Intelligent Recognition of Motion & Tracking of Moving Image Object

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Abstract **- For an effective Human Computer Intelligent Interaction , the computer needs to recognize the motion and track the moving object. In this paper, , an algorithm moving objects detection and description is proposed. Based on the analysis of projection of the 3D motion of objects, the information of motion field is exploited to make moving object detection more efficient. The discontinuities of motion vector field on the boundaries of moving objects enable us to detect the moving objects blocks in which the potential boundaries of the moving objects locate. The aim of implementing this technique can be used to verify real time detection in a defense application, bio-medical application and robotics. This can also be used for obtaining detection information related to the location or position and direction of motion of moving object for assessment purpose.**

Keywords - Frame separation, Moving Object Detection, Boundary Detection, Motion detection.

LITERATURE SURVEY

I Algorithms for detection of movement of objects in an Image

Moving object detection is very important issues in image processing .There are different ways to find out the movement of moving object in image. Here, some techniques are discussed related to that .One of them are consists of some algorithms to detect the movement of object in the image, which is implemented in this paper.

II Detection of movement of object using neural network along with kalman filter

We can also find out the movement of object using neural network along with kalman filter. In that, the technique is based on some predictions and correction. For many applications of autonomous robots it is important to detect moving objects that are in the surroundings of the robot to avoid collisions or enable interaction. The motion detection methods that are based on image processing need high quality images as input. Since the camera used to record images is moving, the quality of images decreases and quake of camera causes more fatal noise. This causes the output of image processing to include considerable error which makes many problems in the following computations.

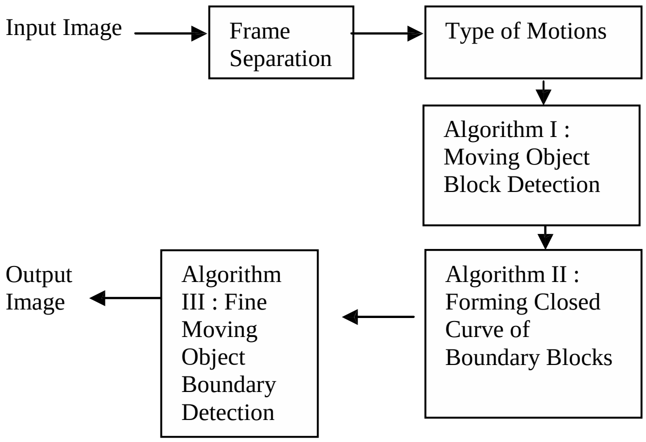
Various filters would help to reduce noise to some extent. Regarding moving objects tracking, Kalman Filtering, Extended Kalman Filtering and Particle Filtering (also known as Condensation and Monte Carlo algorithms) are some of the most common used algorithms. Kalman Filter provides an efficient recursive solution which has a prediction and correction mechanism, in a way that minimizes the mean of the squared error. Due to its simplicity, the Kalman filter is still been used in most of the general-purpose applications [19]. Neural networks have been implemented for image tracking applications, where they are used mostly as classifiers or measures between different types of filters [20]. Zhang and Minai [21] created a two layer pulse coupled neural network for motion detection. The two layers work in iterative fashion and find the largest matching segment between two consecutive video frames. This model adopts the image pixels as the local feature. Based on Grossberg's spreading theory and Ullman's motion decision theory [22], Guo Lei proposed a spreading and concentrating model [23] to perform motion detection. The local feature used for motion detection is the edge elements in the object's contour. The common problem of these models is the model complexity [24]. Motion detection using image processing while the camera is moving is a difficult task. In such conditions, images are not clear and while the camera is quaking quality of images decreases significantly and causes high noise on image processing results.

III Detection or Tracking of moving object based on color

In this technique the motion is detected by an algorithm which is used for tracking non-rigid, moving objects in a sequence of colored images, which were recorded by a non-stationary camera. In an initial step, object parts are determined by a divisive clustering algorithm, which is applied to all pixels in the first image of the sequence. The feature space is defined by the color and position of a pixel. For each new image the clusters of the previous image are adapted iteratively by a parallel k-means clustering algorithm. Instead of tracking single points, edges, or areas over a sequence of images, only the centroids of the clusters are tracked.

INTRODUCTION

Moving object detection techniques have been studied extensively for such purposes as video content analysis as well as remote surveillance. There are many ways to track the moving object [1]-[6]. Most of them use the frame differences to analysis the moving object and obtain object boundary, which may be quite time consuming. In order to reduce the computation cost, a more efficient way is expected. From this point of view, a new moving object detection algorithm is proposed to exploit information of motion field. As motion vectors introduce the discontinuities on the boundaries of moving objects, basic idea here is to use the discontinuous points in the motion field as the boundary of the moving objects.



