FEATURE BASED AUTOMATIC IMAGE STITCHING

PROJECT REPORT

SUBMITTED BY

PRAJITHA P

(TKM20MCA-2028)

TO

THE APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF

MASTER OF COMPUTER APPLICATIONS

THANGAL KUNJU MUSALIAR COLLEGE OF ENGINEERING

KERALA

JULY 2022

DECLARATION

I undersigned hereby declare that the mini project report " **FEATURE BASED AUTOMATIC IMAGE STITCHING** ", submitted for partial fulfilment of the requirements for the award of degree of Master of Computer Applications of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under supervision of **Prof. Natheera Beevi M**. This submission represents my ideas in my own words and where ideas or words of others have been included,we have adequately and accurately cited and referenced the original sources. I also declare thatwe have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in our submission. I understand that any violationof the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or fromwhom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

KOLLAM PRAJITHA P

18/07/2022

THANGAL KUNJU MUSALIAR COLLEGE OF ENGINEERING

DEPARTMENT OF COMPUTER APPLICATIONS

CERTIFICATE

This is to certify that, this report entitled "**FEATURE BASED AUTOMATIC IMAGE STITCHING**" submitted by **PRAJITHA P (TKM20MCA-2028),** to the **APJ Abdul Kalam Technological University** in partial fulfilment of the requirements for the award of the Degree of **Master of Computer Applications** is a bonafide record of the project work carried out by her under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

Internal Supervisor   Head of Department   External Examiner

ACKNOWLEDGEMT

First and foremost, I would like to thank the almighty for giving me the wisdom and grace for making my project a memorable one. I thank him for steering me to the shore of fulfilment under his protective wings.

I am extremely grateful to ***Dr. Fousia M Shamsudeen***, Assistant Professor and Head of the Department, MCA, TKMCE, for her constant support and encouragement throughout the project work.

With a profound sense of gratitude, I would like to express my heartfelt thanks to my guide ***Prof. Natheera Beevi M,*** Associate Professor, Department of Computer Application, TKMCE, for her expert guidance, co-operation, and immense encouragement. I also extend my thanks to the entire faculty and staff of the Department of Computer Application, TKMCE, who have encouraged me throughout my course of study.

I also express my thanks to my family and friends, for their support and encouragement in the successful completion of this project work.

PRAJITHA P

ABSTRACT

Image stitching, also known as mosaicing, is considered a current area of research in computer vision. The goal of image stitching is to create a high-resolution panoramic image by combining two or more photos of the same scene. Feature-based techniques try to create a relationship between the photographs using distinctive features derived from pictures, Feature-based techniques can automatically identify associations between an unordered set of overlapping photos. Within the subject of computer vision, image fusion is considered a current study topic. It has many different algorithms for feature detection and description. This project provided a technique for building a seamless image panorama that uses feature extraction methods to extract visual features. This project compares various feature detection techniques, such as SIFT, ORB, and BRISK. Using feature extractor algorithms, numerous features from both images are extracted. Next, compare the features in both images and stay with the more compatible pairs. For functional matching — KNN (K-Nearest Neighbors) Matcher and BF (Brute Force) Matcher are used and these matchers are examined. The homography was computed using RANSAC algorithm, which stands for Random Sampling Consensus.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

Chapter 1

INTRODUCTION

The process of integrating two or more photos into one image is called an image panorama. The method of constructing a panoramic image from a collection of photographs with overlapping fields is known as image stitching. Image processing technology has become widely employed as a result of the integration and expansion of industries like electronics and modern computing, raising the technological standards for image quality. High-resolution images are required to display the overall influence as well as the local environmental characteristics. In light of this, image stitching technology was developed. In order to create a seamless image with a wide angle, it gathers several photos with overlapping regions and then combines them using feature point extraction, matching, and image fusion. When integrating photos, the issue of removing the obvious seam is a challenge. The creation of a smooth image panorama was demonstrated, where feature extraction algorithms are used to extract image features, K-nearest neighbor and Brute Force features matching used for matching purpose.

The development of this technology has greatly increased the areas in which image processing may be applied, as well as the integration and growth of numerous sectors. For these reasons, image fusion technology research is very important. Image processing has been used since the days of digital computers. Previously, to capture a large area, pictures were captured from various angles by different cameras and then manually stitched together. But as photography evolved over time, the need for panoramas grew. As photography developed, many people became interested in it and began to use different methods that could achieve significant results. This led to the creation of a mosaic, which is also called image stitching. Therefore, stitching is the process of integrating numerous photos with overlapping area to create one with a larger field of view.

1.1 Problem Statement

In the past, several distinct photographs were manually stitched together after being recorded from various angles with multiple cameras to depict a broad region. But as photography advanced through time, panoramas became more and more necessary. The area of view and resolution of the handheld camera are also limited. While employing handheld equipment, picture stitching may produce high-resolution and high-quality panoramas.

1.2 Objective

- The objective is to create a seamless image panorama utilising two input photos by an automated image stitching process based on feature extraction.
- In this project, uses different Feature descriptor algorithms like as BRISK, ORB and SIFT to extract the key points of the picture, also presents a comprehensive comparison of SIFT, ORB, BRISK algorithms.
- RANSAC algorithm is employed to filter the key points. Here, we examine two matches K-Nearest Neighbors (KNN) and Brute Force (BF)

Chapter 2

LITERATURE SURVEY

Literature survey is a thorough examination and analysis of the literature that relates to a certain subject when using a literature review, it is possible to identify connected research questions. Thereafter, it is possible to look for and analyze pertinent material in an effort to find answers to these research questions. The ability to re-analyze study results can lead to the development of fresh insights which is one benefit of literature reviews. A literature survey summarizes and explains the entire and up-to-date body of information on a certain subject that may be found in scholarly publications and journal articles. One may be required to write a literature survey as a stand-alone assignment for a course, or they may be required to write one for the purpose of the introduction to or planning phase for an expanded work, typically a research report or thesis. The type of survey that was carried out will determine the scholar's focus, the viewpoint, and the type of hypothesis or thesis argument. Reading the literature surveys published or the introductory sections of theses and dissertations in our own field might help us grasp the differences between these two types by studying the organization of their arguments and observing how they approach the topics.

2.1 Purpose of Literature Review

1) It provides readers with quick access to information on a specific subject by choosing excellent articles or studies that are pertinent, significant, important, and valid and compiling them into one comprehensive report alone.

2) By requiring the researchers to describe, assess, and compare original research in that particular field, it gives researchers starting out in a new field a great place to start.
3) It makes sure that previous work is not duplicated by researchers.
4) It might provide hints regarding the way future researches should go or suggest topics to concentrate on.
5) It highlights the key findings. It ensures that researchers do not duplicate work that has already been done.
6) It points up gaps, discrepancies, and inconsistencies in the literature.
7) It offers a helpful critique of the methods and strategies used by other researchers

2.2 Related Works

Image stitching is the process in which different photographic images are integrated together to form a segmented panorama or a high resolution image. Multiple images are overlapped and blended to form a wide angle panoramic image.

