Reliable Video Mosaic Using Fast Result Oriented-Variable Shape Search Motion Estimation

K.P.Rane, S.G.Bhirud and O.K.Firke

Abstract--**In this paper we introduced new approach of directional mosaic for video taken from linear motion of camera. Here we used estimation of moving camera direction using video motion estimation. The estimated moving camera direction is used to decide the direction of mosaic of different frames of video. We show here how directional mosaic is necessary for manifold video mosaic. We used different block matching estimation techniques for video motion estimation in which we estimate representative (global) estimation of direction of camera. We introduced new Result Oriented Variable Shape Search motion estimation (RO-VSSME) that improves the complexity of algorithm. We modified manifold algorithm to get reliability for the use of any kind of videos. We got precise results showing the effectiveness of using horizontal mosaic for positive and negative horizontal camera motion. It is also precise to use vertical mosaic for positive and negative vertical motion video. The results are appropriate for motions in any slanted linear direction by using rotational transform with horizontal mosaic.**

I. Introduction

We tested block matching algorithm for estimating the video motion based on different algorithms like variable shape search [2], three step search [3], four step search [4] and hexagon-based search [5] and diamond-based search [6]. Variable shape search (VSS) is precise and faster than diamond-based search. We modify VSS algorithm and proposes Result Oriented Variable Shape Search Motion Estimation (RO-VSSME) for camera direction estimation in mosaic applications.

Y. Wexler [1] already introduced the manifold algorithm for the video mosaic. It is best for the Positive Linear Motion Horizontal Videos. It processes only video taken from negative motion horizontal camera and it only produces negative horizontal mosaic of video. It is useful only for long video and not for short video. It doesn't find the direction check for the motion of the camera so can't predict whether results are correct or not.

Here we design an algorithm that improves the reliability of system. It can handle any kind of linear motion video whether it is in horizontal or vertical or in any slanted directions. It first estimates the direction of video camera motion and according to it horizontal or vertical or slanted mosaic is chosen. Manifold algorithm is used only for long video not for small video so, to handle such condition we first check the length of frame and if video is small it decides positive or negative mosaic according to average information available in half frames at both first and last end of video. More information in last end frames decides the negative mosaic for getting optimized information in mosaic image and vice versa.

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II. Algorithms

We introduced here one algorithm for camera motion direction estimation and three algorithms for directional video mosaic. Combined all those algorithms is nothing but the "Reliable Video Mosaic algorithm (RVMA)".

A. *Horizontal Linear Video Mosaic (HLVM)*

Y. Wexler [1] already proposed manifolds Mosaic algorithm, which requires horizontal motion video for mosaic so we calling it as HLVM. In HLVM slot manifold algorithm is used. Different slots of different frames are stitched to form mosaic image. It is very important to take decision of whether the particular slots stitches or not. One slot is considered as a node from a frame. So in different slots of consecutive frames, first the start node is selected and its similarities with different slots of consecutive frames are calculated to decide to the next node. Maximum similarity node is taken as the winning node and its weight is calculated according to similarity. So this process continues up to the target node if it is found. Otherwise, processes up to last edge of last frame or up to the specified time limit. Manifold algorithm in [1] stitches next slots of next frame from negative horizontal direction so can be called as Negative HLVM. Therefore Negative HLVM is used for only Positive Horizontal Motion Video.

Here we modify Negative HLVM the algorithm given by Y. Wexler [1] for the purpose of Positive HLVM. In graph search, we search in reverse direction for slot formation and taken a starting node from last frame and target node from first frame.

B. *Vertical Linear Video Mosaic (VLVM)*

Similar process as HLVM is used for VLVM. Only slot formation is in vertical direction and start node and target node are selected from top and bottom of first and last frame respectively for positive vertical motion video. Bottom slot is selected as start node and top slot is considered as end node for positive vertical mosaic and reverse for negative vertical mosaic. Algorithm is introduced bellow and steps are shown in Fig.2.1.

Algorithm for VLVM—

1) Select two consecutive frames. Consider Horizontal strip as a node of frame. Select start node and target node.
2) Winning node (Wn) <= Start node.
3) From bottom end of frame, visit the entire nodes in next frame and search minimum similarity node from those nodes.
4) If n^{th} node is maximum similarity node then Max node (MaxN) <= $(n+1)^{th}$ node. Winning node and Max node are placed in priority array and it is stitched left to the winning node.
   Winning node <= Max node.
5) If Winning node is last target node or if any node is not found with in the similarity range limit or time limit is over then go to next step.
   Else repeat 3), 4) and 5) for next iteration.
6) End Process.

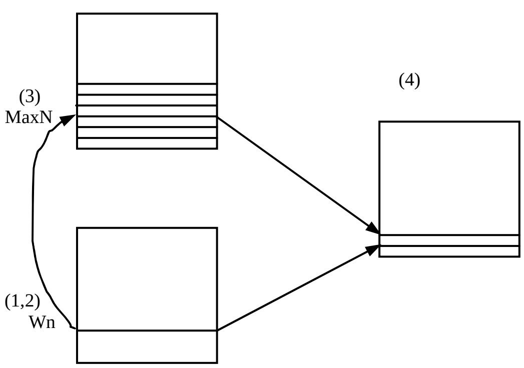

Fig.2.1. Step diagram for VLVM.
(1,2) First frame with Wn as a winning slot.
(3) Next frame with different slots for best slot search.
(4) Mosaic image by combining Wn and MaxN slot.

