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Automatic panoramic medical image stitching improvement based on feature-based approach

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ABSTRACT

Clarification publications in the medical field are very important in making doctors the right decision by finding evidence to support his decision, therefore, the importance of collecting medical images and combining them with multiple overlapping areas of the same scene is important. This (processing, multimedia images and their medical applications) is very difficult. Our system proposed in this paper is applicable to the medical field of scoliosis and other Rib cage. The problem is the narrow vision of the X-ray machine and the lack of a large picture in one frame, the best solution is to combine more than one x-ray image into one panoramic image, our proposed method relies on in light of feature-based methodology by Circle (Oriented-FAST and Rotated-BRIEF). The rapid wave approach is used to describe the feature through the use of BRIEF technology, the standard that has been adopted in our technology to describe the performance of the planning is based on the processing time and image quality created. The purpose of using the feature extraction approach in our technology is to obtain a high-resolution panoramic image plus short processing time, the results that we were able to obtain, according to the experimental results applied, resulted in ORB image quality and recording time.

Keywords: pre-processing, Features, Image Matchıng, Features Matching, Homography

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1. Introduction

Projects provide the use of panorama images of the structure of the rib cage and long bones in the human body by drawing many images that have overlapping points that have the same view or by collecting images by stitching, with this procedure, we create innovative opportunities to learn from the large medical image database, in addition to his role in the pathology of the human skeleton and the discovery of the mysteries of the world of anatomy. The panorama is a great scene for landscapes and is very popular in the field of compilation of images that go into many applications as in satellite images or the establishment of a large display map or radiographs in medical applications. As a result of the complexity of our lives and the increasing accidents, there is an urgent need. for Panorama images to assemble x-rays into an integrated body image that helps doctors diagnose, it. Also occurs when taking a picture of the spine full or align the long legs, such images cannot be captured by conventional radiographs. In this paper we have introduced a proposed system for the development of panorama imaging technology used in medical applications to display X-ray images. There are two ways to group medical images into a single panorama: the menu feature technique and the direct method of adopting a specific approach in converting the pixel value to mismatched pixels [1]. Feature based techniques, discovers characterize highlights and afterward coordinated each other between two information images. Image integration programs are widespread such as REALVIZ, Quick Time and Photo Stitch and other programs, but the problem is the difficulty of automatic seaming of a variety of images in addition to a decrease in accuracy, while zooming in some parts panorama image note not to align many details and this has negatives Clinical Medical Imagery, In our developer proposal, we provide a combination of phase correlation and Feature Based Approach and we use phase correlation to estimate the merging of two overlapping images as well as to ensure the relationship between the images that been merged. The feature based Approach extraction algorithm and strategy for image merging were also improved, Experiments conducted show that our method calculates features very accurate compared to other techniques.. Then we will talk about the background of our research proposal in part 2, reviews of some techniques to detect the advantage in part 3, either the proposed research methodology in the stitching of images, We'll talk about them in Part 4, Part 5 and 6 will deal with the explanations obtained in our developed proposal and conclusions. Image stitching is a newly emerging method for recording images, merging them, and then processing. The purpose of this pre-treatment is to get rid of the distortions that occur in the photos, as well as noise, in this technology we use the phase correlation to be able to distinguish the noise that is not part of the image through the rapid wave method based on BRIEF technology Which leads us to get a panorama photo permanently. Image consolidation has become indispensable, so this comprehensive introduction explains the importance of the techniques used in this field as follows:

- discover the overlapping picture in a blended picture set
- Get the features SURF and matching includes in the interlaced.
- End mismatch by RANSAC and parameter estimation of conversion models.

Improve picture combination technique and use outline by outline extended mosaic strategy to get display picture. This field of techniques has many challenges in the field of image stitching and at the same time there are many techniques to obtain features that are used in image stitching as in Harris, SURF and SIFT (SIFT has a longer processing time, while Harris corners fail to scale the image).

