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Segmentation of Moving Object captured using Moving Camera

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ABSTRACT

Segmentation of video in to objects is must for retrieval of videos based on the contents or detection systems based on the concepts. A variety of video object segmentation algorithms, including semiautomatic and automatic, have been developed. Semiautomatic methods require involvement of human and are therefore inappropriate for numerous applications. Although various applications needs segmentation to be performed automatically, there is still scope for refinement. The goal of the work proposed here is to identify the gaps in existing segmentation systems as well as to provide viable solutions for overcoming such problems in order to develop a accurate and efficient video segmentation method. In this paper the work that is proposed, addresses issues related to segmentation of video automatically, like background that is uncovered, interim poses, and background's global motion.

Keywords: Content based applications, Semiautomatic segmentation, Change detection.

I. INTRODUCTION

Video data is becoming increasingly common in web databases and individual databases. A process known as segmentation is required to retrieve the objects from the video. Segmentation of object and subtraction of background are crucial steps in most of the video processing and computer vision applications. This steps are mostly be the first steps in applications such as detection of concept and automatic surveillance methods [1].

In segmentation of video objects, two methods are commonly used: first is semiautomatic, where user involvement is necessary to represent the objects semantic, whereas the other is automatic, in which from the background the object is selected without the assistance of the user. The majority of applications specifically that deals with real time requirements needs segmentation of video objects to be done automatically.

A wide variety of segmentation of video objects approaches has been presented, many of which are targeted at certain applications and attempt to meet specific constraints. Because there is involvement of human in the segmentation process, excellent results have been produced so far using semi-automatic approaches. Human assistance, on the other hand, is not required in these methods because it adds unnecessary work for users and is unsuitable with some applications. Fully automatic video segmentation systems, on the other hand, are still a challenge, despite the fact that this systems are needed by numerous applications.

Most of the segmentation methods that are automatic are developed for particular issues and based on simple constraints, such as videos that has background fixed. As a result, having a malleable segmentation method that is automatic is essential for dissimilar kinds of videos. Majority of present segmentation methods that are automatic uses complex techniques. In addition, every step of segmentation approach necessitates complex demanding processes in order to get effective results. As a result, complexity of the methods should be necessarily reduced and at the same time good segmentation results should be maintained. In each stage of the segmentation approach, it is accomplished with the help of choosing good methods that has less complications. By using post-processing, the segmentation accuracy can be enhanced.

II. RELATED WORK

A. Review of Literature

A regressive work has been performed with regard to video segmentation methods. Related work presented here gives a detailed information about the different approaches that exists for segmentation of video.

In video segmentation, main areas that belongs to object/s are extracted. In the work object part has extracted from video and used a DAG approach to achieve a good segmentation result in this method. It takes a long time to check which image areas represent objects and which areas represents background. Due to this reason these techniques are incredibly slow [2].

Camille proposes a video segmentation approach based on a Causal Graph. The matching mechanism that uses the concept of graph is used in this method. Although it produces good results for big displacements of camera, the method of spanning tree require more time for calculation [3].

MacFarlane presented an approach for image segmentation and tracking of piglets. The approximate median approach, that uses frame difference with a constantly updated background model, is used in this research. This technique eliminates the storage requirements of median filtering, but it does require continuous updation of model of background [4].

Ricardo proposes a Gaussian method mixture that works on the basis of model of Background. Here the parametric model is used, yet the output of this approach vary when the background modeling changes [5].

Shao-Yi Chien proposes a background registration method for segmenting moving objects. This approach has a low computational complexity, but it does not detect slow or transitory movements, and it only works with a stationary camera [6].

Neri proposed a change detection approach that differentiates the regions belongs to foreground with the help of application of a higher order statistics significance test for finding the difference between the internal frames. The earliest methods relied on pixels to compare successive frames. Because a global comparison could be performed, approaches that uses histograms were also presented [7].

