Design of image stitching model using feature based approach

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Abstract--- Image stitching is basically combining two or more different images to form one single image, that is panorama. Typically, a camera is capable of taking pictures within the scope of its view only; it cannot take a large picture with all the details fitted in one single frame. Image stitching resolves this problem by combining images taken from different sources into a single image. Image stitching can be carried out using direct and feature based techniques. Feature based technique is to determine a relationship between the image through distinct feature extracted from the processed image.. Here, we have proposed feature based approach for making panoramic image Image stitching is done using SIFT algorithm. SIFT being more robust against scene movement, faster, and has the ability to automatically discover the overlapping relationships among an unordered set of image.

Index Terms--- Image stitching, panoramic image, features based detection, RANSAC , SIFT , Image blending

I. INTRODUCTION

Image stitching is a technique in which several picturesque image of overlapping domain of view are blended together to result in a panoramic image .Image stitching is basically combining two or more different images to form one single image that is panorama. The word panorama is derived from the Greek words 'pan' and 'horama'. 'pan' means everything and 'horama' means to view, and thus it means all round view. Typically, a camera is capable of taking pictures within the scope of its view only; it cannot take a large picture with all the details fitted in one single frame. Image stitching resolves this problem by combining images taken from different sources into a single image. Such images are useful for surveillance applications, video summarization, remote sensing etc. Image stitching algorithms create the high resolution photo mosaics used to produce today's digital maps and satellite photos.

In this work, we have extracted images that is scale, orientation, Detecting point of interest called key point,Feature matching is done using RANSAC algorithm,After matching key point, Matched points are selected for stitching and is done using blending and merging.

In this paper first section is specifying the introduction part and explain about overall details of this project.

Second section is explains available image stitching approaches. Third section is about methodology . It explain image calibration, image registration, image blending and image stitching model.

Fourth section discuss about results and conclusion .

II. IMAGE STITCHING APPROACHES

Image stitching is the process of combining two or more different images to form one single image. There are two main approaches for image stitching.

- Direct techniques
- Feature-based techniques

Direct Techniques

The direct technique depends on comparing all the pixel intensities of the images with each other. Direct techniques minimize the sum of absolute differences between overlapping pixels or use any other available cost functions. These methods are computationally complex as they compare each pixel window to others. They are not invariant to image scale and rotation.

Feature based technique-

SIFT algorithm are used. It providing more reliable feature matching.

- Scale space extreme Detection
- Key point Localization
- Orientation Assignment
- Key point Descriptor Generation
- Feature

The first phase, Extreme Detection, examines the image under various scale and octaves to isolate point of the picture that are different from their surrounding. These point, called extreme are potential candidate for image features. The next phase ,Key point Detection, starts with the extreme and selects some of these point to be key point, that are a whittled down a set of feature candidates. This refinement rejects extreme, that are caused by edges of the picture and by low contrast point. The third phase, Orientation Assignment, converts each key point and its neighborhood into a set of vector by computing a magnitude and a direction for them. it also identifies other key point that may have been missed in the first two phases; this is done on the basis of a point having a significant magnitude without being an extreme.The last phase, Key point Descriptor Generation, takes a collection of vectors in the neighborhood of each key point and consolidates this information into a set of eight vector called the descriptor. each descriptor is converted into a feature by computing a normalized sum of these vector.

III. METHODOLOGY OF IMAGE STITCHING

Image stitching is a process of combining different images to form one single image. The image stitching can be divided into three main steps:

- Image calibration
- Image registration
- Image blending.

Image calibration

Image calibration lessens the dissimilarities between an idyllic lens model and the combination of camera lens used. And produces an estimate of the intrinsic and extrinsic camera parameters.
Image calibration aims to minimize differences between an ideal lens model and the camera-lens combination that was used. These differences are resulted from optical defects such as distortions and exposure differences between images. Intrinsic and extrinsic camera parameters are recovered in order to reconstruct the 3D structure of a scene from the pixel coordinates of its image points

Image Registration

Image registration is defined as the process of aligning two or more images which are captured from different point of perspectives. The purpose of image registration is to create geometric correspondence between images. Therefore, we can compare images and apply other steps appropriately. Image registration comprises many different methodologies depending on dimensionality, feature types etc.. Most of the feature based registration techniques can be classified into four steps.
1. Feature detection-relevant and unique features are identified.
2. Feature matching-feature correspondences between the images are established.
3. Transform model estimation-parameters that align the images for the transformation are determined by the use of the correspondences.
4. Image transformation-images are aligned.

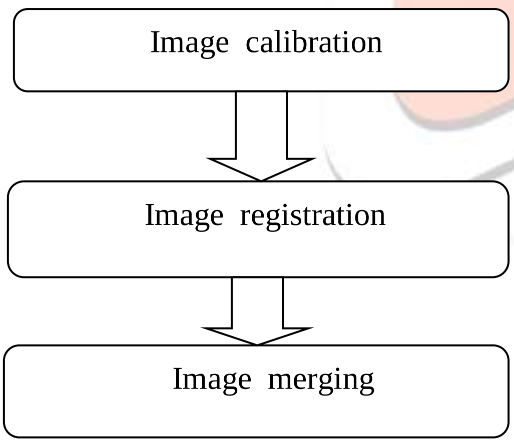

Fig 1. Block diagram of image stitching

C. Image Blending

Image blending is applied across the stitch so that the stitching would be seamless. There are two popular ways of blending the images. One is called alpha "feathering" blending, which takes weighted average of two images. The cases that alpha blending works extremely well is when image pixels are well aligned to each other and the only difference between two images is the overall intensity shift.

