Image Mosaicing

Submitted in partial fulfilment of the requirements of the degree

BACHELOR OF ENGINEERING IN COMPUTER ENGINEERING

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CERTIFICATE

This is to certify that the Mini Project entitled **"Image Mosaicing"** is a bonafide work of **Agarwal Gunjan Hemant (312002), Ishan Ahmed (312018), Tamim Ahmad (312055), Sudarshan Tarmale (312056) submitted** to the University of Mumbai in partial fulfillment of the requirement for the award of the degree of **"Bachelor of Engineering"** in **"Computer Engineering".**

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Mini Project Approval

This Mini Project entitled "**Image Mosaicing"** by **Gunjan Hemant Agarwal (312002), Ishan Ahmed (312018), Tamim Ahmad (312055), Sudarshan Tarmale (312056) is** approved for the degree of **Bachelor of Engineering** in **Computer Engineering.**

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Abstract

One of the image processing methods that is helpful for tiling digital images is mosaicking. One huge radiometrically balanced image is created by mosaicing many randomly shaped photos together so that the borders between the original images are hidden. A technique called image mosaicing permits the easy collection of additional information from numerous small images to create one huge image. By predicting a homography between matching corner features, we propose a framework for mosaicking images in this research. In this framework, we use a Harris corner detector to locate corners in two images, then automatically locate corresponding features, estimate a homography between the two images, and warp one image into the coordinate system of the second image to create a mosaic that contains the union of all the pixels in the two images. Our experimental findings show that our framework performs well.

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Introduction

1.1 Introduction:

Using the technique of image mosaicing, you can combine smaller photographs of the same scene into a larger one. The union of the two input photos will be the mosaic's final product. To create mosaiced images, image-mosaicing algorithms are utilized. The technique of image mosaicing is essentially broken down into five steps.

Long before the invention of contemporary computers, image mosaicing was a common practice. At that time, the captured photos were manually assembled. As satellites began returning images to earth in later centuries, the demand for mosaicing grew even more. Computer technology advancements developed into a natural driving force to create a computational technique and resolve connected issues. It is extensively used in everyday life by stitching together images to create panoramas or a huge image that can display the dramatic, entire scenarios. For instance, it can be utilized for online virtual travel, creating virtual environments in video games and editing individual photos.

1.2 Motivation:

Mosaicing is one of the techniques of image processing which is useful for tiling digital images. Mosaicing is blending together several arbitrarily shaped images to form one large radiometrically balanced image so that the boundaries between the original images are not seen. Image Mosaicing is a method of constructing multiple images of the same scene into a larger image. The output of the image mosaic will be the union of two input images.
Retrieving documents by performing mosaicing and stitching operations. Creating virtual imagery and panoramic views.

1.3 Problem Statement & Objectives:

A method known as "picture mosaicing" allows you to create a sizable, seamless panoramic image from a variety of source photographs. We can see the entire scene in a video, but not all at once because the camera's field of view is less than ours. Using image mosaicing, we may join these landscapes to get more details that can be gleaned from the scenario composition. The basic goal of this is image mosaicing studies conducted in recent years, Numerous modifications have been made to the traditional algorithms that have improved the field of view and picture resolution.

Nowadays almost all digital cameras come with the feature of image panorama. Still, it is not giving a very nice result and lots of improvement can be done. So, this field of image processing also requires effort and still many new algorithms can be developed.

1.4 Organization of the Report:

The rest of the report is structured as follows: Section 2 contains the literature survey wherein a summary of various papers for image mosaicing is mentioned along with their limitations and research gaps. In addition, we have mentioned the research gaps we will be working on, highlighting our contribution to the research area. Section 3 contains details of the proposed system as well as hardware and software requirements, results and experiments, and conclusions.

Literature Survey

2.1 Survey of Existing System

[1] Erik Makino Bakken and Oivind Midtgaarda introduced a new technique for automatically choosing the best image segments for an underwater optical mosaic. Underwater optical pictures' quality is substantially impacted by poor lighting, strong light absorption, and light dispersion. For enhancing the photographs' contrast, intensity distribution, and colour harmony, we have created a revolutionary mix of techniques. In addition, we have shown how to choose the best portions of overlapped photos using a relative quality metric. The Tile Cam colour and grayscale photos were collected by HUGIN AUVs in a variety of underwater environments, and the mosaic processing chain has been successfully tested on these images. We intend to use image-based matching in subsequent work to enhance coregistration for big mosaics. Additionally, we will try to enhance the range-dependent illumination model by taking into consideration the inclination of the nearby scene planes.