[1] With the help of picture stitching technology, it is possible to ensure both a good resolution and a broad range of vision at the same time. This paper focuses on the issue of picture registration, examines and employs several feature point extraction techniques currently in use, and then investigates the extraction based on combination of Orientation Features from Accelerated Segment Test algorithm and Binary Robust invariant scalable keypoints algorithm. RANSAC algorithm is used to sort the key points. This approach offers superior rotation invariance and scale invariance, according to experiments.

[2] The paper offers a productive method according to Speeded up Robust Features (SURF). Here uses the SURF method for identifying and describing image features. First, it extracts reference pictures and matches key points in the picture using the SURF feature detector. Next, it calculates the character descriptions of each feature point vector using the DAISY algorithm rather than the SURF algorithm.

The RANSAC algorithm removes the erroneous matching points during the feature point matching phase. Finally, the matching process is complete when it can estimate the space geometric transformation parameters between two pictures based on the remaining match points. This work proposes an algorithm for image matching approaches based on the SURF-DASIY algorithm. First, the feature point extraction approach in this method employs the conventional SURF algorithm. It is applied to the reference picture, maintained throughout registration, and then the DAISY description vector is applied.

[3] The classic three feature point extraction algorithms are compared and examined in this article. Their benefits, drawbacks, and range of use are discussed in the article. In this study, key points from the two pictures were extracted using the SIFT, SURF, and ORB algorithms, respectively. The best matching points were then chosen using the nearest neighbor matching approach in order to eliminate the false matching points and increase the matching accuracy

[4] The three basic processes of image stitching in this study are image acquisition, image registration, and image blending. The image registration process also involves feature matching, feature extraction, and picture alteration with the aid of a transformation model. The Harris corner detection approach, which makes use of the Harris-Stephens algorithm to detect the corners in the provided picture is the corner detection technique employed in this study. Rotation has little effect on Harris Feature Detection. If the image is sized differently, the Harris Detector cannot function properly

[5] Fundamental techniques for creating panorama images is discussed in this work. The goal is to offer various techniques and algorithms for creating panoramic images. In order to retrieve feature points, SUSAN corner detector is utilized. Susan operator lacks the invariance characteristics. In order to create new and improved picture mosaicing algorithms, many methods must be combined and adapted to the application. The well-known feature extraction algorithms include SUSAN, Harris, and SIFT. Image mosaicing is the method of creating a panorama of high-resolution images from two or more photos of the same scene. In this article, we've covered the fundamental techniques for creating panoramic images. Our goal is to present several approaches and computational frameworks for creating panoramic images. The primary audience of this paper is newcomers who want to work in the field of picture mosaicing. In order to retrieve feature points, SUSAN corner detector is utilised. SUSAN operator lacks the invariance characteristics.

[6] In this study, some experiment findings employing the SIFT feature-based technique are reported. These results demonstrate that stitching photos accurately is possible when SIFT characteristics are used to modify the images. The SIFT feature guarantees seamless translation between photos with varying lighting and orientation, and it can also get over the challenge of vertical direction matching. The method for image stitching based on SIFT characteristics produces results with a significantly higher degree of precision and effectiveness. In this study, some experiment findings employing the SIFT feature-based technique are reported. These results demonstrate that stitching photos accurately is possible when SIFT characteristics are used to modify the images. The approach for picture stitching based on SIFT characteristics produces results with a significantly greater degree of precision and effectiveness. Future work will concentrate on finding efficient techniques to improve the process because SIFT requires a lot of computation and stitching photos proceeds quite slowly.

Chapter 3

METHODOLOGY

3.1 Algorithm Principle

A. Scale Invariant Feature Transform (SIFT)

A computer vision approach called SIFT finds and describes local features in images. SIFT algorithm is used to identify and describe features. Keypoint descriptors are created using SIFT to describe image characteristics.

The SIFT method contains four fundamental phases.

1) Scale-space Extrema Detection
2) Keypoint Localisation
3) Orientation Assignment
4) Keypoint Descriptor

1) Scale-space Extrema Detection

In Scale Space, take an image and make gradually blurred images, then, halve the original picture and make blurred images. Create a new collection of images called the Difference of Gaussians using those blurry images (DoG). These DoG pictures are great for finding interesting key points in the picture. We get the Gaussian difference as the difference of the Gaussian blur of the picture with two distinct scale parameter (The amount of blure). This Procedure is carried out for various image octaves. The figure below illustrates it.

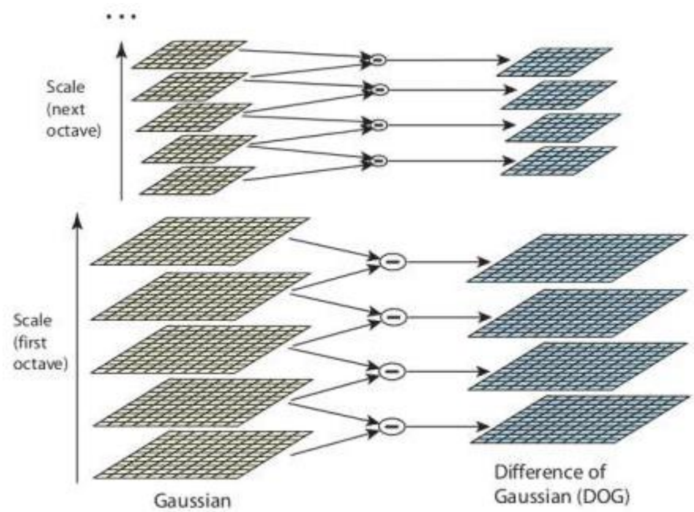


Fig 3.1: The Difference of Gaussian

After locating this DoG, images are checked for local extrema. One pixel in a picture is analyzed to its 8 neighbours, 9 pixels in the scale above it, and 9 pixels in scales below it. It could be a feature point if it is a regional extrema. In the Fig 3.2 it is seen:

2) Keypoint Localisation

This phase tries to reject some key points which is extracted from the previous step by finding those whose location is not precise or are edge key points. The intensity at this extreme is rejected if it falls below the threshold value.