Image stitching is a newly emerging method for recording images, merging them, and then processing. The purpose of this pre-treatment is to get rid of the distortions that occur in the photos, as well as noise, in this technology we use the phase correlation to be able to distinguish the noise that is not part of the image through the rapid wave method based on BRIEF technology Which leads us to get a panorama photo permanently. Image consolidation has become indispensable, so this comprehensive introduction explains the importance of the techniques used in this field, improve picture combination technique and use outline by outline extended mosaic strategy to get display picture. In the past decade, a lot of research focused in the field of image stitching, for the image feature matching algorithm and extraction, scientists both abroad and inside have proposed several representative methods including SIFT and Harris Corner, an image registration algorithm based on the eigenvalue features of the image needs:

- Extracting the characteristics of the adjectives represents the most important step in constructing an eigenvalue, so that feature extraction has a big role in the registration algorithm where there is an abundance of information that is used to represent the similarity in images, this in turn generates different processing methods including angles and heights related to common image features, Straight lines, closed areas, contours, center of gravity, points of inflection, etc.
- Matching feature, This technique is used to compare the features that are extracted from the images that will be recorded.
- registration Image, which will be verified by converting identical eigenvalues to corresponding images [2].

2. Related works

In the last decade, a lot of research has focused in the field of stitching pictures, depending on the feature-based method, which led to this effort to tremendous development in the field of stitching pictures and the most important research, scientists and theories in this field. The integration of medical images has seen a recent rapid development, they are Speedup Robust Feature detector (SURF)[4 ,3], HARRIS-detector [4, 5] and Scale Invariant Feature (SIFT) [6, 7], also Features-Accelerated-Segment-Test (FAST), the nature of the problem determines the need to select an efficient feature detector. Nature-based methods have two stages: recording and stitching, the goal of our proposal is to develop a high quality medical image collection system with low processing time, this proposal goes through five main stages: Pre - processing images, detection and the description of the feature, matching, test homograph and Sew medical images. This proposal is the evolution of technology presented at the 2018 International Conference on Smart Informatics and Biomedical Sciences [8]. Local features are characterized as working effectively through a short set of images that have contrary information that enables algorithms to process them [9]. Local features can be obtained by modeling the content of the image that is prominent and this appears in the unordered form of the feature set in the event that the spatial modeling between features is not possible or through the ideal configuration and such an event requires an estimate of the density of the feature data. They represent unparameterized density estimators such as KNN and KDE which are clearly useful for the unrequired syntax [10]. In early 2006, a group of scientists, including Bang, suggested a (SURF) Speeded procedure Up Robust to improve the performance of the SIFT algorithm [11]. Sewing speed is significantly improved by SURF by counteracting the amount of noise in images, an automation algorithm through strong braiding was proposed in 2004 based on Harris for features [12]. A group of scientists including Cheng, W and Lee, C.O contributed to improving the efficiency of image stitching by proposing the ORB algorithm, which in turn has been widely used [12, 13] Where in 2016 isomorphic matching was combined with the ORB proposal. In mid-2011 the scientist Ruble proposed the ORB algorithm. In mid-2011, the scientist Ruble proposed the ORB algorithm, which depends on the features, whether strong binary or primitively independen[12, 14].

3. Image Stitching Techniques

The image stitching procedure is broadly categorized in many researches into two methods, one of which differs from the other:

- Feature-based technology: In this procedure, the comparison of all the featured points that are extracted from the image against another image, using local descriptors, the value based on stitching the images is represented in (the extracted feature points, the recorded image, and then blending) this generates the connection between lines, points or angles or the edges, The powerful detector has strong features such as stability in noise, translation and rotation shift, best feature detection techniques SURF and SIFT [12, 14].
- Direct Technology: This procedure depends on comparing the intensity between each pixel with each other and the intensity of the whole. There may be overlap between the pixels in which a deviation occurred in the sum of the absolute deviations. The comparison is made between the pixels and the others by determining the frequency [15].