[2] Qiang Chen et al perform a technique of Image mosaic based on rectification is proposed. The image is Preprocessed and rectified through plane homograph. In the last two images are stitched through feature point matching and image fusion which contains Harris corner detection and SIFT feature matching algorithm. The purpose of this is to Use In Traffic Accident Scene Diagramming. The accident scene map is created using the accident mosaic image as a background through traffic accident analysis, and the relative inaccuracy of the measured value is less than 2%. This makes it simple for investigators to map the whole accident scene and guarantee the accuracy of data collection.

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[3] Xiangyan Lan et al proposed a technique to improve the matching performance of the algorithm, an improved UAV aerial image registration algorithm based on GMS-RANSAC is proposed. The characteristics of the GMS algorithm to improve the RANSAC algorithm, reduce the number of iterations of the algorithm, and reduce the time complexity of the algorithm. Images are first divided into a grid image then extraction of extract feature points is done using Brute Force Matching Algorithm. Finally, GMS algorithm is used to verify whether all feature pairs extracted using Brute Force Matching Algorithm match exactly. GMS-RANSAC algorithm introduced in this paper improves the matching performance of the algorithm by improving the stitching speed and matching accuracy.

[4] Yi Zheng et al proposed an effective automatic sorting and mosaic method based on Fourier-Mellin transforms and SIFT proposed and studied deeply. Some intuitive and persuasive simulation experiments have been carried out by using the proposed automatic sorting and mosaic method. The experimental results show that the proposed method can sort and stitch unordered overlapping images automatically. The purpose is for use in the fields of three-dimensional reconstruction, cooperative augmented reality and teleoperation robots.

[5] Pooja Deshmukh et al perform Quantitative analysis of two algorithms. A mosaic image is

created by mixing a variety of image fragments to create a whole image. Videos, photographs, and documents with images can all use this technology. The major objective of this work is to employ stitching images for information retrieval and restoration from documents or photo images. In this paper, we review the numerous image mosaicing techniques. Techniques for integrating numerous photos into one whole and a broader view of the image are known as image mosaicing. There are still many prospects for study in this area. Numerous applications are used in a wide range of industries, including forensic science, photography, archaeology, the preservation of historical documents, and corporate domains.

[6] Abderrahmane Laraqui et al performs a technique to generate mosaic image from video. A key area of study in the field of computer vision is video mosaic. A crucial area of study in the realm of computer vision is the picture mosaic. In this article, real-time video scenes were compressed using picture mosaics. The experiment demonstrated that our approach greatly reduces storage size using a database of eight video sequences. A compression ratio that is between 81.7 and 92.30 percent less than the original video size. In addition, the mosaic's quality is good.

[7] Khellal Atmane et al performed a technique in which it consists in aligning multiple images to construct a single large image of a 3D scene allowing the operator to view images that offer a wider field of view than standard images. To build a mosaic image from a sequence of images (obtained from a set of images, a movie or a real video stream) three basic steps are required: Image Acquisition, Image Registration and Perspective Warping. The purpose is quantitative analysis of image mosaicing algorithms is established. First, a new projection approach for image registration is applied. Then, two algorithms of images mosaicing are implemented and compared using accurate quantitative analysis. Experimental validation shows that the mosaicing algorithm-based SURF gives much better results compared to KLT. Such a conclusion is expected since the robustness of SURF detector and descriptor.

[8] Yuping Feng Shuguang Li proposed a technique to enhance the conventional ORB algorithm without scaling based on SURF and refine the technique of image feature point extraction, which essentially enhances the proper matching logarithm under changing scale. Image mosaic algorithm is proposed by improving the Oriented FAST and Rotated BRIEF(ORB) features combined with the Speeded Up Robust Features (SURF). The experimental results demonstrate that the enhanced ORB method described in this study, which combines the resilience of the SURF algorithm with the efficiency of the ORB algorithm, has the advantages of the two algorithms. The algorithm uses the multi-scale space of the SURF algorithm to extract the feature points.