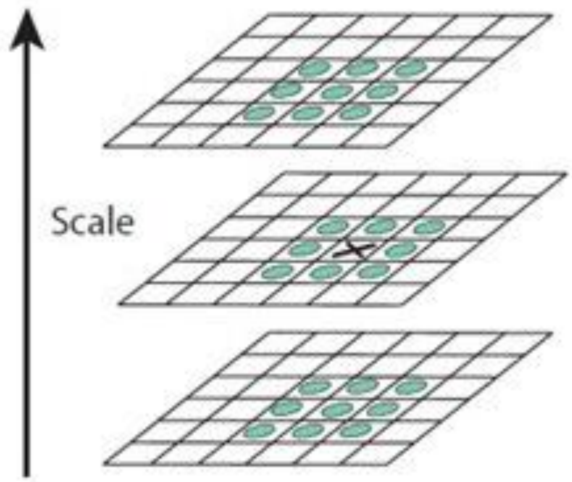


Fig 3.2: Maxima and Minima of Difference of Gaussian

3) Orientation Assignment

To achieve image rotation invariance, each keypoint is given an orientation in this step. Around the keypoint, a scale-dependent neighbourhood is selected, and the gradient magnitude and direction are determined in that region.

4) Keypoint Descriptor

In this step a descriptor for every feature pointst that is computed. The feature point descriptor is generated by computing orientation at each image point in a region around the key point location and the gradient magnitude.

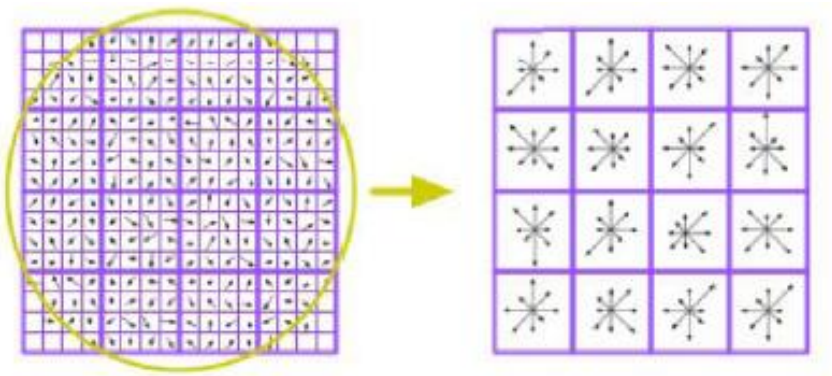


Image Gradient Key point Descript

B. Oriented FAST and Rotated BRIEF (ORB)

ORB used for feature extraction. ORB is efficient alternative to SIFT because SIFT is actually patented, However, ORB is free.

1) OFAST

In comparison to the FAST method, the OFAST algorithm is better. The following is how candidate points are often determined: Given a pixel, in FAST. FAST evaluates the brightness of pixel p in comparison to the 16 pixels nearby. The circle's pixels are then divided into three categories, such as darker than p or comparable to p or lighter than p, if it is more than 8 pixels darker or brighter than p, it is designated as a key point. The key points found by FAST give us information about the location of defining edges in the image.

Candidate corner points are determined using FAST. However, multi-scale features and an orientation component are absent from FAST features. Thus, the multiscale picture pyramid is used by the ORB algorithm.

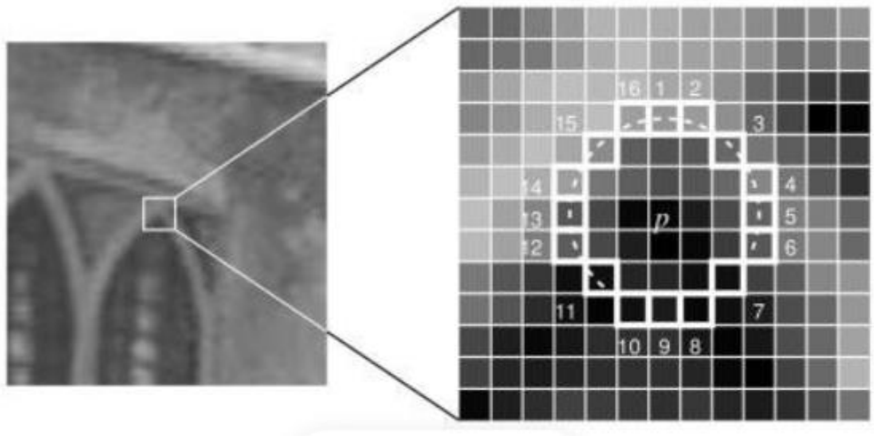


Fig 3.3: FAST determines candidate corner points

A multiscale representation of a single picture called an image pyramid is built up of pictures in a succession, each of which is a replica of the pictures at a various resolution. The picture on each level of the pyramid is down sampled from the level above it. Using the FAST algorithm, the ORB finds important places in the picture after building the pyramid. The ORB successfully locates keypoints at various scales by identifying keypoints at each level. The ORB is thus only partly scale invariant. The ORB will now give each keypoint an orientation after locating them. Based on the identification of the keypoints, the ORB will now give each keypoint an orientation as a right or left orientation—with regards on how the intensity levels vary around it. The intensity centroid is used by ORB to identify changes in intensity. The direction of an element point must be specified in order to guarantee rotation invariance.

2) rBRIEF

In comparison to the BRIEF algorithm, the rBRIEF model is efficient. BRIEF transforms each keypoint determined by the FAST technique into a binary feature vector that is then utilised to represent an object. A binary feature vector or binary feature descriptor is a feature vector that only consists of 1s and 0s. The keypoint is tied to the centroid of the point region and is used as the circle's centre to rotate the feature description without distorting it. The coordinate axis and centroid both rotate as the object rotates. Consequently, while choosing a pair of points, the coordinate axis is fixed, which improves the BRIEF method.

C. Binary Robust Invariant Scalable Keypoints (BRISK)

BRISK is a scale- and rotation-invariant feature point identification and description technique. The idea behind it is to take the built-in scale space pyramid and extrapolate the steady extreme points of sub-pixel accuracy.Figure 3.4 Displays the BRISK descriptor calculation.

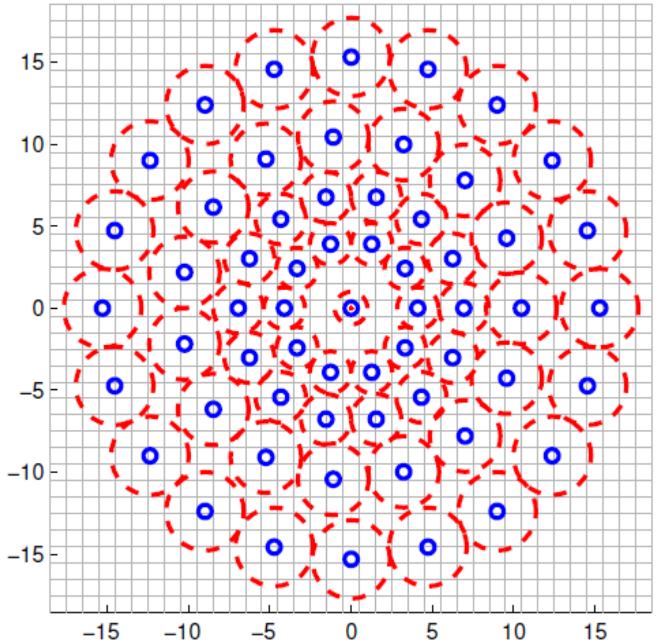


Fig 3.4: BRISK feature point description

The steps for BRISK feature detection are as follows:

1. A case of a smoothed pixel pattern around a feature.
2. Distinguish pixel pairs into short-distance pairs, subsets and long-distance pairs
3. Calculate a local gradient to detect the orientation of a feature.
4. Create a binary descriptor using short distance pairings that have been rotated.

