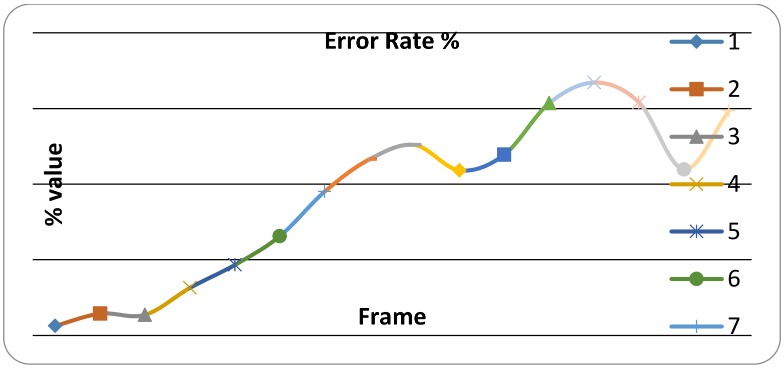

Fig. 6 Graphical Representation of Error Rate

For each video average per frame pixel error is calculated by dividing the XOR result of ground truth and detected object by number of frames of that video .we have compared our result with the other methods and found that pixel error is reduced by our proposed method.

Table 1. Average per frame pixel error

Video	Proposed	[8]	[9]	[10]	[11]
Birdfall	42	155	189	288	252
Cheetah	216	633	806	905	1142
Girl	611	1488	1698	1785	1304
Monkeydog	256	365	472	521	563

5. Conclusion

The proposed work solved the issue of Moving camera which adds the unwanted disturbance in the video and also solved the problem of temporary poses or slow movements. The performance analysis shows that the system gives good precision and recall. The work also improved the accuracy of Video segmentation.

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