2.2 Summary Table

Sr. No.	Authors	Year	Central Idea	Purpose of image mosaicing
1]	Erik Makino Bakken et al	2020	Initial step -read the vehicle navigation and Doppler data files. -calculate image planes and total area coverage -make frame average For each image -read image -calculate quality image -adjust color and contrast using(CLACHE) - undistort image -blend with previous image using quality images -insert image into mosaic using quality images	Novel method for automatically selecting the highest quality image sections for an underwater optical mosaic.
2]	Qiang chen et al	2020	-Image mosaic based on rectification is proposed -Preprocessed and rectified through plane homograph. -Two images are stitched through feature point matching and image fusion which contains Harris corner detection and SIFT feature matching algorithm.	Used In Traffic Accident Scene Diagramming

3]	Xiangyan Lan et al	2020	-The characteristics of GMS algorithm to improve the RANSAC algorithm, reduce the number of iterations of the algorithm, and reduce the time complexity of the algorithm. -The stitching algorithm first divides the image into a grid image To extract feature points, it uses Brute Force Matching Algorithm. -Further it uses the two-way matching strategy to filter the wrong matching feature pairs. - Finally, the GMS [7] algorithm is used to verify whether all feature pairs match exactly.	GMS-RANSAC algorithm introduced in this paper improves the matching performance of the algorithm by improving the stitching speed and matching accuracy.
4]	Yi Zheng et al	2019	-Automatic sorting based on Fourier-Mellin Transforms -image mosaic based on SIFT -image registration based on Feature vectors -image fusion	For use in the fields of three-dimensional reconstruction, cooperative augmented reality and teleoperation robots.
5]	Pooja Deshmukh et al	2019	Quantitative analysis of two algorithms is done. Feature detection and matching using KLT algorithm (Kanade-Lucas-Tomasi tracker) technique based on optical flow.Harris detected is used to detect points of interest in an image and in the next image track them by estimating the optical flow. Feature detection and matching using SURF (SpeededUp Robust Features) algorithm technique based on invariant: SURF detector is used to detect points of interest in the two images and detected points are matched by SURF descriptors.	A Review of Various Image Mosaicing Techniques

6]	Abderrahmane Laraqui et al	2019	-cutting the video in successive frames containing an overlap area between them -geometric relationship between a frame and the frame that follows it can be achieved by using FAST matching algorithm -RANSAC algorithm comes to determine the ؛ transformation between the two input images -The mosaicing operation is repeated until the last frame in the video scene.	-To generate mosaic image from video.
7]	Khellal Atmane et al	2018	It consists in aligning multiple images to construct a single large image of a 3D scene allowing the operator to view images that offer a wider field of view than standard images. To build a mosaic image from a sequence of images (obtained from a set of images, a movie or a real video stream) three basic steps are required: Image Acquisition, Image Registration and Perspective Warping	Real time registers image and mosaic of image taken by UAVs
8]	Yuping Feng Shuguang Li	2018	- Image mosaic algorithm is proposed by improving the Oriented FAST and Rotated BRIEF(ORB) features combined with the Speeded Up Robust Features(SURF). -The algorithm uses the multi-scale space of the SURF algorithm to extract the feature points	To improve the traditional ORB algorithm without scaling based on SURF, and optimize the method of image feature point extraction.

Table 2.1 Summary Table

2.3 Limitations of Existing System and Research Gaps

The systems discussed in the earlier section proved to be fruitful in their respective requirements. However, there are research gaps that we discuss in this section. Following are the limitations of the existing systems for image mosaicing.

- The mosaiced image's color and brightness are not considered.
- It is assumed that the only offsets between two consecutive overlapping images are the large offset in the horizontal direction and the tiny offset in the vertical direction.
- If images are captured at different times, the lighting details will change, and the lighting will be incorrect when the images are stitched together so we assume the images are taken at the same time.
- Assuming that the scene is flat. Geometrical distortions, like the tiny discontinuities of the boulder edges across the image seam, are introduced when this assumption is broken.
- Some pixels may be left blank during stitching if photos are not properly vertically aligned.

2.4 Mini Project Contribution

In addition to the above points, we also intend to train our system on images taken from different distances and every possible angle. The acquisition of images from varied distances and angles will help us train the system on a variety of data and help us in ensuring adequate accuracy. Additionally, we want to train the system to stitch together photos captured under various lighting situations to create a single photo with the proper lighting.