I Frame Separation

Frame separation is the foremost step in motion detection [10]. The input is given in the form of sequence of images. The first image is the first input image and last input image will be the image after which there will not be any change in movement of the targeted object containing in the image.

II Moving Object Detection Algorithm

The process of proposed moving object detection algorithm is presented in Figure. 1. At the first stage, block-based motion estimation is used to obtain the coarse motion vectors, the vectors for each block, where the central pixel of the block is regarded as the key point. These motion vectors are used to detect the boundary blocks, which contain the boundary of the object. Later on, the linear interpolation is used to make the coarse motion field a dense motion field, by this way to remove the block artifacts. This property can also be used to detect whether the motion field is continuous or not. This refined dense motion field is used to define detail boundaries in each boundary block. At last, moving object is detected and coded. This algorithm could be divided into two parts, one is the motion field study and the other is object detection method, which will introduced in following sections.

As the ideal imaging model, perspective projection model is adopted in this paper. Under this model, motion vector corresponding the 3-D motion of rigid objects have following properties.

Proposition 1: Define f(P) = mP = Pz, where mP and Pz are the 3-D motion and the z¡ coordinate of point P respectively, if for three points P1;P2;P3 locating in a surface of an object,
1) P3 = ¸P1 + (1 ¡)P2 and,
2) The surface containing P1;P2 and P3 is a plane surface. and,
3) f(P1) = f(P2) =f(P3), then vP3 = ¸vP1 + (1 i) vP2 (1)
where vP is the motion vector in image plane associated with 3-D point P. This proposition shows that for any three points in a line, if condition 2) and 3) are satisfied. Then their associated motion vectors are linear interpolated as well. The condition 3) means the motion of all along the z-direction should be same. These two conditions almost hold for arbitrary 3-D objects. It is reasonable to assume the motion in same objects should be same. In addition, it is also convenient considering the connected objects with same motion as one moving object. The equation (1) shows that under these constraints, the motion vector associated with the points in one moving object should be linear interpolated. That will introduce the following algorithms.

III Moving Object Detection Algorithms

In this section, object detection algorithms are introduced step by step as detecting boundary blocks, writing chain codes, and detecting boundaries in the boundary blocks, where the boundary block is defined as a block containing boundary of a certain moving object.

To simplify the moving object boundary detection, some assumptions are drawn:
1) At most two objects' boundaries in one block;
2) Any object cannot be hold in one block;
3) The boundary of moving object is a simple closed curve.

The idea of proposed moving objects detection is to exploit the motion vector detected in video compression as the clue for the moving objects and then refine the moving objects boundaries. This scheme will speed up the moving object detection significant.

A. Boundary block detection

At first, we will detect the blocks containing moving object boundaries by using the information of the motion vector field generated by video compression. The motion vector derived by motion estimation is the common motion vector for all pixels in one block. However, we can assume it is the motion vector of the critical points locating in the centroid of each block. As mentioned above, pixels in the same object should satisfy the condition of linear interpolation. Hence the critical points in one moving objects should satisfy this condition. When this condition is violated, the discontinuity of motion vector field exist and imply the existence of the boundary in associated block. Then the algorithm detecting blocks containing moving Objects boundaries is as follows:

Algorithm 1: **Moving Object Block Detection**

1) Scan along horizontal direction, for three consecutive critical points P1, P2, P3, which are central points of each block and satisfying 2P2 = P1 + P3, if 2vP2 6= vP1 + vP3, then P2 might be a boundary block.

2) Scan along vertical direction, for three consecutive critical points P1, P2, P3, which are central points of each block and satisfying 2P2 = P1 + P3, if 2vP2 6= vP1 + vP3, then P2 might be a boundary block. Now the possible boundary blocks are selected, for further verification, another condition is provided.

3) For six consecutive critical points P1, P2, P3, P4, P5, P6, which are in a same line, and P3, P4, P5 are possible boundary blocks, while P1, P2, P6 are not. The central block P4 is the boundary block.

The above algorithm does not guarantee the moving objects boundary of closed simple curve. Thus we the following algorithm to find the simple closed curve corresponding the boundary of moving objects. Then we describe the boundary blocks by chain code. 8-neighboring connectivity is used here. The number 0 to 7 denotes neighboring blocks. Initial search starts from block 0, then round the target block, from block 1 to block 7. During the search, once a neighboring block is found as a boundary block, then the search will stop and the neighboring block will be regarded as current target block to start 8 neighboring blocks search iteratively. The searching algorithm applied to blocks is as follows:

