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A Survey on Motion Detection by Image Stitching techniques

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Abstract: In today's world, an image stitching/homogenizing is considered as a dynamic research area in graphics and computer vision. Image homogenizing literature shows that it is a challenging task for panoramic images. Panorama Image stitching is the process of merging two or more images of the same scene into one high resolution seamless image called as panoramic image. Tracking motion and moving object identification is the basic source to extract important information regarding moving objects from anomalous sequences in continuous image based surveillance systems. This paper presents a survey study about the process of panoramic image stitching(PIS) process and the main components of PIS. Further, a framework of a complete panorama image stitching system to detect the moving objects based on these approaches will be introduced.

Keywords- Image stitching; Panorama; object detection; Surveillance; seamless image

I. INTRODUCTION

Image/video stitching or photo homogenizing is the process of combining multiple photographic images with overlapping fields of view to produce high- resolution image/video or segmented panorama to track and detect the moving objects. Insurgent incidents like terrorist attacks or several others, abandoned objects were used to threaten the harmony of community and sovereignty in India. Many damages are caused due to such unusual incidents to public/private properties causing financial losses as well as pulled people in emotional trauma. One solution is to use public surveillance camera to detect anomalous events and trigger alarms to vigilance and authority. Most approaches to image stitching nearly require exact overlap between the identical exposures and the images to produce seamless results performed commonly through the use of computer software which is known as mosaicing. Algorithms for aligning images and stitching them into seamless photo-mosaics are most widely used in computer vision. Image stitching algorithms create the high resolution photo-mosaics used to detect today's digital maps and satellite photos. They also come bundled with most digital cameras currently being sold, and can be used to create beautiful ultra wide-view panoramas. The aim of this project is to create software that merge images which have similar features and create a panoramic image for moving object detection using surveillance cameras. Recognition/identification of the object and its motion/activities with least amount of processing is required which is compromised in research area whenever high accuracy is met.

II. LITERATURE SURVEY

Over the period of last many years, several approaches have been proposed for image stitching and motion detection. Image stitching is a process in which several images are stitched together after establishing geometric relationship between them. The geometric relationships are coordinate transformations that relates usually the various coordinate systems. By applying these transformations via a merging operation and by combining the overlapping of the images it is possible to create a noteworthy form of mosaic.

The two main expectations from the image homogenizing process are that the Stitched image should be nearly as close as possible to input images and in Stitched images the seams should be invisible. New algorithms are coming to make the work clear and less tedious for the programmers to work upon. In the era of 3-D imaging and videos, image/video stitching is an inevitable task. Hence, there is a large scope for research in this field.

The authors in paper[1], presented a real-time video stitching system which can stitch videos acquired from multiple moving cameras, so that cameras could move freely to stitch the videos. They proposed an algorithm which estimates refined homography in both spatial and temporal domains. That is, their work initially detects feature points by SURF and then by K-Nearest Neighbors (KNN) method, they accomplished feature matching. Further, subsequently they applied RANSAC to estimate homography transformation from the extracted feature pairs in the spatial domain. In experimental setup, they stitched three videos acquired from three cameras placed on a linear

setting and assumed the middle view as the reference view. In addition to GPU-based feature extraction, CUDA parallel programming is applied to speed their video-stitching system to achieve real-time stitching. In this way, their video stitching system frame work includes feature detection, spatial and temporal homography estimation, image warping, blending and cylindrical warping. Finally, they concluded that their proposed vide stitching algorithm provides better image alignment than other methods. The streams used to upload the data and calling Kernel concurrently can speed up the execution time.

The authors in paper[2], presented an advanced approach to motion detection for automatic video analysis through which they achieved complete detection of moving object which is robust against of changes in brightness, dynamic variations in the surrounding environment.
Their proposed method is a pixel-dependent and non-paramatrized approach which is based on first frame to build the model. Their approach utilizes the unique tracking methodology that identifies and eliminates the ghost effect from dissolving into the background of the frame. Algorithm they introduced integrates background subtraction with normalized graph cut segmentation which is robust if any changes in the illumination of the frame.
The algorithm performs a step by step tracking and classification of the detected object with more accuracy and within minimum processing time. Their algorithm involves the following steps: Initial background modeling, background subtraction and normalized cut segmentation, tracking of the detected object, update background model and classification of moving objects. In experimentation, they used optical flow method for tracking the object.
Finally, they concluded that an advanced algorithm based framework is proposed which is capable of producing background with almost null noise pixels. It overcomes the trial of artificial ghost. Their results proved the efficiency of their method on scales of accuracy and low processing requirements.