Proposed System

3.1 Introduction

In layman's words, image mosaicing is also known as image stitching, which is the process of combining two or more photos to create a single image. Today, practically all digital cameras have the panorama image feature. It still doesn't produce a very attractive result, and there is much room for development. Therefore, there is still much room for innovation in the field of image processing. Numerous uses of image mosaicing include video conferencing, creating 3D views from various nodes, telemedicine, astronomy, cartoons, virtual museums, and architectural walkthroughs.

As mentioned earlier, image mosaicing involves the individual images to be aligned to some reference image. The relation between the coordinates of the reference image and the image to be aligned is governed by a property called the homography. The following are the major issues in image mosaicing:

- Image alignment: Finding the homographies between the given images with respect to some reference image.
- Image registration: Pasting the aligned images so that overlapping regions between them are merged.
- Image blending: Smooth out or rectify the intensity differences between the two stitched images.

In our system, the algorithm uses keypoint detection using SIFT, matches the keypoints, and stitches a pair of images using RANSAC and Homography matrices.

3.2 Architecture/Framework

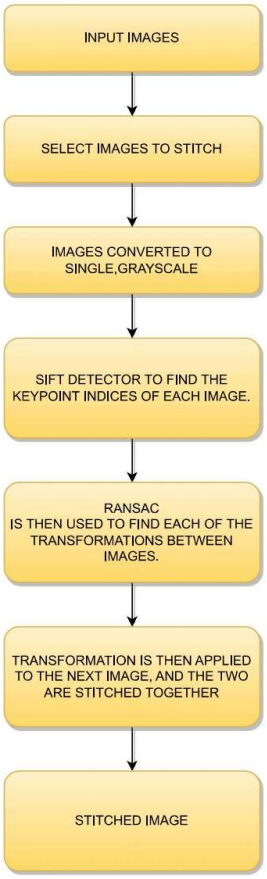

Figure 3.1 Basic Flowchart of Proposed System

3.3 Algorithm and Process Design

1. Load the images from the data folder into the algorithm and convert them to single, greyscale images.

2. Use a SIFT detector to find the keypoint indices of each image.

3. Match the key points of each image using their SIFT descriptors.

4. Use RANSAC to find the most likely transformation between images, removing any outliers.

5. Apply the transformation to the next image and stitch the two images together.

6. Repeat step 4 and 5 until all images are stitched together.

7. If there is an odd number of images, start with the exact middle image and stitch it with the image to its right. Then, stitch the two stitched images with the image to its left. Continue stitching the remaining images in an alternating pattern of right and left.

8. If there is an even number of images, start with the middle-left image and stitch it with the image to its left. Then, stitch the two stitched images with the image to its right. Continue stitching the remaining images in an alternating pattern of left and right.

9. Output the final stitched image, ensuring that it is not distorted.

3.4 Details of Hardware & Software

Hardware:

The input of this system will be taken through a good camera. Thus, the hardware component in the proposed system is a camera for capturing the image for mosaicing.

Software:

Hardware	Camera Laptop
Coding Language	MATLAB
External Tools	MATLAB MATLAB Computer Vision Toolbox MATLAB Image Processing Toolbox MATLAB VLFEAT library
System Requirement	4.0 GB RAM Intel or AMD x86–64 processor Hardware accelerated graphics card supporting OpenGL 3.3 with 1GB GPU memory is recommended.
Operating System	Windows 11 Windows 10 (version 20H2 or higher) Windows Server 2019 Windows Server 2022