B. Review of literature with summarized findings

Approaches that works on the concept of change detection that are presented till now has used the difference between the information within two back to back frames for example current and previous frame only. Interim poses or moderate movements are the problems that confuse classical change detectors. If we only use the dissimilarity in frames then in that scenarios, the information about the motion disappears. However, we can plainly observe that these pixels which are from the object region must be assigned to the object mask if we employ background difference information. With moderate movements and interim poses, most approaches fail to segment the foreground. The use of gradient-based optical flow algorithms has yielded good results, but they come with a higher computational overhead. If a video contains moderate movements and the motion of the objects is very less then, block-based algorithms provide satisfactory results. Although there are other methods for segmenting video objects, the fastest segmentation of video object methods are using a change detection method. Video segmentation will be easier and more accurate if the video is captured with a fixed camera. But, if the videos are acquired using a camera that is in motion and if the reference frame of initial background is also not present, then segmentation will be challenging, at the same time we will not get good results. This shows that much work needs to be done in order to achieve a better segmentation system.

III. PROPOSED METHODOLOGY

The goal of this research is to create a system that will automatically segment objects in video. We'll try to handle the problem of a camera in motion and an background that is uncovered in the proposed work. Motion estimation and compensation will be used for moving cameras. By combining segmentation based on the concept of region with system spelling and grammar, the work that is proposed here aims to overcome the problem of interim poses.

A. Registration of Backgroung Method

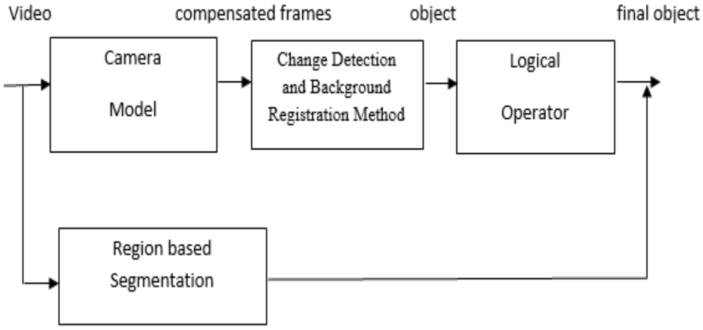

Fig. 1. Schematic Flow of Registration of Background

Background's Global motion:-

Due to the motion of camera unnecessary disturbance is generated in object movement. This unwanted movement must be eliminated at the starting stage preceding the segmentation of object that is moving. This can be performed in 3 stages like estimation of motion vector, elimination of motion vectors that belongs to background and at the end computation of the new frame. Here every frame is bifurcated in to sets of y*y (8*8/16*16) to compute the vectors of motion. Finally the vectors of motion are computed by finding the accurate match in the previous or reference frame. Accurate match is observed between the blocks of previous frame and current block frame which has minimum value for matching error. This is represented using following equations:

D(x, y) = 1/x*y (Σ grey level (I)-grey level (I-1)) *(1)*

(a, b)=minimum (D(x, y)). *(2)*

Here D represents mean absolute difference and (a, b) represents the vector of motion.

When motion vector computation is done then motion vectors that are completely dissimilar with respect to their neighborhood are eliminated. The average of 3 by 3 sets of vectors that belong to motion is computed and it is compared with respect to base motion vector. Previous or successive frame is associated with current frame using frame warping. Previous frame is used to compute the new frame with the help of conversion of the position of previous frame into new position represented as

A'=p1*A + p2* B+ p3 and B'= p4*A + p5* B+ p6

Here parameters of the camera are described by p1 to p6.

