Generating Building Drawings using Image Processing

Abhishek Chandra

Department Of Computer Science and Engineering
National Institute Of Technology, Hamirpur

November 29, 2024

Under the Supervision of -
Dr. Kamlesh Dutta
Dr. Hemant Kumar Vinayak

Table of Contents

Introduction

- The traditional methods for generating building drawings are often costly and time-intensive.
- In cases involving old structures, obtaining precise measurements is difficult. Therefore, there is a need for a computer-aided approach to efficiently produce these drawings.
- This research introduces a method that leverages image processing techniques to generate building drawings, significantly reducing both time and cost compared to traditional approaches.

Motivation

- The growing need for quick and affordable solutions in architectural design drives the demand for innovative methods.
- Simplifying this process can benefit architects, urban planners, and researchers by reducing time and financial barriers.
- This research proposes a novel approach to address these limitations, offering a more accessible and efficient method for generating building drawings.

Problem Statement

- The research, ”Generating Building Drawings using Image Processing,” addresses the challenge of creating accurate building drawings, particularly for old buildings. These limitations highlight the need for automated and cost-effective solutions.
- **Gaps:** Though there are software tools to obtain 3D models using various scanning techniques, there isn’t any existing model that provides the elevation drawing of the building in DXF format.

Objectives

- To develop a computationally efficient and simple method for producing accurate architectural drawings in a desired format that can be viewed and edited in CAD software.
- To generate accurate drawings without the use of complex LiDAR and laser-based systems.

Related Work - 1

Name	H/W Used	S/W Used	Technology Used	Result
Documentation of architectural scenes using a hierarchical method (2010)	8 MP point and shoot camera	Custom Model	Harris Corner Detector, SFM, RANSAC, CAM-PLAN	3D model of Anna University created using 100 photos on 8 MP camera; part of software contains text data.

Related Work - 2

Name	H/W Used	S/W Used	Technology Used	Result
Architectural Photogrammetry: A low-cost image acquisition method in documenting built environment (2021)	Canon DSLR D60, DJI Phantom 4	Lightroom, ContextCapture	Point Cloud Generation	3D model of SEWU temple created; results were compared to laser-scanned model and found to be a good enough solution.

Related Work - 3

Name	H/W Used	S/W Used	Technology Used	Result
Quality enhancement in Digital Twin production of complex architectures with integrated use of terrestrial and aerial images (2023)	Nikon D300, DJI Phantom 4, CHC i80 GNSS, Geomax Zoom25	Lightroom, ContextCapture	Point Cloud Generation	3D point cloud model of Gebze Technical University Geomatics Engineering Building, along with roof.