The researchers in paper[3], showed the impact of selecting image feature detection for the development of a panoramic image under different illuminations. They used 3 main steps. Image acquisition, image registration and image blending for development of panorama under different light conditions. They used image registration method which is based on feature-based method for feature detection. The performance evaluation is done to compare three combinations of well known methods of image feature detectors and descriptors which are Scale Invariant Feature Transform(SIFT), Speeded up robust features(SURF) and ORB method for different light conditions. Further, the comparison of above method steps is done, the final panorama is constructed using RANSAC feature matching is proposed. Their important findings are, de-blurring of image can be done using light streak algorithm. For day light conditions, ORB algorithm works better as it requires less time for more features extracted where as for night light conditions. It is further highlighted that SURF detector performs better then SIFT detectors.

The authors in paper[4], designs on a harbor panoramic browsing system based on image based rendering technology. Here, the system realizes harbor images mosaic seamlessly by adopting panorama mosaic technology and develops the harbor panorama browser by using VS2010. Their system overview consisted of harbor panorama mosaic subsystem and scene browsing subsystem. Their key technology of the system involves, shooting technology of the harbor images, Image projection technology, Panorama mosaic technology and Smooth transition technology of harbor scene.
Their conclusions involve harbor panoramic browsing system which provides more vivid, visual and real harbor study method for navigators. It enables the navigators to view vivid harbor objects by constructing a virtual sea environment and realizes harbor scene browsing in different positions, directions and view the angles in real-time. The advantages of this system are convenient usage, comprehensive information, various view angles, vividness, high interaction and immersion which can greatly enhance the navigators in real-time and precise study of the harbor.

The work of authors in [5] is to propose solutions for the automatic detection of moving objects in real-time with a surveillance system. They made several changes such as illumination changes, dynamic background, video noise and moving object. And they proposed a method which can reduce the effect of the challenges listed above and can run in efficient manner and fairly effective in terms of response time and results. They presented two different approaches. In the first approach, they seek to detect non-rigid moving objects that has some geometric shape through modified moving average technique. In the second approach, they seek to detect non-rigid moving objects that have geometric shape by using captured images. Their evaluations and results have shown that their proposed approaches were able to detect moving objects with sought forms despite noticed limitations.

In paper [6], the authors described about an approach to moving object detection with the usage of improved background subtraction and model updating methods in video stream. Further, by applying quadtree creation algorithm to speed up the performance by comparing only the random pixels and also to use the quadtree structure created on the previous frame instead of creating from scratch. They concluded by comparing the background model updating method with quadtree structure which shows the same frame rates and better accuracy. Processing

fast motion detection will allow the increased performance rate of the whole system.

The authors in [7] have worked on panorama stitching, moving object detection and tracking. Using UAV videos, it is convenient to acquire more static and dynamic information to grasp the scene situation. Panoramic image mosaic, moving object detection, frame registration and tracking are the key foundation of the aerial video analysis and processing. They used estimation method and utilized moving direct linear transformation (MDLT) method to find the homography of the frames more accurately and stitch the frame sequence to get a panorama. Finally, they applied 5-frame difference method on the warped frames to detect the moving object. They did experimentation work and also and their results showed that their method can work well in both less-textured background and well-textured background scenes for registration, stitching, detection and complex scenes for tracking.

Authors in paper [8] has presented about Abandoned object detection and vigilance enhancement using video surveillance system. In developing countries like India, there exists a threat on social security and support due to famous extremists and miscreants. Abandoned objects are used to frighten the sovereignty and communal harmony. Several human beings are caused due to such incidents, along with damages done to public/private properties, which leads to financial losses as well as emotional trauma. In this research paper, the researchers organized a solution using surveillance cameras to track and detect abandoned objects, and triggered necessary alarm to vigilance. The algorithm used here is based on frame by frame image segmentation and by fusing various frames within the critical time window. The algorithm takes care of angular alignment, and multiple movements. The authors tested on real time video capture and the results were found to raise very low false alarms and scarcely missed the detections when the video streams were captured.

In paper [9], the authors described various Image stitching techniques used to combine multiple images together to make a wide- view picture called Panorama. Algorithms for stitching and aligning have many applications in computer vision like texture synthesis, object recognition, medical imaging. Image stitching requires identical exposures to produce seamless results. Stitching can be done into three stages Acquisition, Remapping and Blending. Image acquisition is carried out using translating camera and hand held camera and rotating camera. Image Remapping involves conversion of camera image to Sphere, alignment, exposure setting and Selection of final projection. Image remapping is also referred as Warping. The final warped images should blend correctly so that visible seams between the images can be eliminated. Image blending techniques like Alpha Blending, Feathering, Pyramid blending, average blending are used to remove ghost effect, exposure difference, Blurring. Finally, the redundant data is cropped using several cropping methods like graph cuts, gradient blending etc.

