Development of Mosaic Algorithm for Mosaic-video Creation using Modified Strip Search Algorithm

Kantilal P. Rane
Department of E/TC
Godavari College of
Engineering Jalgaon (Indian)

Shrirang S. Pandit
Department of E/TC
Godavari College of
Engineering Jalgaon (India)

Sunil G. Bhirud
Department of Computer
Engineering and Technology
VJIT Mumbai (India)

ABSTRACT
Creating Mosaic-video is still a relatively new pursuit. It is also useful inside virtual reality environments, computer game settings, movie special effects and region of interest tracking. Immersive teleconferencing is another application that is being developed using mosaic-video. Many mosaic-video creation techniques are proposed by the researchers but most of them are based on the multiple cameras. We developed it with the use of single moving camera by incorporating simple and efficient steps. Initially a strip search algorithm is modified for mosaic creation with high sensitivity and linearity followed by video background extraction and then mosaic-video frames are created with merging the required dynamic motions from all the frames to mosaic backgrounds. This method handles major problem of non-redundant information retrieval and visualization along large view with respective to the video of tracking camera.

Keywords
Video Mosaicing; Video Background Extraction; Motion Extraction and Mosaic-video.

1. INTRODUCTION
Mosaic creations deal with the transfer of maximum information from input images/video frames into a large view image. Image mosaicing technique is limited to the static view of the scene but video mosaicing can be extended to dynamic mosaicing. Dynamic motions can be visualized into the mosaic created from video mosaicing in the form of mosaic-video.

Mosaic-video [1] is a video of large view with panoramic background in which some or all the possible or required and non-redundant dynamic motions (moving objects) are visualized. In [2-4], two or more overlapped videos are combined to form a video of panoramic view. Dynamosaicing [5] is a recently presented technique/mechanism for mosaic-video creation using a single moving camera. It is assumed that the temporal variations at different frames of video with in a particular period are combined in a frame for the creation of mosaic video. It should be visualized on the different frames of mosaic-video accordingly.

The proposed method includes the steps as follows,

1) Mosaic Method using Modification of Strip Search Algorithm [6].
2) Background Extraction from Mosaic Image [7].
3) Mosaic-video Creation from Background Mosaic Image (based on single moving camera).

As background mosaic is required to be extracted, a specific mosaic method which doesn't include more dynamic motions in mosaic and called Strip Search Algorithm [6] based on the SSD similarity measure is modified to get high sensitivity, clarity and linearity

2. MOSAIC METHOD USING MODIFIED STRIP SEARCH MODELING
Many authors [8-10] have used horizontal registration of two frames for video mosaicing. Seam line is the line across the overlapping portion of video frames which is perpendicular to the direction of camera motion and is required to properly register the frames of video captured in any direction of camera motion. Here, it is required to handle the mosaic creation with the use of handhold camera generally acquiring significant vertical distortions with translational motions rather than use of smoothly moving camera. Also mosaic image used for the creation of background mosaic should contain the minimum dynamic motions so that it can be removed as easily as possible in the background mosaic creation process which is possible with strip search mosaicing [6]. Horizontal and Vertical sensitivity is a major requirement in the video traversing in any direction, so relative variation to horizontal and vertical direction are required to be analyzed. This leads to modify strip search algorithm [6]. To get more sensitive in both horizontal and vertical direction, Modified Strip Search Algorithm is used based on new similarly measure called MRVCSD - (Maximum relative variation in cumulative squared difference).

Steps for Modified Strip Search Algorithm are given as follows.

1) Find SSD.
2) Find horizontal accumulation of SSD (HA_SSD).
3) Calculate relative variation of HA_SSD (RVHCA).
4) Estimate horizontal similarity (HS).
5) Find vertical accumulation of HS (CD-SSD).
6) Calculate relative variation in CD-SSD (RVCSD).
7) Estimate similarity (MRVCSD).

3. BACKGROUND EXTRACTION FROM MOSAIC IMAGE
Background of video doesn't visualize any dynamic motions. It is better to visualize the background view of video on the mosaic image. So, all the moving objects are required to be analyzed. A proposed mosaic method based on Strip Search logic, basically cuts the strips from one extreme end of the frame as a part of mosaic images. Generally dynamic motions in video are located at the central position of the frames and introduced mosaic method is having the nature that it

eliminates all possible centered dynamic motions from all frames. Even if, some dynamic motions remain in a mosaic image, they can be eliminated by image in-painting technique. Normalized Cross Correlation [15] based Auto-positioning Algorithm (NCCAPA) [7] is utilized for image in-painting process for easy operation.