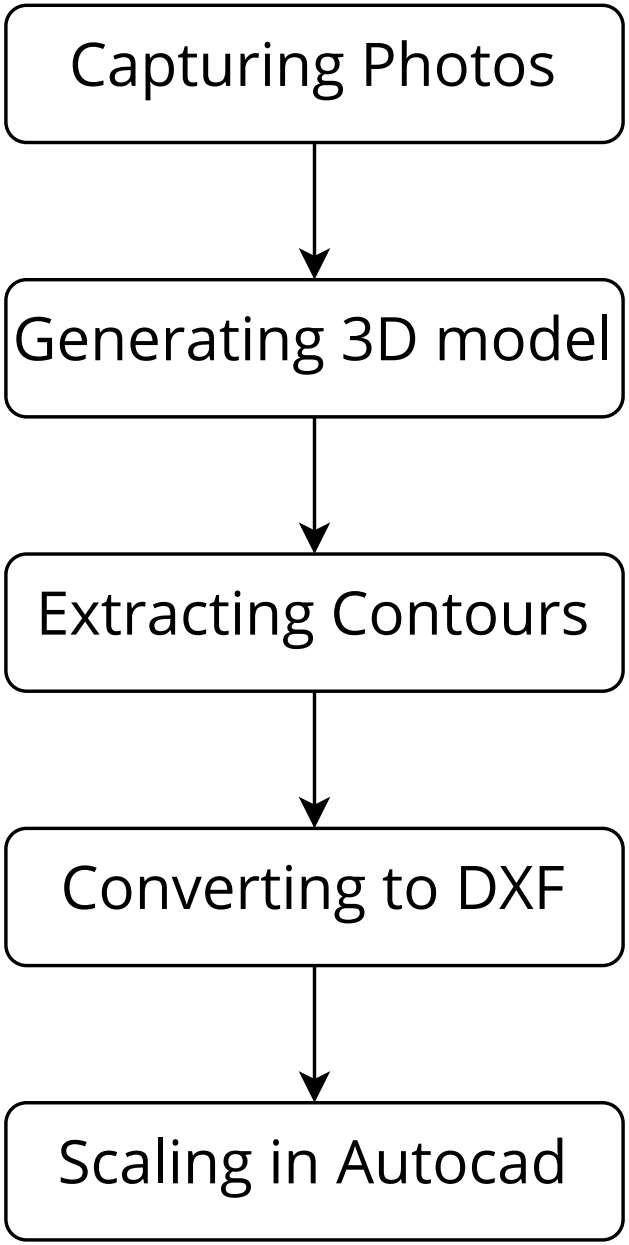
Related Work - 4

Name	H/W Used	S/W Used	Technology Used	Result
3D modeling of cultural heritage with point cloud generation by integrating UAV and terrestrial photogrammetry techniques (2023)	Canon EOS600D, DJI Zenmuse P1, Topcon HiPer Sr GPS, Topcon GPT-3500	Agisoft Metashape	Structure from Motion	3D model of Yildiz Technical University Guest House building; 53 aerial photos and 521 ground photos used.

Related Work - 5

Name	H/W Used	S/W Used	Technology Used	Result
3D Modeling of Sanggrahan Temple using UAV imagery and terrestrial photogram-metry method (2023)	Nikon D300 DSLR 24MP, DJI Phantom 4, 20MP	N/A	Structure From Motion	Dense point cloud model, mesh model, and textured model made of Sanggra-han Temple.

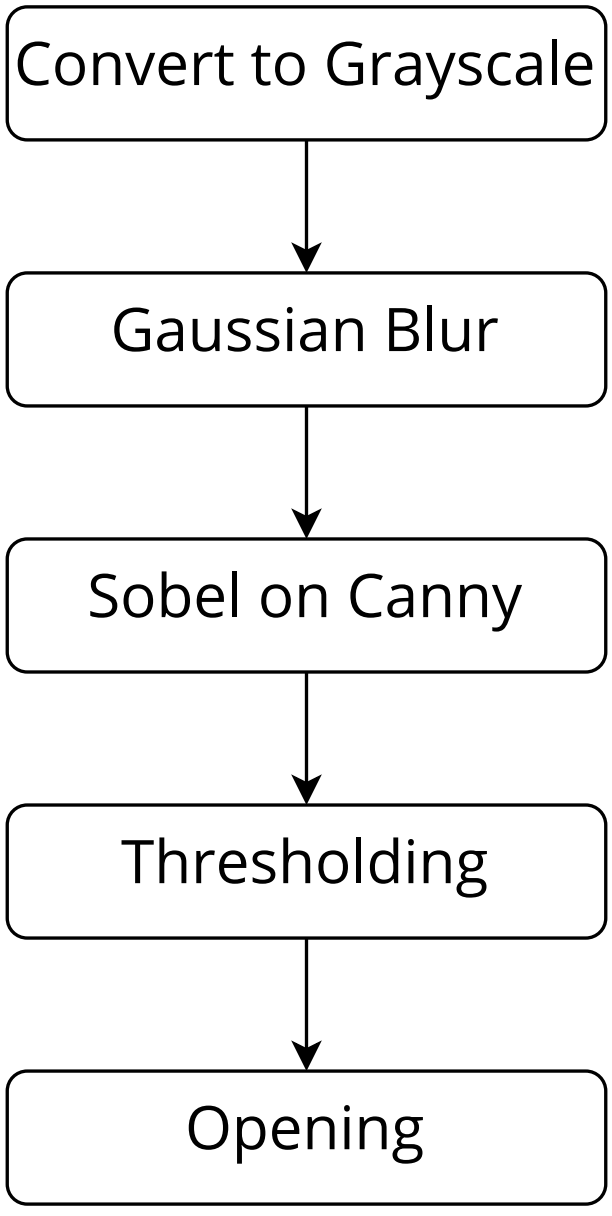
Methodology - Workflow



Methodology - Workflow

- Around 100-150 photos taken with more than 80% overlap.
- Photos are taken at varying height and from different angles.
- Here Agisoft metashape is used for generating 3d model.
- A custom edge detecion pipeline is made by for quality edge detection.
- Image processing and Conversion is done using Python and its various libraries.
- Click here to see Application