3.2 System Architecture

The suggested work makes use of SIFT, ORB and BRISK feature extraction techniques and filtration is done by RANSAC algorithm. Figure 3.5 depicts the overall system design.

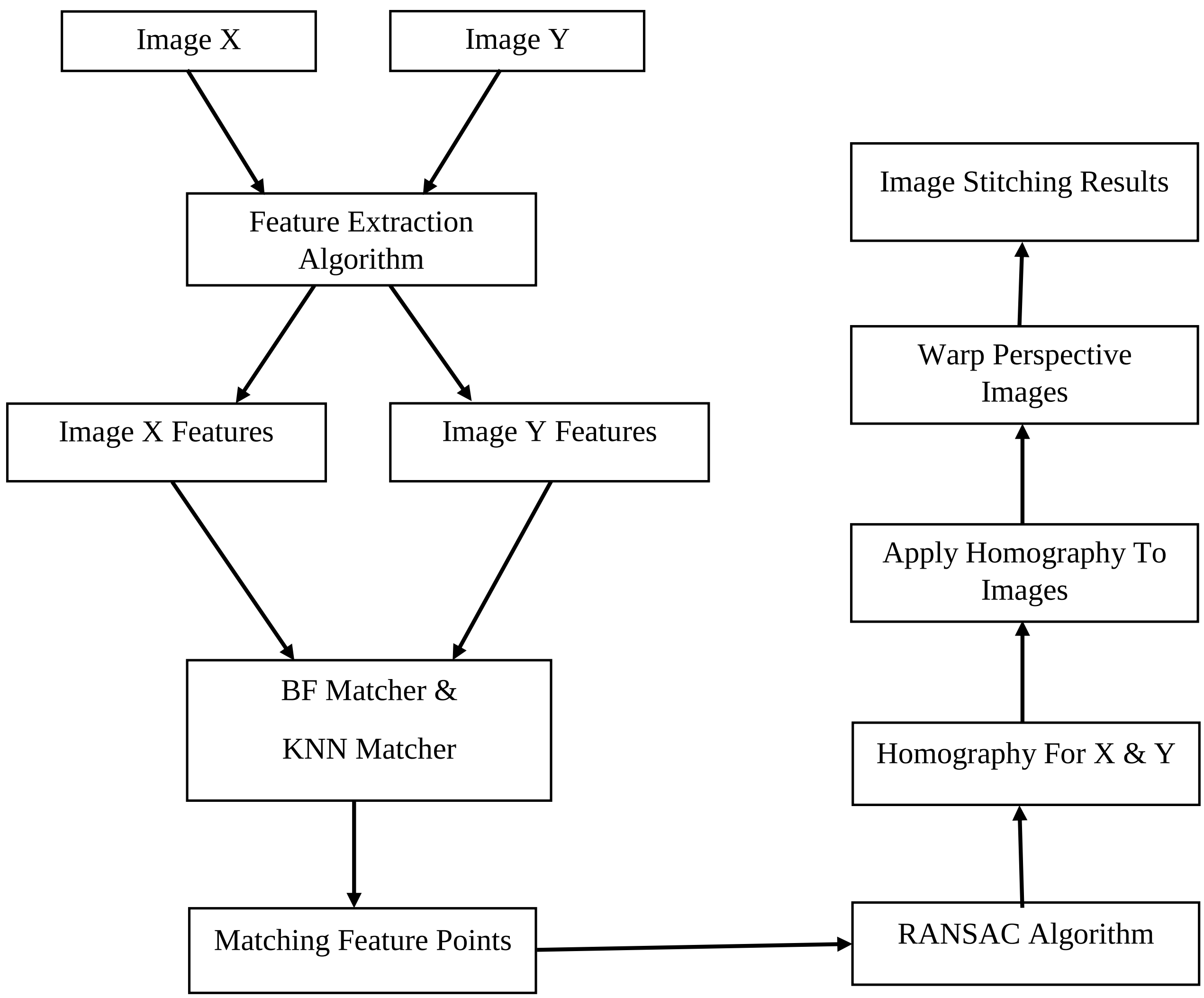


Fig. 3.5: The flow diagram

.

1) Input Images

Choose two images that should contain a common region or an overlapped area

2) Image feature point extraction

By extracting various features, features-based approaches attempt to establish a link between the pictures. Feature invariance for rotation, translation, and scaling conversion are essential characteristics of a trustworthy detector. SIFT, ORB, and BRISK are a few algorithms that may be used to find features.

A. SIFT

The SIFT technique consists of 4 fundamental stages, and it generates the image descriptor of every key points according to the the directions of every point of the picture sample in the region centred on the feature point and magnitude of the image gradient. The first step is to calculate scale space extrema using difference of gaussian(DoG). The key point candidates are localised and further refined in the second step by removing the low contrast spots. Third, assignment of the feature point's orientation depending on the local picture gradient. Finally, a descriptor for each keypoints are generated.

B. ORB

ORB used for feature extraction. ORB is efficient alternative to SIFT because of SIFT is a patented algorithm, ORB was created. However, using ORB is totally free. FAST keypoint detector and BRIEF descriptor are combined to create ORB, which has some extra characteristics to boost performance. To find features in the given image, FAST, or Features from Accelerated Segment Test, is employed. Additionally, a pyramid is used to create multiscale features since it no longer computes the orientation and descriptions for the features, BRIEF fills this gap. Because the BRIEF performs poorly with rotation, ORB employs BRIEF descriptors. Therefore, ORB rotates the BRIEF in accordance with the positioning of keypoints. The rotation matrix for the patch is obtained using the patch's orientation, and it rotates the BRIEF to produce the rotated version. You must pay a fee to utilise SIFT, which is patented. However, ORB is unpatentable. BRIEF critical points and FAST detectors form the foundation of the ORB. Lower memory requirements and more effective comparison.