Table 3.1 Hardware & Software Requirement

3.5 Experiment and Results

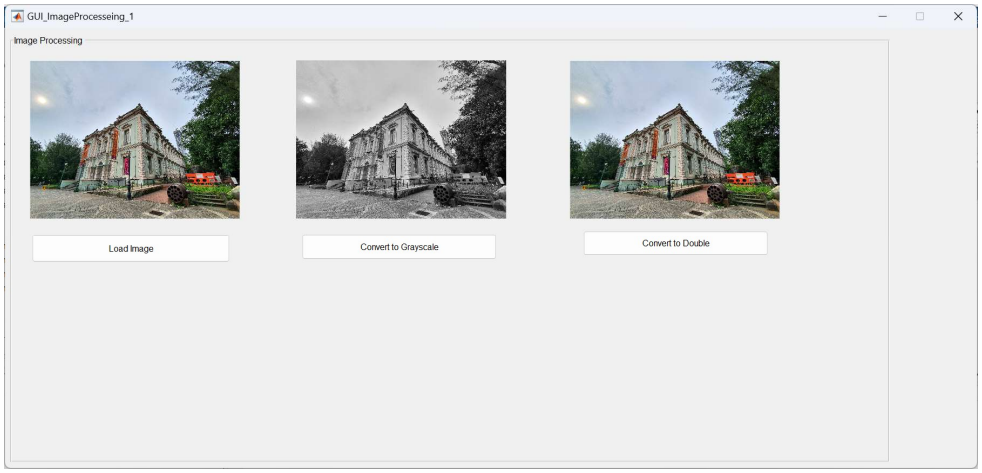

Figure 3.2 Creating GUI

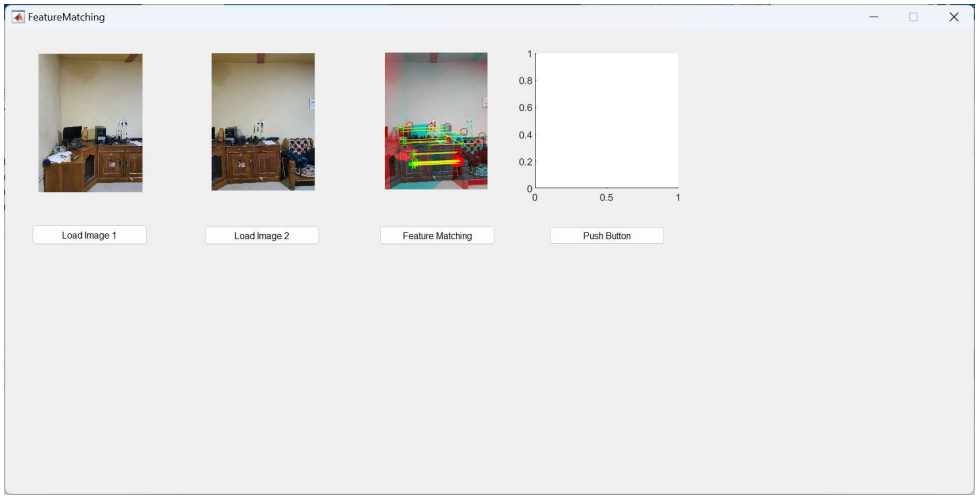

Figure 3.3 Extracting common features using Harris Corner Detection

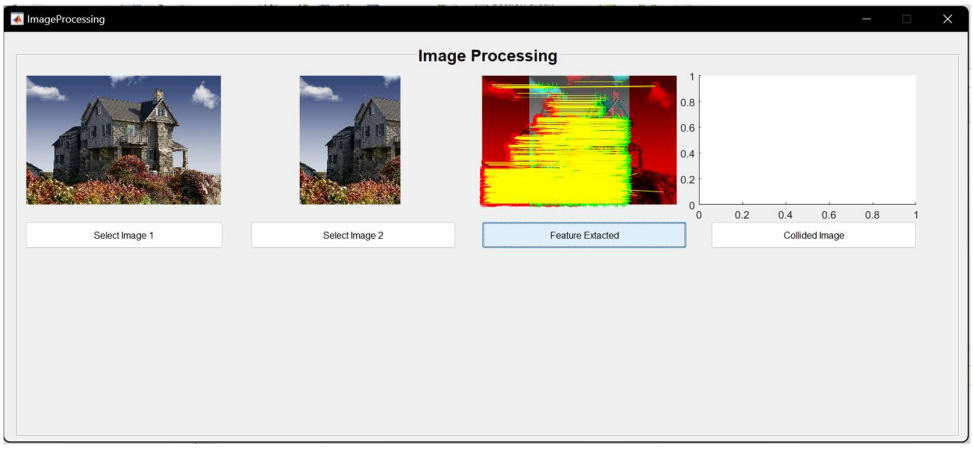