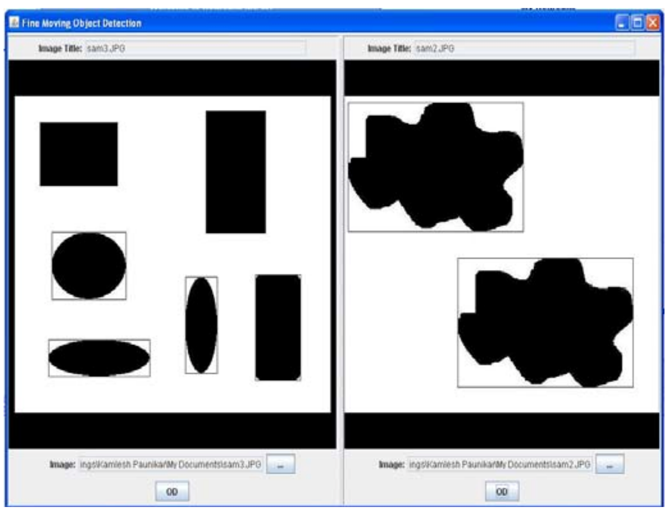


Fig. 2. Object Block Detection

Algorithm 2: **Forming the closed curve of boundary Blocks**

1) Let m = 0, Scanning from the left top corner block of the blocks in image to find the first boundary block.

2) The first boundary block of m^{th} object is denoted by B = B0 = (*i; j*), initialize the current direction as horizontal right *c* = 4; The boundary blocks of moving object *m*, is denoted by Sm = f(*i; j*)*;* cg

3) Define the 8-neighboring blocks of B as fBctg where ct = (ci 3 + t) mod 8; t = 0; :::; 7, and Bct denotes the block searching from B along direction ct.

4) Searching the next boundary block of B in the set fBctjt = 0; ¢ ¢ ¢ ; 7g to find the next boundary block. Once it is found, it is defined as B1 and c = ct is the current chain code.

5) If B1 6= B0, then B = B1; Sm [fctg ! Sm, and ct ! c; go to the step 3)

6) m + 1 ! m, searching the first boundary block for the m^{th} object in remain blocks. If it is successful, then go to the step 2);

7) End.

The chain code of mth moving object is Sm = f(i; j); c1; c2; c3; :::; cjg, where (i; j) means the first boundary block is (i; j)th block in the image.

B. Detection of the detail boundaries of moving objects

To simplify, we use the line segment in one block to approximate the actual boundary of moving objects in that block. In the other words, we use polygon to approximate the moving objects boundary. Therefore, each boundary block obtained in algorithm 2 is replaced by a line segment. That will be the algorithm of detecting detail boundary of moving objects.

Assume there are M moving objects = fiji = 1:::Mg. Please pay attention here, in the following contents, the subscript i; j of Bi;j does not denote the position of block B, instead, i denotes the ith moving object and j denotes the jth boundary block of ith moving object. As mentioned above, each moving object can be represented by a sequence ªi = (Bi;0; di;1; di;2; :::; di;Li), where Bi;0 is the index of the initial boundary block and Bi;0(x; y) is used to denote its location, di;j is the chain code from block Bi;j¡1 to block Bi;i, i.e., Bi;j = Nb(Bi;j¡1; di;j); j = 1; :::;Li, and the chain code is defined clockwise in the 8-connected. The intensity function of the frame k is fk and an indicator function will be generated for every boundary block.

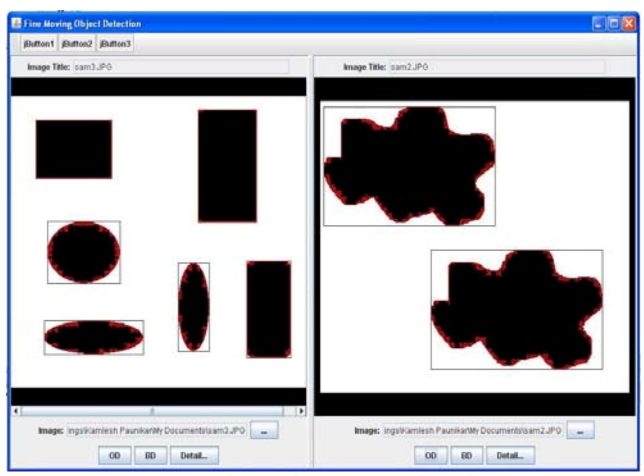


Fig. 3. Object detection (closed curve)