C. BRISK

A technique called Binary Robust Invariant Scalable (BRISK) Keypoints addresses the issue of traditional computer vision detection.It detects the corners. To achieve rotation invariance, BRISK determines the typical orientation of the features. The characteristics of the descriptor are scale-invariant, and it is built as a binary string. BRISK is a scale- and rotation-invariant feature point identification and description technique. The idea behind it is to extract the stable extreme points from the scale space pyramid that has been built. By utilising the grey scale relationship and collecting the binary feature descriptor of each keypoint, it may locate random point pairs that are close to the local picture. BRISK is speedier and doesn't need a lot of Memory for storage, After identifying the feature point, create circles with various radii around it by using the feature point as the circle's centre and sampling 60 points in each circle. Then Gaussian filter the sampling points; the filter radius increases with increasing circle radius. Combine the sampled points in pairs to determine the local gradient value of the feature points. Separate the long-distance and short-distance point pair subsets. Based on the gradient of the determined long-distance point pair, determine the direction of the key point. To create a descriptor, randomly sample the set using points that are close together.

3) Matching feature points

Instead of scanning the entire image, feature detection and extraction are made to focus on specific areas, such as the corners and edges. The next step after extracting features from two set of images is to compare the extracted features. Descriptor data is compared between matching points on the picture during the matching process. This stage aims to compare a picture's best features with that of another image. Feature extraction Obtain a numerous features from both images, for each image there are many key points and their descriptors. The matching process searches for and compares matching points on the images using the descriptor data. Finding corresponding matching points in the images is done by the matching process using the descriptor information. Every point in one picture was compared to every point in another, and the matching points were identified. A matcher object is necessary for feature matching. Here, investigate two matches, K-Nearest Neighbors (KNN) and Brute Force (BF).

1. BF matcher: The BF Matcher returns the best match. The descriptor considers all alternative and select the most appropriate matches in the original set. It then selects one feature and compares it to every further feature in the second image feature set utilizing a distance-based approach with every other feature in the second image. Finding two feature vectors in the two photos that are the most similar to one another is known as brute force matching. Select the first image's feature point first, to discover the key point with the shortest distance, first run a distance test for each important point in the second picture.

2. KNN matcher: KNN (k-Nearest Neighbors) is employed while considering many candidate matches. Rather than giving single best match on every descriptor, KNN gives the k best matches. K Nearest Neighbors (KNN) was employed here to match the essential keypoints of two images. The fact that K is equal to two means that there are two matches for each keypoints in the first image, where k is determined by the customer. Based on the Euclidean distance, the KNN algorithm estimates the degree of similarity.

4) Homography using RANSAC

RANSAC (Random Sample Consensus) stands for Random Sample Consensus Algorithm. Essentially, what is being done here is searching through continuous iterations for model parameters that can hold more interior points. Image matching purification is based on the RANSAC algorithm, which retains the "interior points" in the sample and removes the "outer points" or "noise points". Algorithms initially select a few key feature points (sub-point sets). Uses a subset to produce the transformation matrix, which is then used to identify the original feature point set within the feature points. You can mark all of the points that satisfy the model constraint as interior points. This process runs continuously. The transformation matrix that is now obtained is utilized as the final transformation matrix; the outer points are removed and all are obtained, and the inner points are preserved if the number of obtained points is sufficient and does not change significantly. The RANSAC loop consists of selecting (randomly) four pairs of features. Compute the homograph H precisely; calculate the inliers, maintain the largest set of inliers, and then recalculate the least-squares H estimate for each inlier.

The RANSAC algorithm's implementation steps can be defined as follows:

1) From pairs of identical points, four sets of matching points are chosen at random. And using the relationships between the pairs of points, the transformation matrix is calculated.

2) Determine the threshold and, using the transformation matrix H produced in step 1, determine the distance between each point in the original feature set and its corresponding point. Keep the distance if it falls below the predetermined threshold and note the precise matching points.

3) Complete the previous steps. When the correct matching points are sufficiently large and there is no change at all, iteration ends. The obtained transformation matrix is the transformation matrix of the original feature point set, and the collocation point in this instance is the maximum internal point permitted in the threshold range.

5) Image stitching

Upon the identification and matching of the feature points, perspective transformation is applied to one of the photos.The two images are then stitched together. The picture X is mapped using an OpenCV function, and then the image Y is coupled to the rear. Image blending is the stitching algorithm's last phase. Images are combined to produce a huge, seamless image. Once the homography matrix is obtained, it can be applied to the source image to implement warping.

3.3 Software Requirement and Specification

The tools used for the project are:

- Python
- VS Code

3.3.1. Python

Python being an object-oriented programming language, is ideally modelled for fast proto- typing of complicated applications. It has interfaces to several OS system calls and libraries and is protractile to C or C++. The Python programming language is utilized by many large companies, including NASA, Google, YouTube, BitTorrent, etc. Python programming is extensively used in artificial intelligence, natural language processing, neural networks, and other cutting-edge computer science disciplines. Python is a potent language that can be used to create GUIs, create online applications, and create games. Python reading and writing are quite different from reading and writing Standard English statements. Python programs must first be processed by machines since they are not written in a language that is machine readable. This indicates that each time a program is executed, its interpreter reads the program's code and translates it into byte code that can be read by a computer. The quality of Python is excellent throughout. In Python, all classes, data types, functions, and methods are treated equally. Programming languages are developed to meet the needs of users and programmers for an effective tool to construct program that have an influence on people's lives, way of life, economy, and society. By boosting productivity, improving communication, and boosting power, they help improve life. Here, python version 3.8.5 is used

3.3.2. VS Code

In simple words, VS Code is a code editor. "A free editor that helps the programmer create code, supports in debugging, and corrects the code using the intelli-sense approach," is what Visual Studio Code is described as. In plain English, it makes it easier for people to develop code. Microsoft created the free open source text editor known as Visual Studio Code (often referred to as VS Code). Windows Linux and macOS, all support Visual Studio Code. Visual Studio Code has recently become one of the most widely used development environment tools.

Chapter 4

RESULT AND DISCUSSION

4.1. Image feature extraction

The key points of the given image help us in the object detection of the image comparison. There are several algorithms for detecting key points in a given image. The next figures display a few features that were derived by SIFT, ORB and BRISK algorithms.