In paper [10], the authors showed that image Mosaicing is the process of conjoining two or more scenes of the same picture into one image and create a panorama of high resolution picture. In this paper, the researchers used SIFT (Scale Invariant Feature Transform) based algorithm to create a panoramic image. This method is used to extract feature points from an input image by examining the image locations, then the descriptors defined on the key point are computed. The next step for homograph calculation they used is RANSAC algorithm which removes false feature points. Finally to get a seamless image they used blending technique and completed image stitching process creating a panoramic image.

III. COMPONENTS OF IMAGE STITCHING PROCESS

Panorama image homogenizing is a process of joining two or more images of the same scene to one high resolution image referred as panoramic image. The Image homogenizing process can be divided into five main components – image registration, Image warping, color correction, image labeling and image blending which leads to a wide-angled panoramic output image as shown in Figure 1. This paper presents a survey about the process of panorama image homogenizing. The detailed description about the components of panoramic image stitching will be mentioned in this paper. A framework of complete PIS process based on these approaches is introduced. The following figure is the block diagram of the components of the image stitching process.

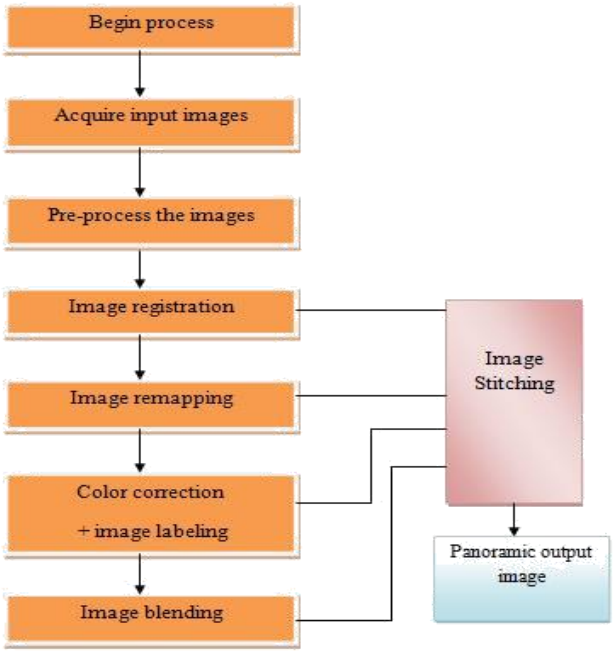

Figure 1: Components of Image Stitching Process

A. *Input Images:*

Input images in panorama image stitching can be broadly defined as the action of extracting an image from the source, usually a hardware-based source, so that it can be passed through the processes need to occur afterward. Input image is nothing but occurs image acquisition process. Image acquisition in panorama image stitching is the fundamental step in the workflow sequence.

B. *Feature Detection:*

The second step in the image stitching process is the pre-processing stage which includes feature detection process and feature extraction process. The feature detection process, which is considered as one of the important image stitching stage. The features can be defined as the elements in the two or more input images to be detected and matched. It is based on the idea that instead of looking at the overall image, it can be advantageous to select some desired points in the image and perform a local analysis on those points. According to the different search methods, each image can be analyzed on the basis of a set of feature points that contains from ten to hundreds of feature points anywhere. Two methods are often used for feature detection and matching such as SURF, SIFT.

C. *Feature matching:*

Once we have extracted features and their descriptors from random images, the next step is to organize some preliminary feature matching methods between those images. The Feature matching algorithm divides the problem into two separate components. The first one is to select a matching strategy, which determines that which correspondences are passed on to the next stage for further processing. The second is to construct efficient data structures and algorithms to perform on the images. The more consistent search strategy being used nowadays is full traversal search, but the computations required is too complex. The more efficient search strategy is the Best-bin-first (BBF), which is based on the k-d tree algorithm.

D. *Color correction:*

Color correction is an important phase in image stitching process. There will be a color inconsistency issue between the images during stitching. The digital camcorder examines large shifts in image colors under different light conditions. When a human observer viewing each scene, he will be able to discount the colors of the illumination and perceive the colors in each scene as the same. This property of compensating for illumination is called as color consistency. Color consistency is a hidden color correction part that all humans have. So during the process of panorama image stitching the problem of color distortion by capturing images under different light conditions can be solved by linear color correction process. There are various approaches used that reduces both the color differences of neighboring image and the overall color correction over the full image sequence.