4. Proposed Method

The proposed methodology for stitching a medical photo jigsaw goes through six main phases in our technology that include (pre-processing, extracting description and features, matching the features, efficiency of Homography and finally panorama, the purpose of accepting our technology is to enter images with overlapping areas and areas such as medical phases (x-rays) by extracting the ORB features of this selected image to create the final panorama image. Figure (1) shows the flow of work for our technology.

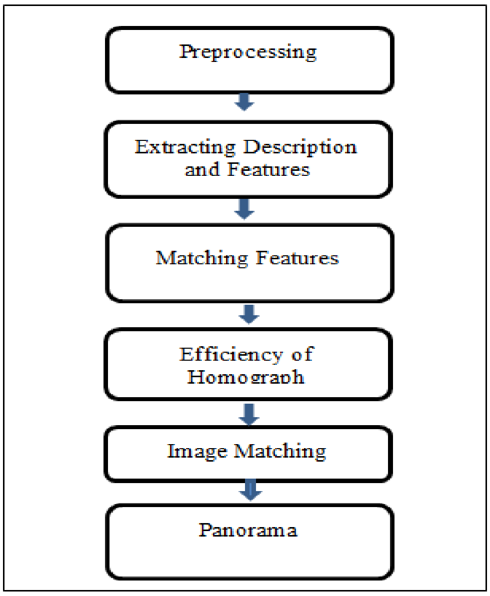


Figure 1. A diagram showing the purpose of the system

4.1. Medical image pre-processing

The images are displayed by a matrix of two dimensions, each element is called pixels, and the images are stored in Dicom technology. In our technology, we reduce the size of the image by converting the Dicom procedure to JPEG, in these two techniques, 90 medical images were used with 45 pairs of overlapping images, In order to obtain panoramic stitching, the images will enter the user in 1430% of the required procedures between the overlapping areas in order to be able to perform the stitching process. The purpose of this step is to improve the quality of the medical images used [16]. Here, a direct based approach technique was used for sewing medical images, with correlation often applied and the development was done through Fast-Fourier-Transform (FFT) so that two images of the same size were stitched, but the technical disadvantages are the high costs [17].

4.2. Extraction description and features

Our proposed Panorama-based stitching system is ORB-style. The ORB approach is comprised of a vector-mix for rapid detection of vector-oriented and brief rotation descriptors. Here are featured points are revealed by Oriented FAST while to create descriptors Rotation-BRIEF is used which is very fast. One of the prominent advantages of this algorithm is the stability of rotation and speed and reduces the sensitivity to noise, figure 2 represents the ORB feature in X-ray medical images.

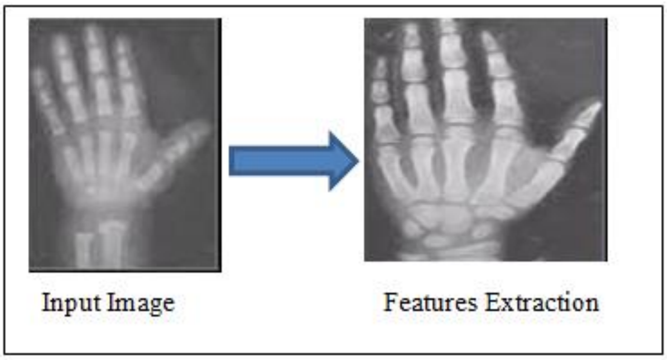


Figure 2. The example input images and extraction features that used in our proposed system

4.3. **Features matching**

Matching features in this field are very important, as you go through the first two steps that include extracting the SIFT features for two input images, Then, it is followed by the second step which is to match the points of interest between each two images used in the application by extracting the SIFT feature [18-20].

Register SIFT Features

SIFT ("Scale-invariant-feature-transform") is an algorithm for discovering features within the points of interest of an image, the ideal solution to image stitching lies in the SIFT procedure where it is perfectly appropriate because it is consistent in orientation, scaling and distortion, in order to be able to calculate the SIFT features for each image used in the application, the MATLAB function is used "sift (imageName) from Lowe's SIFT Keypoint Detector"[20, 21].