C. Slanted Linear Video Mosaic (SLVM)

If camera moves in slanted linear direction then HLVM and VLVM fails to get proper information from mosaic image so we modify HLVM to get new SLVM algorithm. We used image registration techniques for it, which are previously used for two-image mosaic. We rotate each frame in horizontal direction according to the direction extracted from the camera motion estimation algorithm. After rotation, each frame is conditioned to get proper horizontal motion frame and the reproduced video from those frames is passed through HLVM to get mosaic image.

D. Result Oriented Variable Shape Search motion estimation (RO-VSSME)

In RO-VSSME we used either Simplified-VSS (SVSS) or VSS depending on the expected results. SVSS is the part of VSS. The global direction estimation has to calculate for mosaic of video and SVSS got more complexity than VSS algorithm. So SVSS algorithm is better for the global direction estimation for video. In SVSS, if the expected result is not found then we go for VSS algorithm, which extracts local motion estimation and then from local motion estimation, global motion is estimated. An expected result is found by calculating the density of codes of motion vectors. If the density is more than the threshold then motion vectors are valid only. Global motion vector is the vector code having maximum density in local vectors. We had taken representative motion camera direction estimation as the inverse of the estimation of global motion in video in this algorithm.

Minimum Absolute Difference (MAD): MAD is used instead of MSE in RO-VSSME. It finds difference between the points of first frame to the point of second frame.

Search pattern used for our algorithm is shown in Fig.2.2. The pattern shown by 1 point is the big diamond Pattern. The pattern shown by 2 point is the square Pattern. The pattern shown by 3 point is the hexagon Pattern. The flow diagram is shown in Fig.2.3.

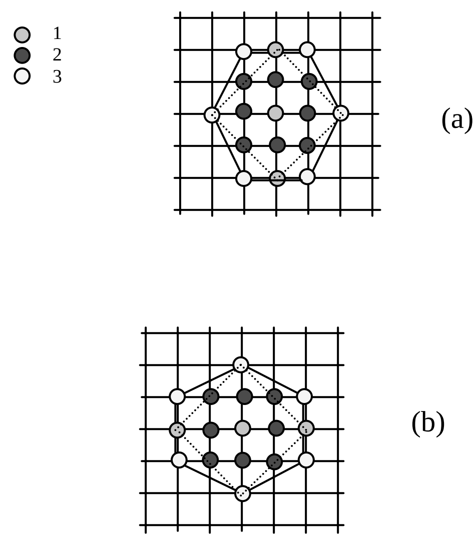

Fig.2.2. Two Search pattern [2] for RO-VSS algorithm
(a) Horizontal RO-VSS pattern
(b) Vertical RO-VSS pattern

E. Information in video

We used average density of motion vectors as key point for extracting the information between two images. Densities of vectors are calculated by getting the histogram of motion vectors. Information available in two images is more when the densities of all the motion vectors are approximately same as that of average density. If density of some motion vector goes very high (more than threshold) than the average density then information in images is assumed as less information. So average of average vector densities of all pairs of test frames is calculated and all vector densities of frames are combined for the calculation of information in video.