E. *Image labeling:*

Labeling of an image is the process of assigning a distinct value to the pixels belonging to the same region. A connected component in a binary image is the set of pixels that form a connected group. The connected component labeling is the process of identifying the connected components in an image and assigning each one a unique label. Image labeling approach combines a set of aligned source images into a composite image and finding optimal seams in overlapping areas between consecutive source images to generate high-resolution and high-quality panoramic images with less computations. Image labeling is a operation in which, an error surface is constructed with some squared differences between the overlapping images. The overlapping images are merged together with the optimal seam. The labeling process is much faster and consumption of memory is much lower. The use of color correction can improve the quality of image labeling.

F. *Image blending:*

When several images are stitched together, for various reasons, the adjacent pixel intensities between those images differ enough to produces some artifacts. To eliminate these artifacts, we use image blending techniques. Image blending

is applied across the stitch so that the stitching leads to be a seamless stitched image. After the source pixels have been mapped onto the final composite surface the next step is to blend them in order to produce a final attractive panoramic image. The following figure shows an example of image blending.

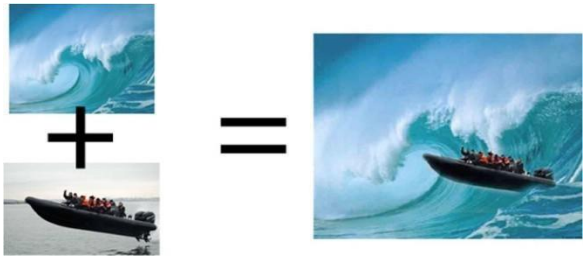

Figure 2: Example of Image blending

The following table shows the comparison for the image stitching techniques.

TABLE 1: A COMPARISON TABLE FOR IMAGE/VIDEO STITCHING TECHNIQUES

Title	*Year*	*Techniques/Algorithms*	*Results*
A Real-time Video Stitching	2017	SURF and KNN method	A video stitching system framework with better alignment of the images than other methods.
Motion detection, tracking and classification for automated video surveillance	2016	Background Subtraction method	Achieved complete detection of moving object and eliminates ghost effect with better accuracy, good efficiency with minimum processing time
Impact of selecting Image feature detection method for development of Panorama under different light conditions	2017	SIFT, SURF and ORB techniques	Deblurring of the image is achieved. ORB works better with less computational time to extract features from input image.
The design and implementation of harbor panoramic browsing system based on image based rendering technology	2017	Generated panorama browser by VS2010 software. Shooting technology, image projection technology, mosaicing technology and smooth transition technology of harbor	Enable navigators to view vivid harbor objects in real time.
Automatic detection of moving objects in real-time	2016	Tools used are C++ under Microsoft visual studio and openCV 2.4.10.	Reduces effect of dynamic background video noise. The algorithms runs in an efficient manner and fairly effective in terms of response time and results.
A Real time motion detection for video Surveillance system	2009	Background subtraction method and model updating method and Quadtree creation algorithm	Increases performance of the overall system and provides better accuracy.

TABLE 1: CONTD…….

Panorama stitching, moving object detection and tracking in UAV videos	2017	MDLT method to find homography of frames. 5-frame difference method to detect moving object.	These methods can work well in both less-textured background and well-textured background scenes.
Abandoned object detection and vigilance enhancement using video surveillance	2015	Frame by frame image segmentation method	This method enables for angular alignment and multiple movements of the moving object by triggering necessary alarm.
Image Stitching techniques -An Overview	2013	Acquisition, Remapping and Blending -alpha blending, pyramid blending and average blending techniques.	Eliminates ghost effect, blurring and redundant data is cropped with graph cut and gradient blending cropping methods.
Panoramic Image mosaicing	2013	SIFT and RANSAC algorithms	Remove false feature points to get a seamless panoramic image.

IV. CONCLUSION

Panorama Image stitching is an emerging research area in the field of computer vision and graphics. It has a huge amount of intelligent algorithms for feature detection and matching. In this paper, a comparative study on different panoramic image stitching techniques is presented. In future, the comparison between the algorithms studied and other feature based panorama image stitching algorithms will be implemented. And, the process of Stitching videos together to create dynamic panoramas in the presence of large amounts of parallax will be examined.

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