Video background extraction process involves two major steps as,

1) Identification of Moving Objects,
2) Image In-Painting Algorithm,

3.1 Identification of Moving objects

Normalized Cross Correlation (NCC) based detection contributes two images as, 1) the image to be positioned, say template and 2) the image in which template is to be positioned, say A. The image A must be larger in size than the template image for positioning to be validated. NCC extracts the correlation coefficients (values between -1.0 to 1.0). Detected matched portions are having maximum values of correlation coefficients along the template image A.

Normalized Cross Correlation (NCC) based detection is responsible to search a template over the other image. It is utilized to search the multiple template images over the big image using NCCAPA. NCCAPA is modeled by function as shown in equation (1).

$$[x1, y1, x2, y2, ..] = NCCAPA(template1, template2, ..., A) \quad (1)$$

Where template1, template2 etc are input images to be positioned, A is input image in which templates are to be positioned and *x1,y1,x2,y2,…* are the estimated location co-ordinates of respective input templates

3.2 Image In- Painting Algorithm

Image in-painting based on NCCAPA is introduced as demonstrated in Fig. 1. A vertical strip along non-desired visible moving object (like a car), which is to be in-painted in the mosaic image is considered as a target strip. The strip in touch with a target strip is considered as a reference strip, which may contain stationary objects. The background behind the moving object of the target strip is required to search within the remaining original frames, which can be the strip in-touch with reference strip without having any portion of moving objects, as shown in m^{th} frame of Fig.1 Within the other frames like n^{th} frame, both the strips may be identified but the distance between both strips is less than the target strip size so background strip cannot be extracted. By considering this, the condition is decided to extract background strip as, distance between both target and reference strips must be greater than or equal to the target strip size L.

Proposed NCCAPA based Image In-Painting Algorithm includes two procedures as, Motion Tracking Algorithm and Optimal Strip Pasting Algorithm. The motion Tracking Algorithm searches the target and reference strips within the different frames and Optimal Strip Pasting Algorithm checks the condition and accordingly copies and merges the background strip at the place of the target strip over the mosaic image to get a background view of the video.

4. MOSAIC VIDEO CREATION FROM BACKGROUND

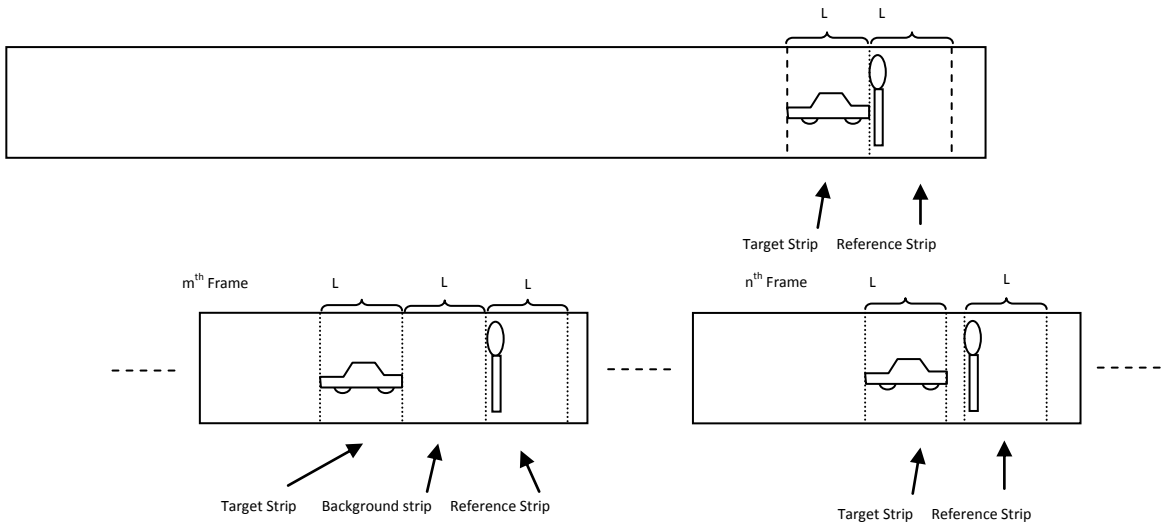


Fig 1: The process of Video Background Extraction having a moving object (car)

Dynamic motions of video are always considered as motions in the direction of camera motion. As an example, in a video of the scene having a walking man with a beach view, the motion of man is a dynamic motion and the background motion is a static motion. Mosaic video should contain the common background view with visualization of all the possible or desired dynamic motions which are very necessary and highly non-redundant. Background mosaic image can be utilized as a common background view for the mosaic video. Need is to track and extract the dynamic motions (eg. walking man in a beach view) separately from every original video

frame and transfer (paste and merge) it to the background mosaic image to create a corresponding mosaic frame.