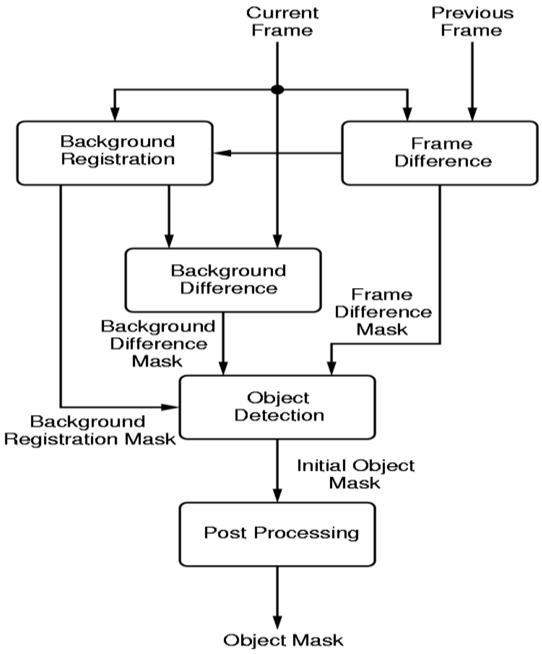

Fig. 2. Flow of Registration n of Background

Interim Poses/Moderate Movements:-

We chose the Block Matching approach to calculate the motion vectors since it produces good results for slow movements. We coupled segmentation based on region with our system to address the problem of interim poses. Segmentation based on the region divides the frame into areas that exhibits the similar properties like intensity and color. To produce the final output, the output of segmentation using region is integrated with the output of object detection.

Registration of Background:-

Dissimilarity between the current and previous frame is selected as a base to compute the mask of difference in frame and the mask of difference in background in background registration. Object is detected using data of these two masks.

B. Uncovered Background using Three Frames Method

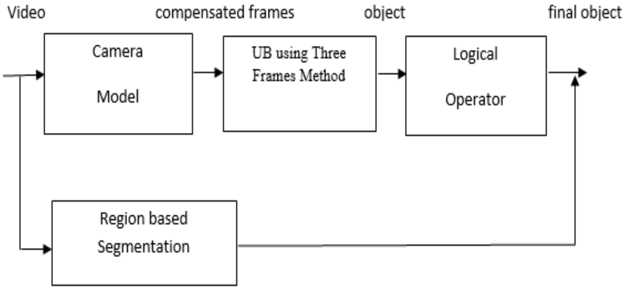

Fig. 3**.** Schematic Flow of Uncovered Background using Three Frames Method

In the registration of background method registration block is interchanged by an uncovered background using three frames block.

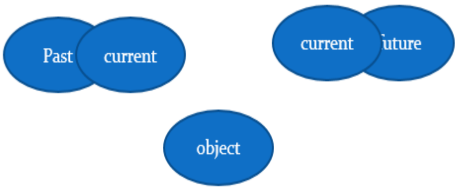

Fig. 4. Removal of Uncovered Background

Three back to back frames are used in this system: past, present, and next. Here past frame is preprocessed as compared to the current frame and the future frame is normalized with respect to the current frame. A logical AND operator is used to combine these two. All parts excluding the foreground object is selected, which is the area where two masks are overlapped. Then this area is removed by operator.

IV. EXPERIMENTAL RESULTS

A. Result of Registration of Background Method

The method is tested using standard dataset named as Segtrack. There are fourteen videos in all, with connected objects, moderate movements, distortion, blur motion, and occlusion among them.

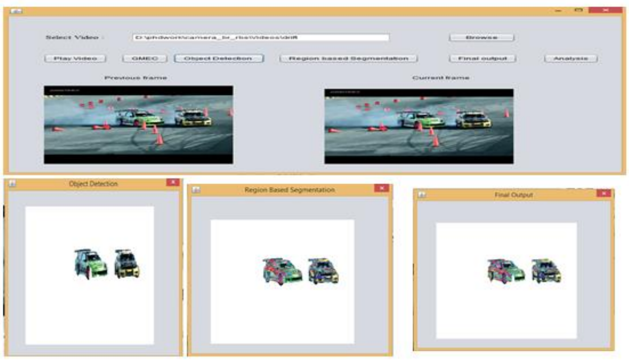

Fig 5: Experimental Result of Registration of Background Method

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TABLE I. PROCESSING TIME

Parameter	**Execution Time for a Video**
	Execution Time
GMEC	239
Object Detection	2588
Region Based Segmentation	1170
Final Output	1150

TABLE II. AVERAGE PER FRAME ERROR IN PIXEL

Table Head	**Average per frame error in pixel**					
	Registration of Background Method	***[2]***	***[4]***	***[5]***	***[8]***	***[10]***
Birdfall	1176	155	184	288	252	454
Cheetah	121	633	806	905	1142	1217
Girl	308	1488	1698	1785	1304	1755
Monkeydog	188	365	472	521	563	683

Average per frame error in pixel is computed for every video. To do this, first the result of ground truth is XOR with the detected object and then it is divided by the count of frames present in that video. Here results are compared with the existing methods and it has been observed that error in pixel is reduced by the registration of background method.