IMAGE STITCHING MODEL

In this section, a complete image stitching model is discussed. The image stitching model consists of five stages: images acquisition, features detection and matching, RANSAC estimation, global alignment, and image blending.

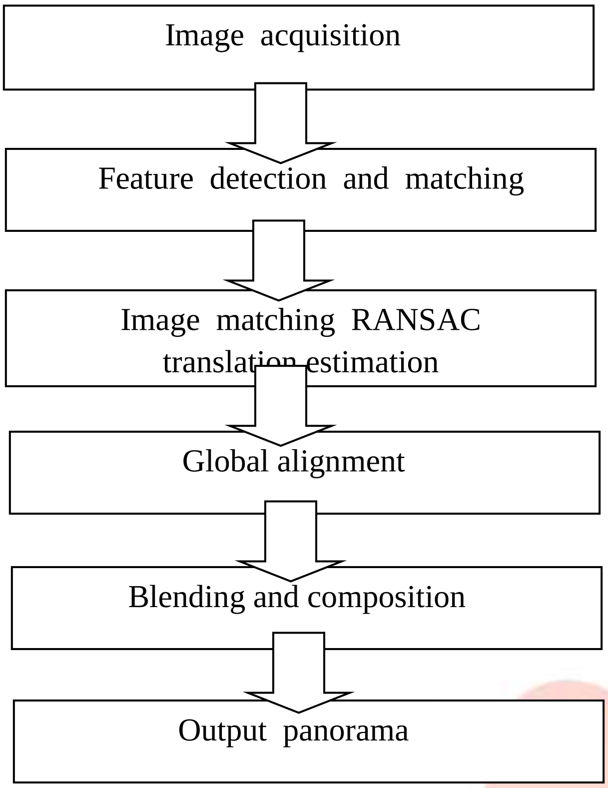

Fig.2 Image stitching mode

A. Image acquisition

The first stage of image stitching is the image acquisition stage. Image acquisition can be broadly defined as the action of retrieving an image from some sources. Typically, images can be acquired for panoramic imaging by a handheld camera.

B. Features detection and matching

The second step in image stitching process is the features detection which is considered as the main image stitching stage. Features can be defined as the elements in the two or more input images. It relies on the idea that instead of looking at the image as a whole, it could be advantageous to select some special points in the image and perform a local analysis on these ones. Feature detection forms an important part of image stitching algorithm. Online image processing algorithms need real-time performance. Thus the speed at which features are detected is crucial in many applications, such as visual Simultaneous localization and mapping (SLAM), image registration, 3D reconstruction, and video stabilization which are needed to match corresponding image features between multiple views. The detected corners or feature points need to be described unambiguously so that the correspondence between multiple views can be computed reliably. Real-time processing requires the feature detection, description, and matching to be as fast as possible. To provide a better feature matching for image pairs, corners are matched to give quantitative measurement. Corners are good features to match. The features of corners are more stable features over changes of viewpoint. The other most important feature of corner is that if there is a corner in an image than its neighborhood will show an abrupt change in intensity. On the other hand, local feature descriptors describe a pixel (or a position) in an image through its local content. They are supposed to be robust to small deformations or localization errors, and give us the possibility to find the corresponding pixel locations in images which capture the same amount of information about the spatial intensity patterns under different conditions.

C. Homograph using RANSAC

After we have the information of feature matching of all pictures, we can use this useful information to do image matching. In image matching step, we are going to find out which picture is a neighbor of another picture, and find the correctly feature matching set we need for next step of all feature matching set. RANSAC (Random Sample Consensus) is a nondeterministic algorithm, because it doesn't ensure to return acceptable results. It is used to estimate parameters for Homograph of a mathematical model from a set of observed data which contains outliners iteratively. RANSAC loop involves selecting four feature pairs (at random); compute Homograph H (exact); compute inliers, keep largest set of inliers, and finally it recomputed least-squares H estimate on all of the inliers**.**

D. Global alignment

The most relevant technique is bundle adjustment, which is a photogrammetric technique to combine multiple images of the same scene into an accurate 3D reconstruction. The aim of this step is to find a globally consistent set of alignment parameters that minimize the miss-registration between all pairs of images. Initial estimates of the 3D location of features in the scene must first be computed, as well as estimates of the camera locations. Then, bundle adjustment applies an iterative algorithm to compute optimal values for the 3D reconstruction of the scene and camera positions, by minimizing the log-likelihood of the overall feature projection errors using a least-squares algorithm. In order to do this, we need to extend the pair wise matching criteria to a global energy function. Once we have computed the global alignment, we need to perform local adjustments such as parallax removal to reduce double images and blurring due to local mis-registration. Finally, if we are given an unordered set of images to register, we need to discover which images go together to form one or more panoramas.