Tracking of dynamic motions is possible by NCCAPA. NCCAPA can provide the locations of matched portion in each frame. Dynamic motions can be extracted in the form of cropped strips along the tracked locations of these frames. 3-Point Masked Blending Algorithm is introduced to merge cropped image on background mosaic image Mb with the help of the masked strip. Image binarization can convert the cropped strip into the mask strip. All the motions can be tracked, extracted and merged from all the frames to get the corresponding mosaic frames of mosaic/panoramic video.

4.1 Tracking of Dynamic Motions

Tracking of dynamic motions are required to estimate 1) the tracked strips similar to the desired dynamic motions and 2) the distances travelled by them with respective to some reference position. Initially dynamic motions from some reference frame are decided to track as desired dynamic motions (say target strips). An invariant portion of the same frame is decided as reference strip. NCCAPA is used to track target strips and reference strip in all frames to get their corresponding locations. All the tracked target strips and reference strips are cropped and are placed in a database (say motion database) with the reference of their frame numbers and tracked locations. The distance between the location of the tracked target strips and their corresponding reference strip (say relative distances) can be used to decide the positions for pasting of tracked target on the corresponding background mosaic frame.

After processing of some frames, the reference strip may be escaped from visualization (indicated by non- tracking of reference strip). The system can be designed for asking the new reference strip. The distance between the location of the new reference strip and the location of the old reference strip should be added to the distances between the location of next tracked target strips and corresponding tracked new reference strips to get the exact relative distances.

4.2 Extraction of Dynamic Motions

Background (portion other than the moving object) of the tracked target strips from the original frame and the background of the strip where the tracked target strip is to be added to the background mosaic image are always unmatched. It is necessary to merge these two backgrounds by using some blending algorithm. In this case, direct blending of two background strips is not feasible. Instead of that, background of the tracked target strip is masked and replaced with the background of the located mosaic strip. It is then merged with moving object by using 3-Point Masked Blending Algorithm. Image binarization can be used for masking of the background of the tracked target strip from a moving object. Unwanted regions of mask image can be removed by filling holes and eliminating small area boundary regions.

4.3 3-Point Masked Blending Algorithm

A function maskblending based on horizontal blending algorithm, prior presented by Benjamin Berger [16-17], horizontally blends two images along full overlapped region across the seam line. It can horizontally blend two images along 3 lines (left, middle and right) across the vertical boundary line (seam line) for fast operation. Precision can be maintained if we take accurately registered strips as an input for blending. Modification is made on a function maskblending based on horizontal blending algorithm [16] for irregular shape blending along the boundary of the defined mask. The mask is defined along the target object. This algorithm is used to merge the object of the first image (tracked target strip) on the background of the second image (located mosaic strip).

The algorithmic steps are as follows.

1) Initialize two blending images. Define an Inner Blending Image in which object to be merged is available and define another one Outer Blending Image whose background has to be merged.
2) A mask is created from Inner Blending Image. The mask is the binary image separating an object from its background and its process is given as follows.
   - The inner Blending Image is converted into gray images.
   - A gray image is converted into a binary image by Image Thresholding.
   - The binary image is filled with holes (black pixels in the white portion) to remove noise.
   - All the separated regions of binary image are identified and only a maximum area region is considered as the mask region. All the remaining regions are made non-masked.
3) 3-point pixels of the Inner Blending Image and Outer Blending Image along the boundary of the mask are considered similar to the middle 3 line pixels for a maskblending function. These pixels are merged by using a function maskblending along the irregular shape of the mask to get a blended image.

5. EXPERIMENTAL RESULTS

Mosaic image created with Modified Strip Search Algorithm is shown in Fig. 2. Because of the property of this proposed mosaic method, non-dynamic end strips are combined as a mosaic image, which is found helpful for the background extraction. Due to this, only moving object from the initial part of mosaic is required to be extracted. This moving object on the mosaic image is replaced with its background view using background extraction process and result is presented in Fig. 3. Some of the output frames of Mosaic-video formation Process are displayed in Fig. 4 (a-d) as below to visualize the dynamic nature of mosaicing. Walking man is seen with different poses in the theses frames without any distortion to the background image.

6. CONCLUSION

An efficient Modified Strip Search Algorithm is used to create panoramic mosaic image. Dynamic motions are removed from mosaic image using background extraction method. Very few authors had proposed background extraction methods with moving camera. Their problems like distortion of moving objects, addition of noisy patterns and action recognition of moving and varying objects are handled by using mosaic based background extraction method. Mosaic-video construction generally uses the multiple cameras but we proposed to use a single camera based mosaic-video creation method which can visualize all instances of specified motions. Video is created from large mosaic frames with proposed mosaic-video construction method. Accuracy and robustness clearly reflects from the results of mosaic applications like background extraction and mosaic-video construction.