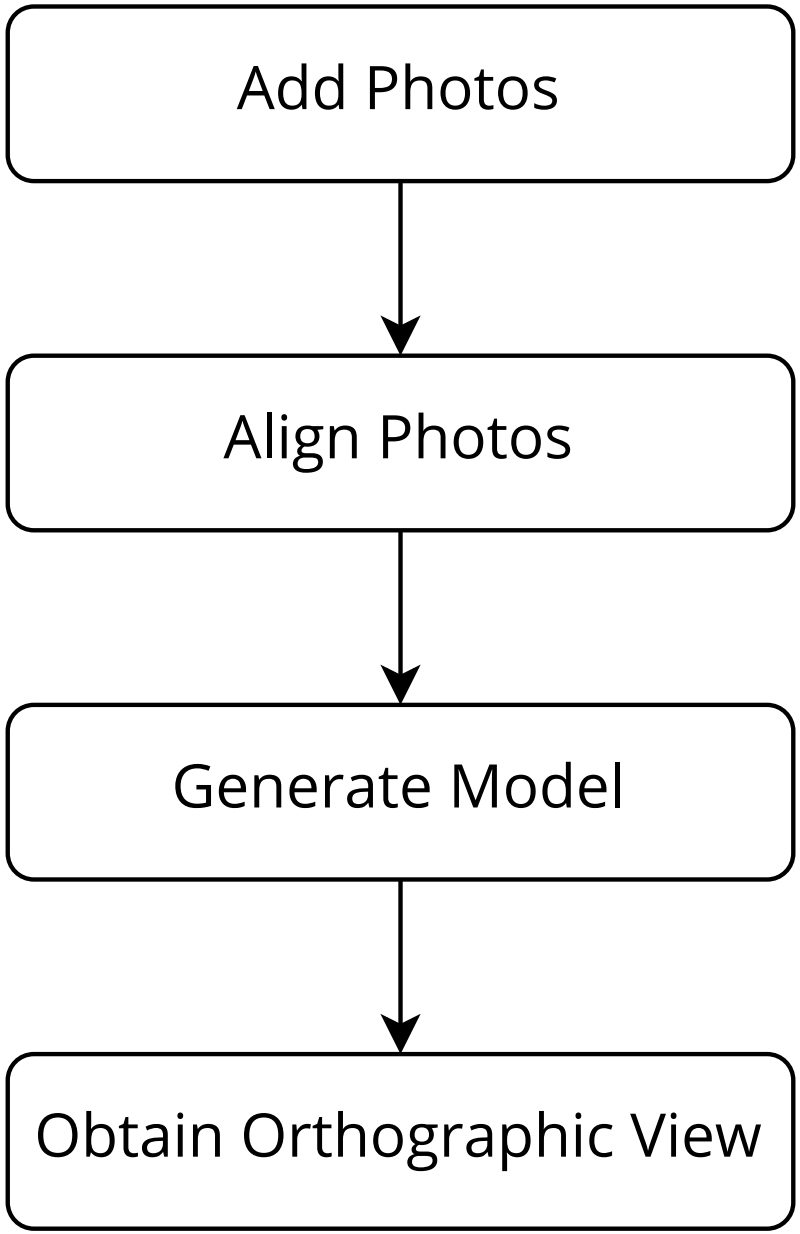
Methodology - Edge Detection



Methodology - Edge Detection

- Converting to grayscale to reduce complexity and increase accuracy of edge detection algo.
- Gaussain blur reduces noise resulting in sharp and clear edges.
- Thresholding is used to convert image to binary further reducing noise.
- Opening reduces noise and remove small edges keeping meaningful data and increasing accuracy.
- Here opencv and numpy are used for image processing tools and for working with array respectively.