Matching Features

Conformity of features means matching of points of interest, so that after calculating the SIFT matching of two images, provided that they are matched. To calculate parity later the matched SIFT pairs are extracted, in this experiment, we used the "(imageName1, imageName2) MATLAB function match" to adapt some codes, similarly from this work, in this procedure two features were accepted in order to obtain a pair, and this requires that the angle between the features be less than the threshold, while the angle is calculated through the point of coordinates of the SIFT features.

4.4. **Image matchıng**

Our procedure for merging two images is along the lines of matching features, and this happens after the matching process is completed, as for the process of stitching images, it follows two steps, where the first step is done by obtaining the symmetry calculation via RANSAC, and through this symmetry we start with the second step to merge the two overlapping pictures and then mix them to obtain the panorama in the final image.

4.4.1 Compute homography

After the matching process is performed, an important stage in Homography assessment begins, it depends on the RANSAC algorithm (Random sample compatibility), note that the homograph matrix is a matrix used to convert between two images, so it is necessary to calculate the symmetric matrix to connect the two images together.

$$\mathrm{P_b} = \mathrm{H_{ab}} \mathrm{P_a} \qquad 1$$

Where $\mathrm{P_b}$ and $\mathrm{P_a}$ Are represented are focussed from Image A and Image B separately.

To give our technology a lot of power to perform a homogeneous matrix between two images, We applied the RANSAC procedure, as shown below:

- Select four pairs of features (indiscriminately)
- Homography account H (definite)
- Where's inliers account dist. $(\mathrm{P_b}, \mathrm{H_{ab}}, \mathrm{P_a}) < \varepsilon$ Go 1
- Keep biggest arrangement of inliers
- Recalculate the least squares of H grades on all employers

In the first step, four SIFT pairs are defined randomly, then it follows the second step of computing the homography matrix. Four randomly selected SIFT pairs. "Function MATLAB homography 2d (sifts1, sifts2) from Kovesi's Matlab Functions for CV and IP" [6, 22-24] to get a matrix, as for our third step, we convert points using symmetry to measure the error rate between SIFT pairs, the method of transferring points was initially made with a form object from holography by using make form (projective, H), this leads us to use tformfwd (tform, X, Y), and convert the SIFT points that are used to calculate the error, by taking the square distance between each pair. ORB technology is superior in the feature matching field and this is done by adopting the Hamming distance method to get the matching features, so that the proposed procedure works to extract the compute Homography Matrix: When completing the feature matching procedure, a second stage begins, which is matching Homography by using the RANSAC algorithm, which means random sample compatibility, a search that enables us to get rid of the wrong matching features, when completing the feature matching procedure, a second stage begins, which is matching Homography by using the RANSAC algorithm, which means random sample compatibility, a search that enables us to get rid of the wrong matching features and then compute the homography matrix transformed, through which the matching pictures are obtained.

4.4.2 Stitch and blend images

When we can get the homography value of the input images that the merge is being performed, by converting an image according to the homography matrix, then this image is stitched and blended with the second input image, provided that the format of both images is preserved. To prove this, the homography matrix form was derived by maketform " (projective, H)", our next step after completing the transformation is to start stitching and merging images with a simplified linear combination, by creating a mask to the cross section of the images, which makes it easy for us to blend the images.