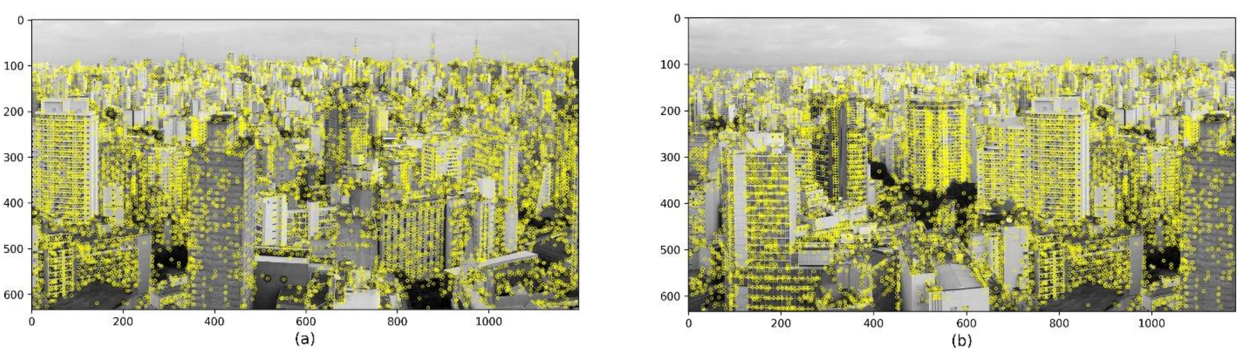


Fig 4.1: Detection of key points using Scale Invariant Feature Transform algorithm

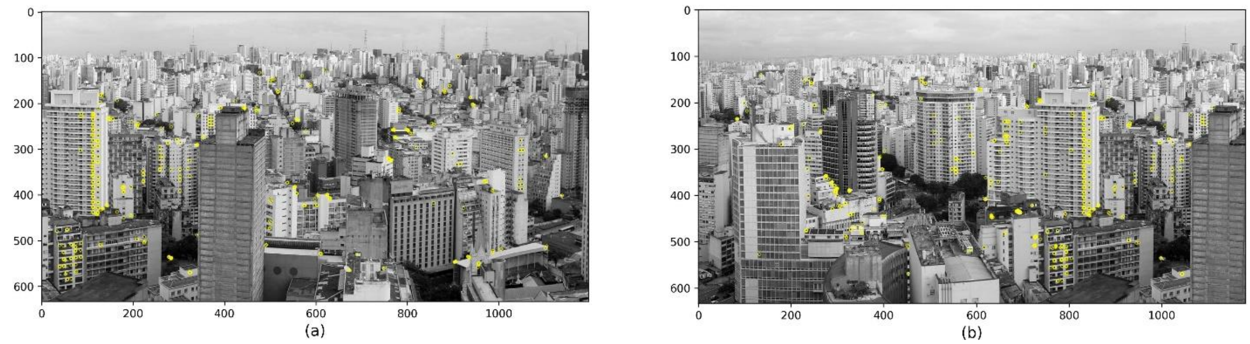


Fig 4.2: Detection of key points using OrientedFAST and rotatedBRIEF algorithm

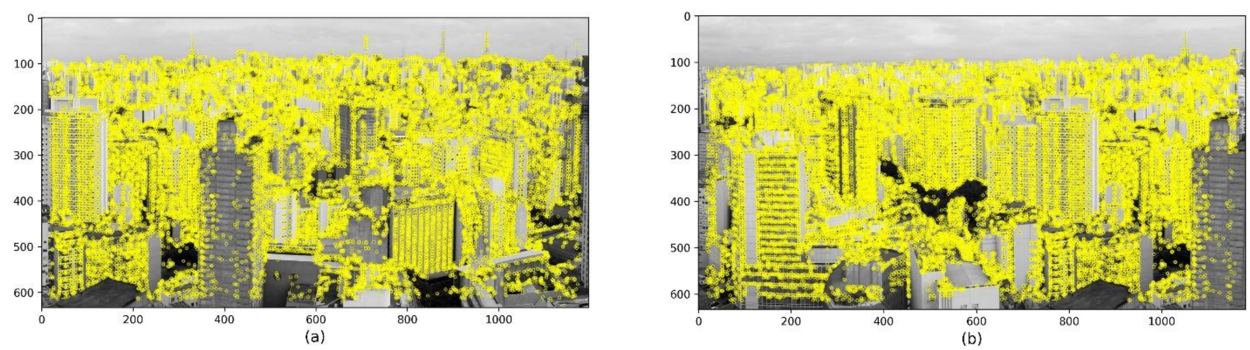


Fig 4.3: Detection of key points using Binary Robust Invariant Scalable Keypoints algorithm

4.2. Image feature matching

Feature extraction provides many characteristics from both photographs. Examines two sets of characteristics in this stage and keeps the pairings that have the greatest similarity. We can use two types of matchers for feature matching: Brute Force Matcher and KNN (K-Nearest Neighbors).Brute force returns the single best match for a given descriptor. On the other hand, KNN (k-Nearest Neighbors) is used when Take into account several candidate matches. The corresponding image is shown in the following figures.

Fig 4.4: Feature matching using BF Matcher and Features Extracted by Scale Invariant Feature Transform algorithm

Fig 4.5: Feature matching using BF Matcher and Features Extracted by OrientedFAST and rotatedBRIEF algorithm

Fig 4.6: Feature matching using BF Matcher and Features Extracted by Binary Robust Invariant Scalable Keypoints algorithm

Fig 4.7: Feature matching using KNN and Features Extracted by Scale Invariant Feature Transform algorithm

Fig 4.8: Feature matching using KNN and Features Extracted by OrientedFAST and rotatedBRIEF algorithm

Fig 4.9: Feature matching using KNN and Features Extracted by Binary Robust Invariant Scalable Keypoints algorithm

4.3. Image stitching

To create a seamless large image, the images are combined. Below are the outcomes of matching and stitching the feature points.