7. REFERENCES

[1] Ni. Qin, Dezhen Song, "On-demand sharing of a high-resolution panorama video from networked robotic cameras," International Conference on Intelligent Robots and Systems, pp: 113-118, October 2007.

[2] Yuan Hong-Zhao, Wang Bang-Ping, Zhang Jun, Li Hui, "A Novel Method for Geometric Correction of Multi-cameras in Panoramic Video System," International Conference on Measuring Technology and Mechatronics Automation (ICMTMA-2010), vol. 1, pp: 248 - 251, March, 2010.

[3] Xinding Sun, Foote, J, Kimber, D, Manjunath, B.S, "Region of interest extraction and virtual camera control based on panoramic video capturing," IEEE Transactions on Multimedia, vol. 7, no. 5, pp: 981-990, Oct. 2005.

[4] Tzavidas, S. and Katsaggelos, A.K, "A multi-camera setup for generating stereo panoramic video," IEEE Transactions on Multimedia, vol. 7, no. 5, pp: 880-890, Oct. 2005.

[5] Rav-Acha, A, Pritch, Y, Lischinski, D, Peleg, S, "Dynamosaicing: Mosaicing of Dynamic Scenes," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 29, no. 10, pp: 1789-1801, Oct. 2007.

[6] Kantilal P.Rane, S.G.Bhirud, "Image Mosaicing with Strip Search Algorithm based on Novel Similarity Measure," International Journal of computer application, vol. 27, no. 2, Aug. 2011.

[7] Kantilal P.Rane, S.G.Bhirud , "Video Manipulation using frames Estimation through Mosaic creation ," Computer_Education Advances in Intelligent and Soft Computing ,Vol. 133, pp: 737-743, 2012.

[8] Shum, H., Szeliski, R., "Construction and refinement of panoramic mosaics with global and local alignment," IEEE Int'l Conf. Computer Vision, 1998, pp: 953-958.

[9] I. Zoghlami, O. Faugeras, R. Deriche, "Using geometric corners to build a 2D mosaic from a set of images," Proceedings of the IEEE Conference on CVPR, Puerto Rico, 1997, pp: 420-425.

[10] R Hartley, A. Zisserman, "Multiple View Geometry," Cambridge University Press, UK, 2000.

[11] Fangmin Shi, Neil Rothwell Hughes,Geoff Roberts, "SSD Matching Using Shift-Invariant," British Machine Vision Conference, pp: 113-122, 2001.

[12] Steven L. Kilthau, Mark S. Drew , Torsten Moller, "Full Search Content Independent Block Matching Based on the Fast Fourier Transform," IEEE International Conference on Image Processing , pp: 669-672, 2002.

[13] Lai-Man Po, Kai Guo, "Transform-Domain Fast Sum of the Squared Difference Computation for H.264/AVC Rate-Distortion Optimization," IEEE Trans. Circuits Syst. Video Technology (TCSV), vol. 17, no. 6, pp: 765-773, 2007.

[14] Trucco, E. and Verri, A., "Introductory Techniques for 3-D Computer Vision," Prentice Hall, 1998.

[15] Tomas Gänsler, Jacob Benesty, "The fast normalized cross-correlation double-talk detector," IEEE Trans. Signal Processing, vol. 86 , Issue 6, pp: 1124 – 1139, 2006.

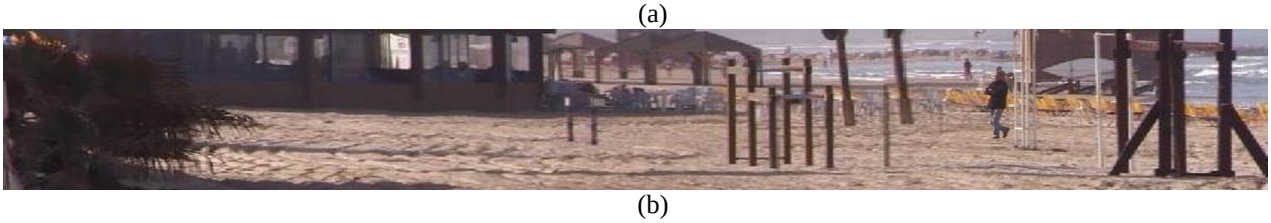
[16] A function maskblending, http://www.eecis.udel.edu/~qili/ta/cis489/2/.

[17] Kantilal P.Rane, S.G.Bhirud, "Text Reconstruction using Torn Document Mosaicing," International Journal of computer application, vol. 30, no. 10, pp: 21-27, Sept. 2011.

Fig. 2. Mosaic image

Fig. 3. Background Mosaic Image

(a)



(b)

(c)

(d)

Fig.4 (a-d): Frames of mosaic video (“Walk through Mosaic”)