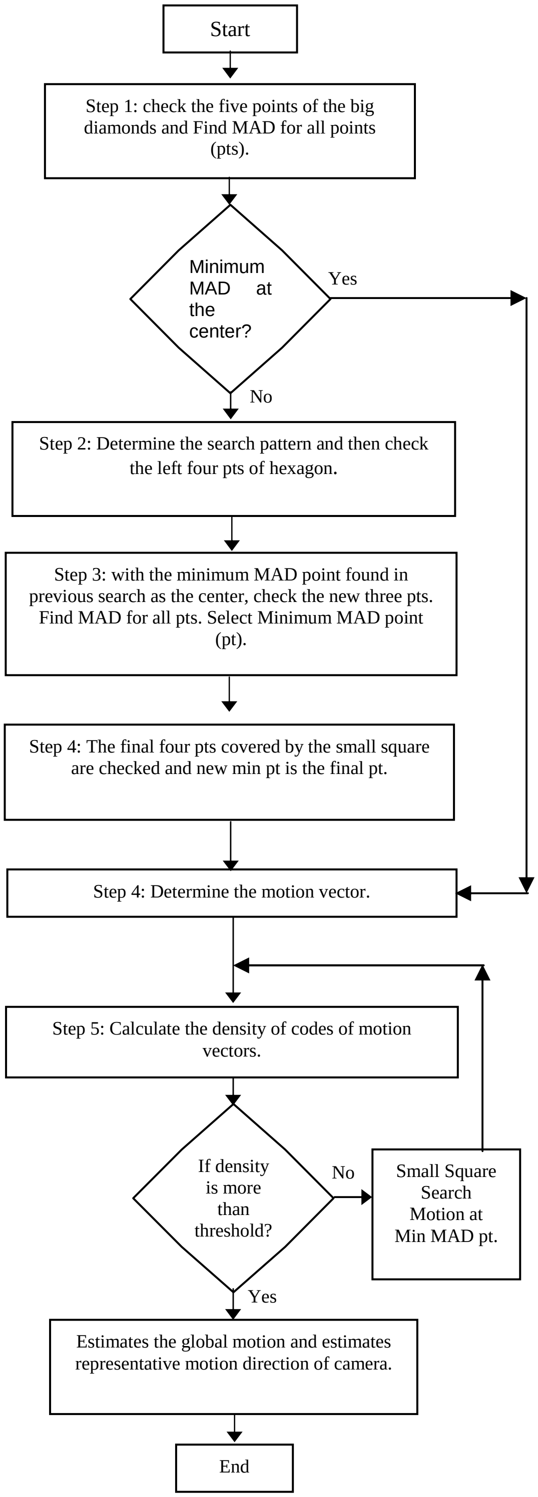

Fig.2.3. Flow diagram for RO-VSSME algorithm

III. Experimental Results & Conclusion

We experimented on different videos, which are having different directional motions like positive horizontal direction motion, negative horizontal direction motion, positive vertical direction motion and slanted direction motion. One directional video is failed by another directional mosaic algorithm. So it is necessary to go for directional mosaic of videos. We tested all the videos for all mosaic algorithms separately and with combined algorithm (RVMA). This Combined algorithm of proposed RO-VSSME and all mosaic algorithms give conformation of mosaic for all directional videos. All the possible results are shown in APPENDIX-1.

IV. References

[1] Y.Wexler, D.Simakov, “Space-Time Scene Manifolds”, *IEEE International Conference on Computer Vision (ICCV’05)*, 2005.

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[6] Zhu, S. , Ma, K.K., “A new diamond search algorithm for fast block-matching motion estimation,” *IEEE Trans. On Image Processing* **9**(2), pp. 287-290, 2000.

V. APPENDIX-1

A. *Database of videos sequences.*

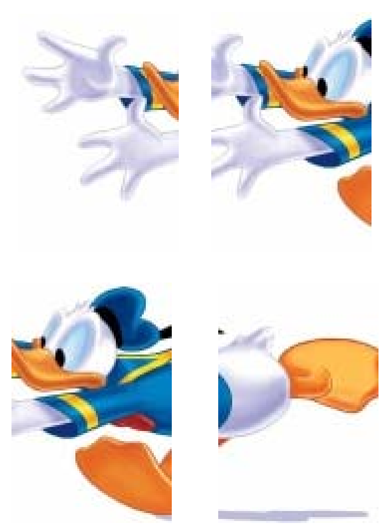


Fig.5.1.1. Negative Horizontal Motion Video (NHMV)

Fig.5.1.2. Positive Horizontal Motion Video (PHMV)

Fig.5.1.3. Slanted Motion Video

Fig.5.1.4. Negative Vertical Motion Video

B. Results of different mosaic

Fig.5.2.1. Vertical Mosaic Image with NHMV

Fig.5.2.2.Vertical Mosaic.

Fig.5.2.3. Positive Horizontal Mosaic Image with NHMV

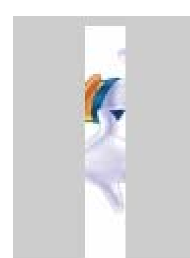


Fig.5.2.4. Positive Horizontal Mosaic image with PHMV

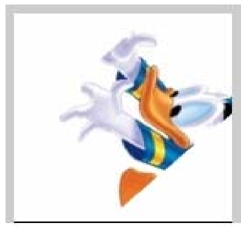
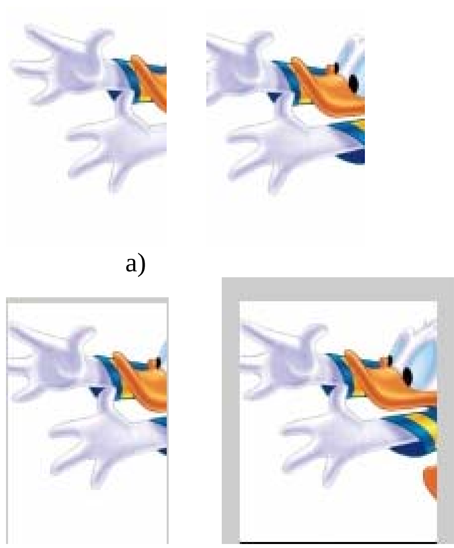


Fig.5.2.5. Slanted Mosaic Image with PHMV



a)

b) c)

Fig.5.2.6. a) First and last frames (20th frame) of small video
b) Positive Horizontal Mosaic Image for small video (20 frames less than number of pixels in horizontal direction) so provides less information than the information in frames.
c) Positive horizontal Mosaic Image for sufficient large video (40 frames greater than number of pixels in horizontal direction) so provides more information than the information in frames.