1) Feature Extractor: SIFT

Fig 4.10: Matching Based on KNN

Fig 4.11: The panorama created by the stitching technique

2) Feature Extractor: ORB

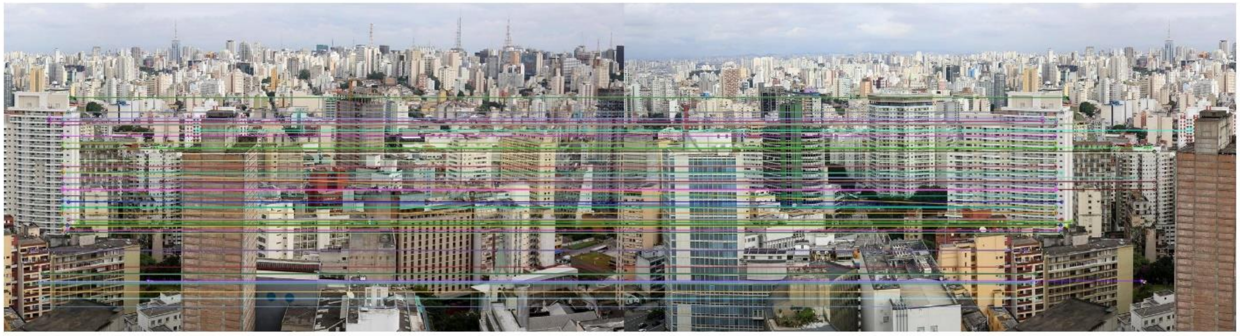


Fig 4.12: Matching Based on KNN

Fig 4.13: The panorama created by the stitching technique

3) Feature Extractor: BRISK

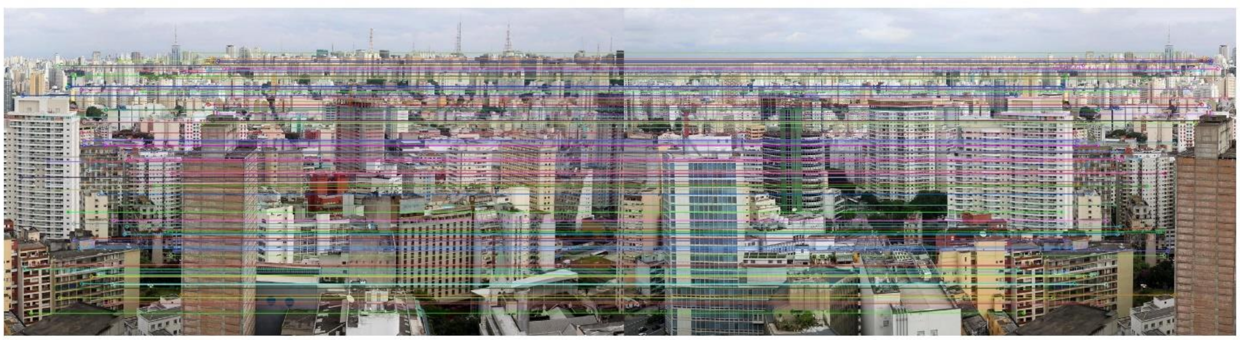


Fig 4.14: Matching Based on KNN

Fig 4.15: The panorama created by the stitching technique

	Number of feature points		Time (s) taken for feature extraction (Image 1)	Time (s) taken for feature extraction (Image 2)	BF Matcher	KNN Matcher	Time (s) taken By BF Matcher	Time (s) taken By KNN Matcher
	Image1	Image2						
SIFT	**8889**	**9021**	**1.1**	**1.4**	**4281**	**9021**	**13.9**	**6.3**
ORB	**500**	**500**	**0.2**	**0.2**	**274**	**500**	**0.2**	**0.1**
BRISK	**24701**	**22627**	**2.2**	**0.9**	**8938**	**22627**	**24.4**	**12.8**

Table 4.1. SIFT, ORB and BRISK features matching result.

The detection rate and speed of the feature extraction detectors on images are shown in Table 4.1. The findings show that the ORB approach recognized the features of the input images far more quickly than the SIFT and BRISK techniques, demonstrating ORB's superior speed.

The table demonstrates that the SIFT algorithm and BRISK method extract much more key points than the ORB algorithm. Among which the ORB algorithm’s feature point extraction speed is the fastest. In this project, Brute Force matching and KNN matching are used to obtain matching pairs. According to the table data, among the feature matchers KNN gives a greater number of matching feature points in a limited time.

Chapter 5
CONCLUSION

By figuring out the geometric relationships between several input photographs taken from the same location, a method known as "image stitching" may integrate them into a high-resolution composite image. The images should have overlapping regions. In this project, an automatic method for creating seamless image panorama was introduced. A comparative studies of features detection algorithms such as Scale Invariant Feature Transform (SIFT), OrientedFAST and rotatedBRIEF (ORB) and Binary Robust Invariant Scalable Keypoints have been done in this project. There also a comparison performed between BF and KNN matcher.

Experimental findings reveal that when Compared to BRISK and SIFT algorithms, the ORB method recovers unit feature points more quickly. The BRISK algorithm and SIFT algorithm extract substantially more feature points than the ORB method. The k nearest neighbour technique can more accurately find matching points and remove a significant amount of false matching points. KNN Matcher returned more best matching pairs than Brute Force Matcher and KNN is faster than BF Matcher. Finally, it was determined that, ORB is the best suitable image stitching approach for real-time applications since it is the fastest. When comparing the two matchers (KNN Matcher and Brute Force Matcher), KNN offers a greater selection of candidate features. Based on experimental findings, KNN outperforms BF Matcher in terms of speed. SIFT and BRISK detectors have retrieved more key points than ORB, although SIFT approach required more time for feature extraction than ORB technique did.

5.1 Future enhancement

In the future work the algorithm needs to be more reliable when stitching three or more photos together. Another improvement in the future is to stitch videos together to make dynamic panoramas.

Chapter 6

REFERENCES

[1] Zhongke Zhang, "Image stitching algorithm based on combined feature detection", IEEE International Conference on Advances in Electrical Engineering and Computer Applications (AEECA) , 2020

[2] Jia Xingteng, Wang Xuan, Dong Zhe, " Image matching based on improved SURF algorithm", IEEE International Conference on Computer and Communications (ICCC), 2015

[3] Ruirui Ma, Chunlin Zhang, Qing Guo, Fangyi Wan, "Research on Aerial Image Stitching Technology", 2019 IEEE International Conference on Sensing, Diagnostics, Prognostics, and Control (SDPC), 2019

[4] Shreyas Mistry, Arpita Patel, "Image Stitching using Harris Feature Detection", International Research Journal of Engineering and Technology (IRJET), Volume: 03 Issue: 04 | Apr-2016

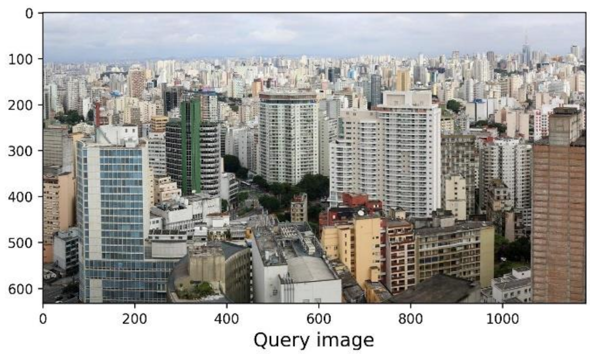
[5] Hetal M. Patel, Pinal. J. Patel, Sandip G. Patel, "Comprehensive Study and Review of Image Mosaicing Methods", International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181 Vol. 1 Issue 9, November- 2012

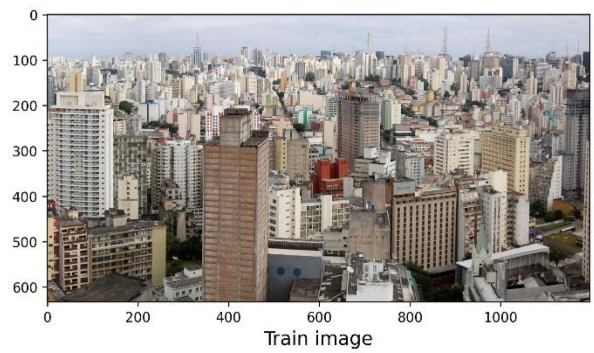
[6] Jing Xing, Zhenjiang Miao, "An Improved Algorithm on Image Stitching Based on SIFT features", 2008 IEEE Second International Conference on Innovative Computing, Information and Control (ICICIC), January 200