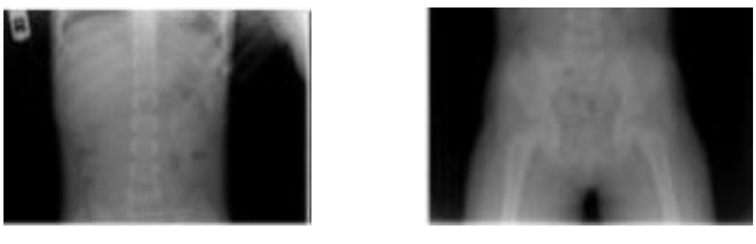
5. Result and Analysis

The results obtained by applying our proposed procedure are two images, as shown in the figure (3). The application's first task is to calculate the SIFT features for all images entered as shown in the figure (4), our next step is to calculate the matches between the SIFT properties as shown in Figure (5). Then the homography of the images is calculated through the matching that was extracted through the RANSAC application to see the best four matches of our sample used. Ultimately, inliers are collected in the top four matches that will come up with a homography matrix and this can be seen in Figure (6).

$$\begin{bmatrix} 0.6056 & -0.0279 & -32.0495 \\ 0.0503 & 0.5704 & -9.5209 \\ 0.0003 & 0.0000 & 0.5349 \end{bmatrix}$$

Fig. 6. Matrix Homography

Finally, the output of the process is obtained after it is done according to the symmetry matrix, the first image distortion and simplified blending, as shown in figure (7). It should be noted that in the technique used, the focus was on the two most important parameters, which are the minimum for the initial drawing report, in addition to the number of times RANSAC runs that monitors the effect of the inlier threshold. Then calculate the panorama images of the operating sample with thresholds 1, 0.1, and 0.001. The expected the threshold will become smaller after projecting the inhaler. For these values of the threshold, the initial charges were 185, 98, and 24, respectively, one of the strengths here, that the inhaler number even if it is low does not affect the end result.



First Image Second Image

Figure 3. Images Input

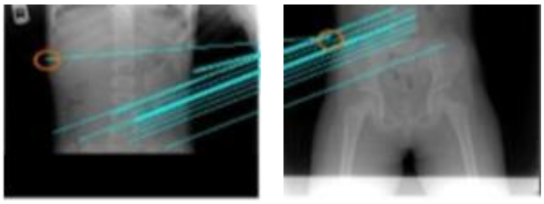


Figure 4. SIFT representation

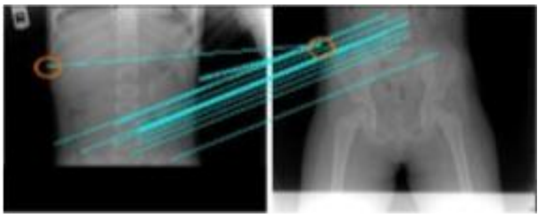


Figure 5. Extracting Matches

Figure 6. t Panorama

Requirements for this technology, A computer with the following specifications:

- processor cori7 .
- speed 2 GB
- RAM: 4GB

Table 1. Measurement of image quality resulting from feature-based image methods

Method	MSE	PSNR	Average Processing
SIFT	146.46	26.50	8.012931
ORB	139.22	26.88	0.013490
SURF	186.74	25.90	0.65412
HARRIS	216.32	23.66	0.75312

6. Conclusion and future work

In this work, a feature-based approach was relied upon in our proposal for an image stitching system for feature detection and matching. The ORB features were then used the proposed method was tested using 90 x-ray images with 45 interfering pairs. The main purpose of our proposed system was to create a high-quality, advanced photo stitching system that coincides with low processing time. This suggestion has accuracy in image quality as well as is characterized by low processing time as it was compared with other algorithms based on other features such as SURF and SIFT and after calculating the final quality of the images used through the use of PSNR and MSE values, It achieved high-quality images with a decrease in processing time observed. This proposed work possesses the ability to expand three-dimensional images in addition to stitching moving objects with two-dimensional images through the use of features based on direct methods as a future work. We also propose to improve this work and apply it as a future work in research by applying it to making panoramic images of buildings as well as moving objects such as trains, cars, planes and other vehicles, and there will be some obstacles that need some development for its success, such as the difficulty of collecting these vehicles in images Panoramic due to the difficulty of calculating the smoothing matrix due to linear behavior, so that the perspective angles become distorted because it does not give any result.

Declaration of competing interest

The authors declare that they have no any known financial or non-financial competing interests in any material discussed in this paper.

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