Figure 3.4 Extracted Feature Output

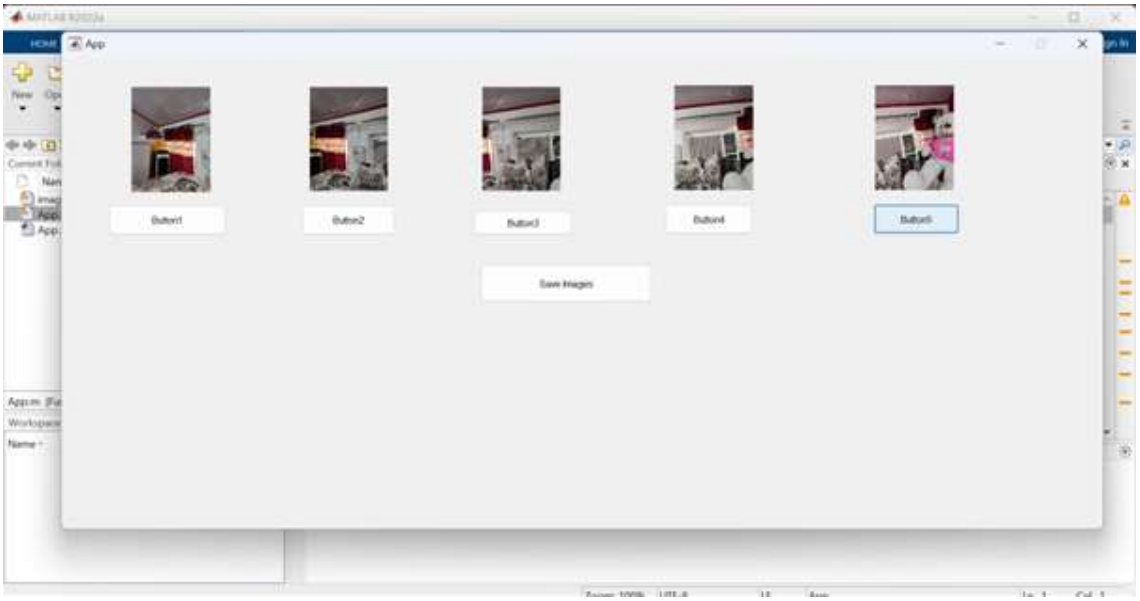

Figure 3.5 Selecting the images for mosaicing

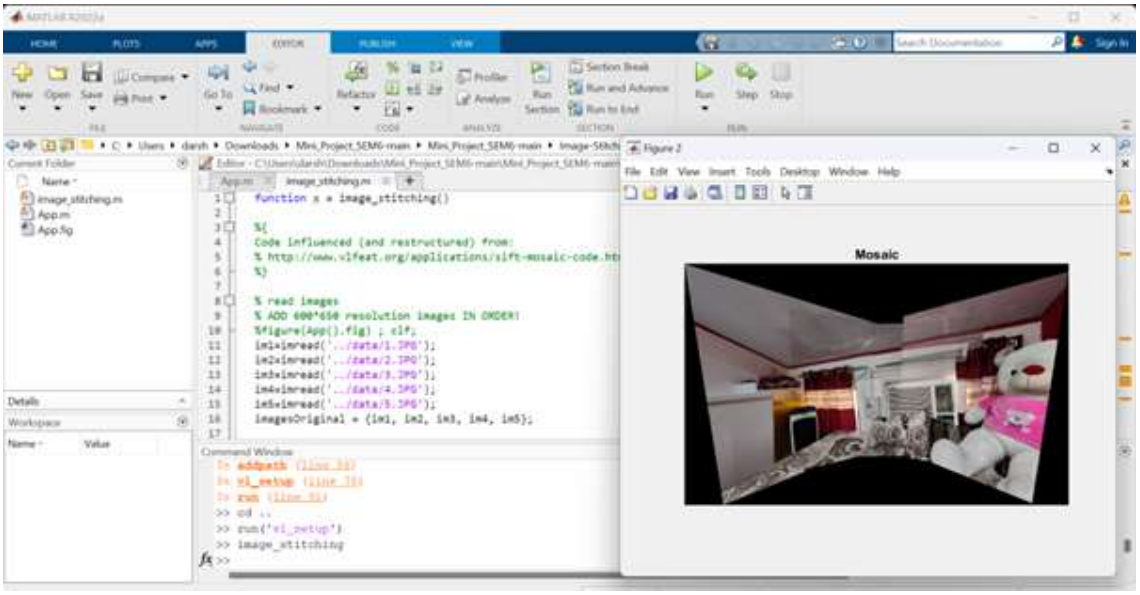

Figure 3.6 Final Mosaiced Image

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