APPENDIX

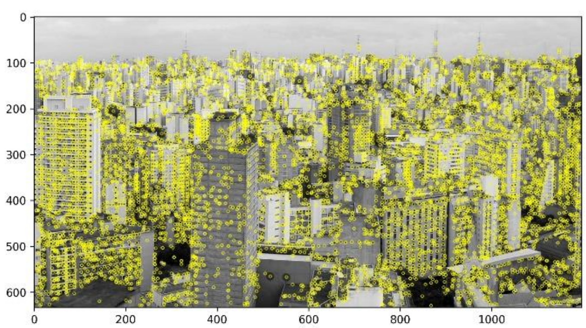
SIFT

Input

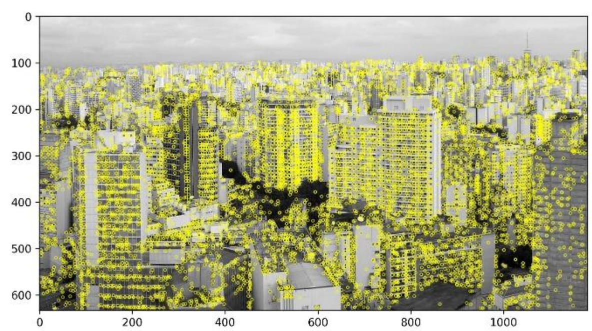




Feature Detection



(a)



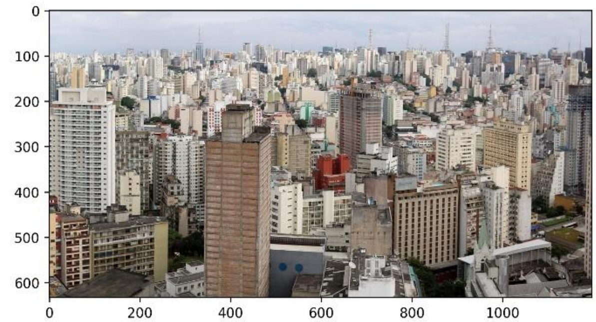
(b)

Output

ORB

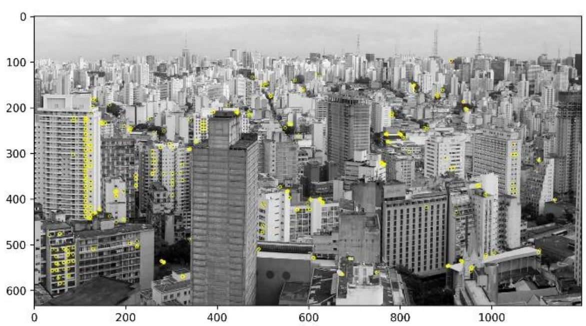
Input

Query image

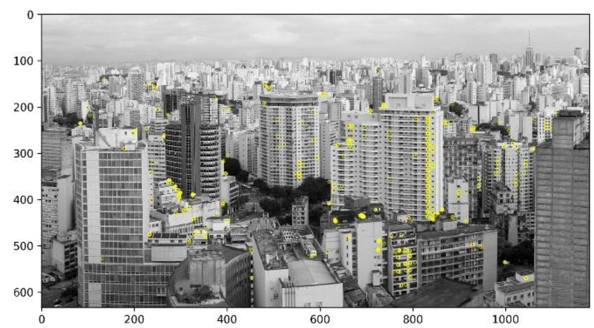


Train image

Feature Detection



(a)

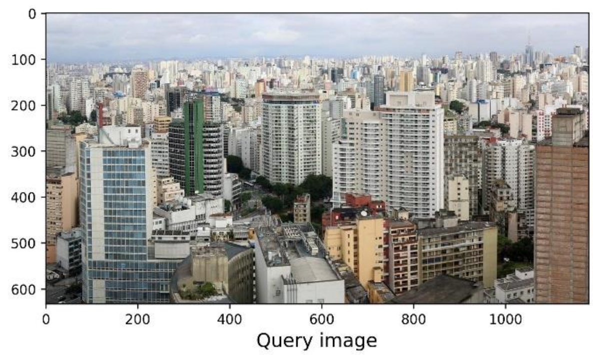


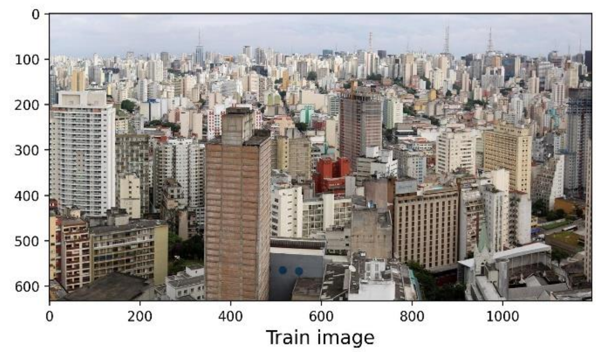
(b)

Output

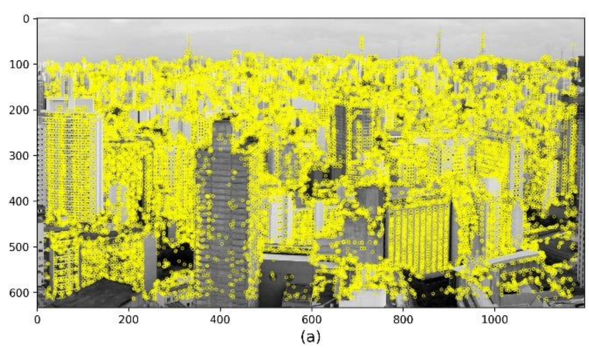
BRISK

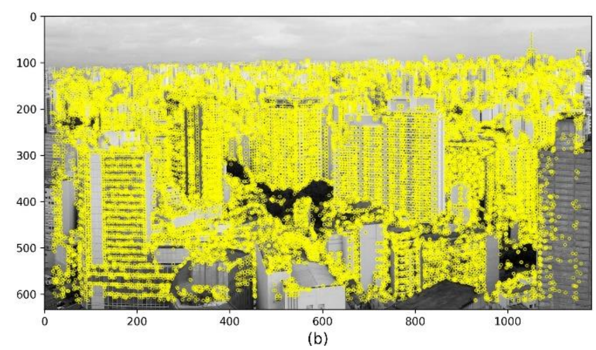
Input





Feature Detection





Output