E. Blending and composition

Once we have registered all of the input images with respect to each other, we need to decide how to produce the final stitched image. This involves selecting a final compositing surface, e.g., flat, cylindrical. Finally, we must decide how to blend them in order to create an attractive looking panorama. The first step to be made is how to represent the final image. If only a few images are stitched together, a natural approach is to select one of the images as the reference and to then warp all of the other images into the reference coordinate system. The resulting composite is sometimes called a flat panorama. Since the projection onto the final surface is still a perspective projection, hence straight lines remain straight. There are many different projective layouts on which image stitching can be used, such as rectilinear projection, where the stitched image is viewed on a two dimensional plane intersecting the pan sphere in a single point. Lines that are straight in reality are shown as straight regardless of their directions on the image. One case of rectilinear projection is the use of cube faces with cubic mapping for panorama viewing. It also shows the cylindrical projection where the stitched image shows a 360° horizontal field of view and a limited vertical field of view. Panoramas in this projection are meant to be viewed as though the image is wrapped into a cylinder and viewed from within. To build a cylindrical panorama, a sequence of images is taken by a camera mounted on a leveled tripod. If the camera focal length or field of view is known, each perspective image can be warped into cylindrical coordinates. Two types of cylindrical warping are forward warping and inverse warping. In forward warping, the source image is mapped onto cylindrical surface, but it can have holes in the destination image (because some pixels may never get mapped there). Therefore, we use inverse mapping where each pixel in the destination image is mapped to the source image. Since the mapping is unlikely to be exactly on the pixel values, bilinear interpolation is used to calculate the color at the destination pixels. Once the source pixels have been mapped onto the final composite surface, the second step is to blend them in order to create an attractive looking panorama. If all of the images are in perfect registration and identically exposed, this is an easy problem (any pixel combination will do).There are many different pixels blending methods used in image stitching, such as feathering image blending, gradient domain and Image Pyramid blending .

Featuring image blending is a technique used in computer graphics software to smooth or blur the edges of a feature; it is the simplest approach, in which the pixel values in the blended regions are, weighted average from the two overlapping images. Sometimes this simple approach doesn't work well (for example in the presence of exposure differences). But if all the images were taken at the same time and using high quality tripods, therefore, this simple algorithm produces excellent results. An alternative approach to multi-band image blending is to perform the operations in the *gradient domain*. Here, instead of working with the initial color values, the image gradients from each source image are copied; in a second pass, an image that best matches these gradients is reconstructed. Copying gradients directly from the source images after seam placement is just one approach to gradient domain blending.

Another important approach of image blending is Image Pyramid blending; the image pyramid is actually a representation of the image by a set of the different frequency-band images (i.e. Hierarchical representation of an image at different resolution). Image pyramid provides many useful properties for many applications, such as noise reduction, image analysis, image enhancement, etc.Laplacian pyramid is an algorithm using Gaussian to blend the image while keeping the significant feature in the meantime.

It downsizes the image into different levels(sizes) with Gaussian. Later, it expands the Gaussian in to the lower lever and subtracts from the image in that lever to acquire the Laplacian image. This Laplacian Pyramid is the true useful member of the image pyramid. Each layer of this pyramid is the band-pass image. We can now do some things to the specific frequency just like in the frequency domain.

CHALLENGES OF IMAGE STITCHING

There are many challenges in image stitching such as: Noisy image data or data with uncertainties: An image is often corrupted by noise in its acquisition and transmission, the cost of extracting features is minimized by taking a cascade filtering approach.

Very larger images collection need for efficient indexing: large amount of images may lead to high processing time, since each image needs some processing. The main challenge on image stitching is the using of handled camera which may lead to presence of parallax (a shift in apparent object position while observed from different angles of view), small scene motions such as waving tree branches, and large-scale scene motions such as people moving in and out of pictures. This problem can be handled by bundle adjustment.

Another recurring problem in creating photo-mosaics is the elimination of visible seams, for which a variety of techniques have been developed over the years.

IV RESULT: The proposed work frame is implanted using MATLAB. It can be seen the variation in two different images and the complexity of the stitching problem. We have designed image stitching model by image deformation, where the overlapped region may contain significant intensity inconsistency and geometrical misalignment images stitched in a panorama using MATLAB.

Input image: Input image are shown.

Fig 3. Input image

Output image: Matched points are selected for stitching. The result are shown in fig.

Fig 4. Output image

Command window shows
Performing Image stitching
Finding key points...
455 key points found.
Finding key points...
449 key points found.
Found 70 matches.

H =

1.0190	0.0961	73.5837
-0.0048	0.9927	0.1495
-0.0001	-0.0000	1.0000

CONCLUSION

Image stitching has a large amount of different algorithms for features detection and description. The choice of the feature detector depends on the problem. In this paper, we have offered a comprehensive study and implementation of features-based image stitching algorithm i.e. SIFT which is rotation, scale invariant as well as more effective in presence of noise. It has highly distinctive features. However, it needs high computational time; In future we want to compare between the algorithms we have studied and other feature based image stitching algorithms.

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