C. Motion Detection of an object

Algorithm 3: **Fine moving objects boundary detection**

1) i = 1;0 = A.
2) 0i = A; j = 1.
3) B0i;j = Nb(Bi;j¡1; di;j ¡ 1), suppose Pi;jQi;j is the common edge of Bi;j and B0i;j .
4) If motion vector v(Bi;j) = v(B0i;j) g(P) = jfk(P + v(B0i;j)) ¡fk¡1(P)j ¡ jfk(P + v(Bi;j)) ¡ fk¡1(P)j; 8P 2 Bi;j
Else g(P) = jfk(P + v(B0i;j)) ¡ fk¡1(P)j ¡ T0; 8P 2 Bi;j
where T0 is predetermined threshold.
5) Generate indicator function I(P) = ½1; if g(P) > 0
0; if otherwise ; 8P2 Bi;j .
6) If I(Pi;j)I(Qi;j) = 1, go to step 9).
7) P0 i;j = ½Pi;j ; if I(Pi;j) = 0 Qi;j ; if otherwise
8) Regarding P0 i;j as the initial point, to find the first pixel whose indicator is nonzero at the boundaries of Bi;j along the counter clockwise direction to replace Pi;j, and find the first pixel whose indicator is nonzero at the boundaries of Bi;j along the clockwise direction to replace Qi;j .
9) Ã0i = Ã0i [f(di;j ;Pi;j ;Qi;j)g
10) If j < Li; j = j + 1 then go to step 3.
11)0i =0i [fÃ0i g 12) if i < M; i = i + 1 then go to step 2.
13) End.

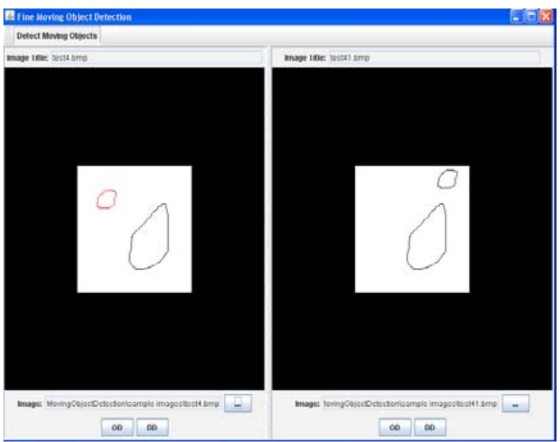
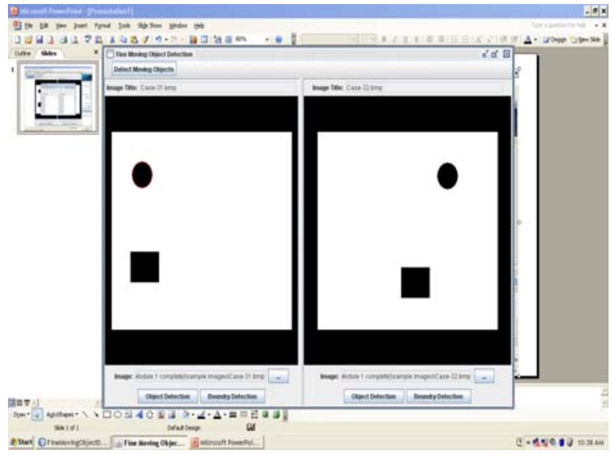
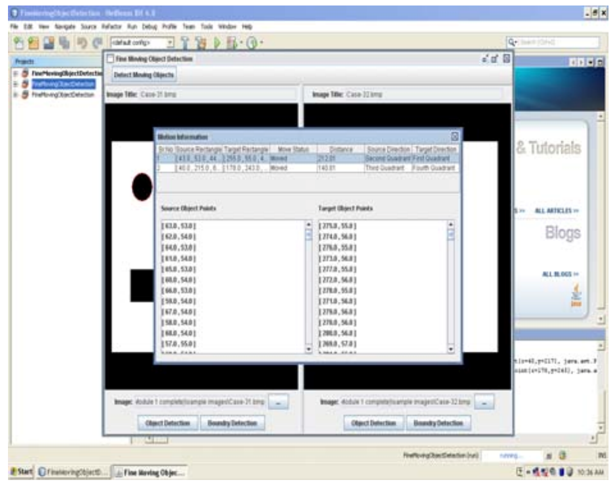


Fig. 4. Detection of Moving Object

Results

The results are presented as shown in Figure 2, Figure 3 and Figure 5. As shown in Figure 2, the connected outline is the object boundary in the motion field, which is also the chain code. The short white lines are the motion vectors for each block, while the grey short line surrounded by short white lines denotes for the block which is not boundary block. As shown in Figure 3 and Figure 4, the results are moving objects in previous frame and current frame separately. As displayed in the figures, the moving object can be tracked with visible effect. Figure 5 also provides the information regarding the location and difference between actual and moved image in the form of coordinates.





Application

- Biomedical Science
- Robotic Science
- Security Purpose
- Simulation of images

This can also be used for obtaining detection information related to the size, location and direction of motion of moving objects for assessment purposes.

Conclusion

In short, a more efficient moving object detection algorithm is suggested for video compression. First of all, the coarse motion vectors are obtained through block-based motion estimation. Then these motion vectors are used to detect the boundary blocks. Later on, a dense motion field is formed by linear interpolation to define detail boundaries in each boundary block. At last, moving object is detected and coded. Simulation results show that moving object could be identified correctly with visible effect.

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