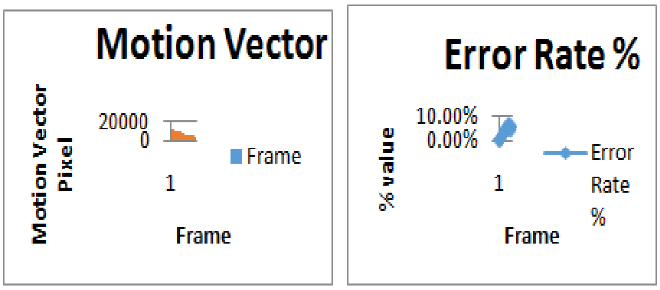

Fig 6: Motion vectors and Error rate

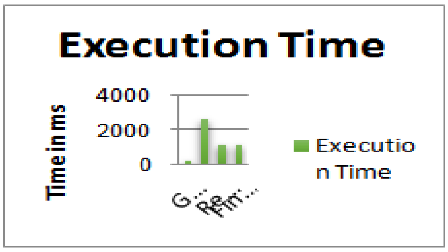

Fig. 7. Processing Time

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B. Result of Uncovered Backround using Three Frames Method

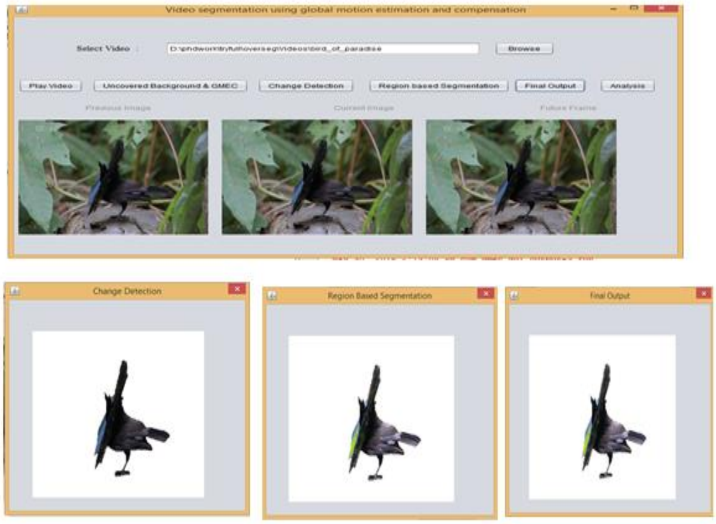

Fig 8: Experimental Result of Uncovered Background using Three Frames Method

TABLE III. PROCESSING TIME

Parameter	**Execution Time for a Video** ***Execution Time***
GMEC	239
Object Detection	1524
Region Based Segmentation	1170
Final Output	1150

TABLE IV. AVERAGE PER FRAME ERROR IN PIXEL

Table Head	**Average per frame error in pixel**						
	Registration of Background Method	***Uncovered Background using Three Frames Method***	***[2]***	***[4]***	***[5]***	***[8]***	***[10]***
Birdfall	42	1176	155	184	288	252	454
Cheetah	216	121	633	806	905	1142	1217
Girl	611	308	1488	1698	1785	1304	1755
Monkeydog	258	188	365	472	521	563	683

We can see from Table III that processing time is faster than the existing methods and the registration of background method. Table IV shows that when compared to existing methods, the average per frame pixel error has improved.

V. CONCLUSION

The work which is presented over here addressed the problem of a camera that is in motion. Due to motion of camera it causes unwanted disruption in the video, as well as it also creates the interim poses problem and moderate movement problem. According to the results of analysis of performance, both the performance time and the average per frame error in pixel is improved. Uncovered background using Three Frames method performs better as compared to Registration of Background method.

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