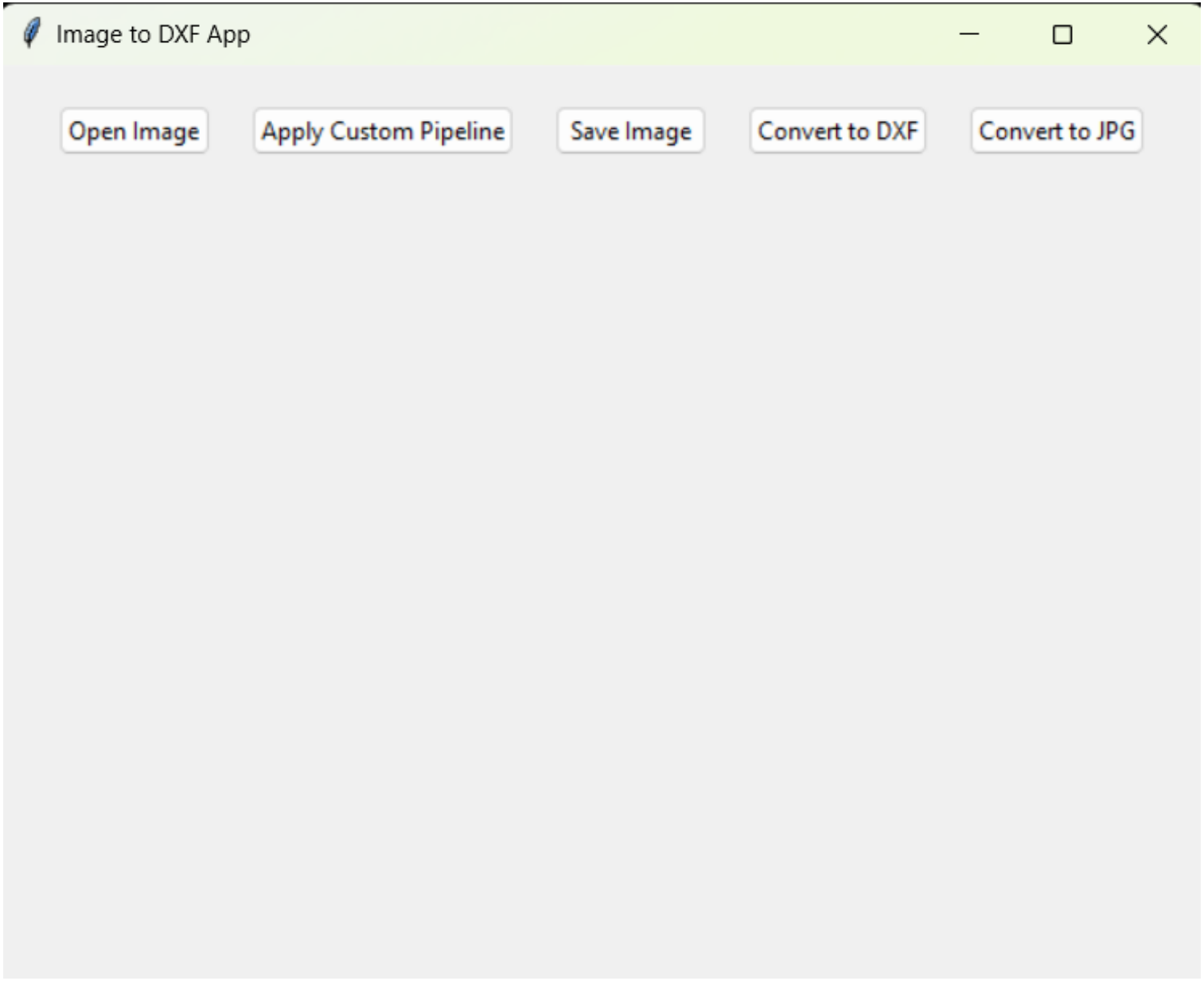
Methodology - Obtaining Projection



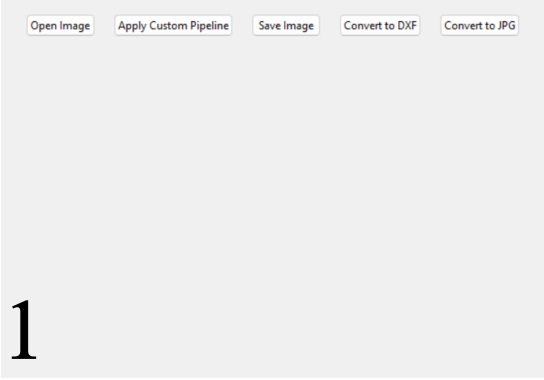
Methodology - Obtaining Projection

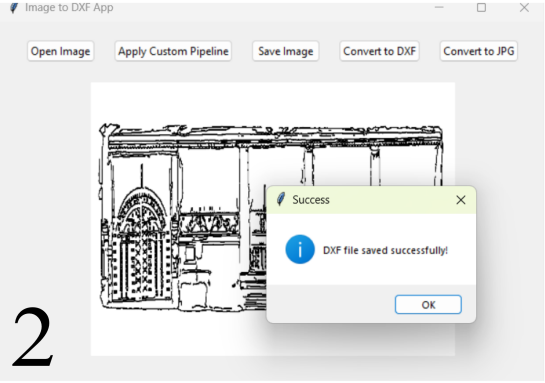
- Generation of 3d model is done in Agisoft Metashape which is a professional photogrammetry software.
- The quality of generates model depends on the quality and quantity of photos used.
- The textured view of model provide realistic view of model.
- 3d model is used obtain the orthographic view,this orthographic view image is further processed to get the drawing of building.

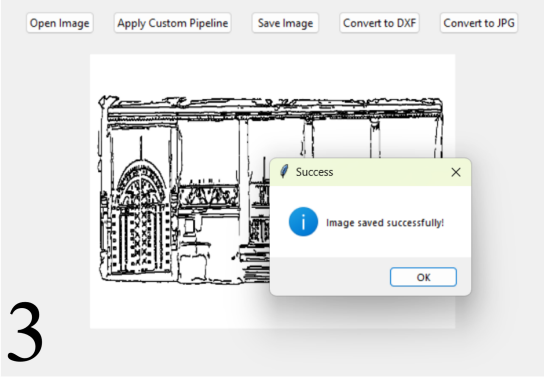
Methodology - Application

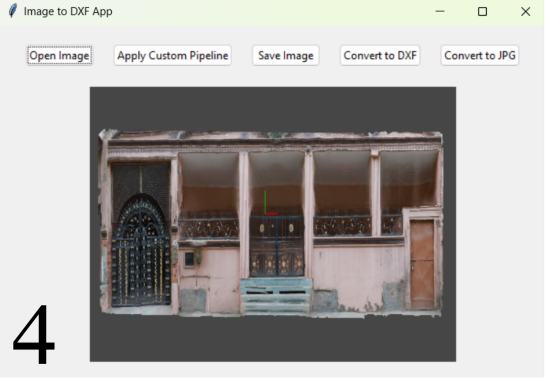


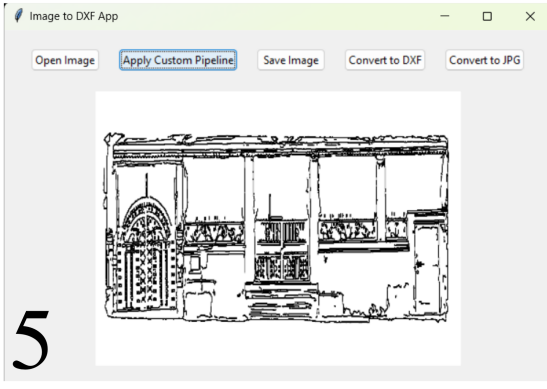
Methodology - Application Workflow

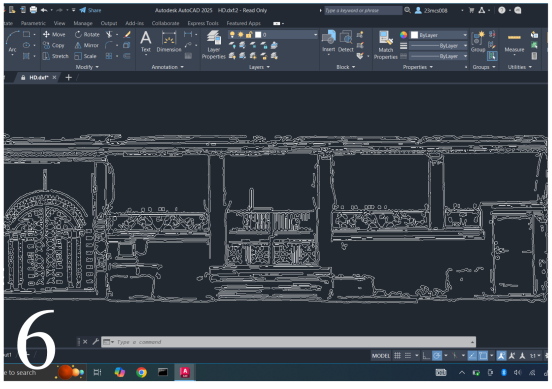












Results and Analysis

- The proposed model will be able to generates elevation drawings of buildings in DXF format, which can then be imported into Computer-Aided Design (CAD) software.
- These generated drawings can be easily scaled within CAD software to accurately represent the building's measurements.
- A robust edge detection pipeline extracts detailed contour information from the image, while effectively filtering out noise.

Conclusion

- The proposed model will be capable of generating building drawings with the desired accuracy while maintaining minimal computational requirements.
- This model offers a cost-effective solution for building documentation, requiring only a fraction of the cost compared to traditional methods.

References

- Nitin, J.S., Rohini, S.S., Sabarish, S.M., Srinath, S., Vidhya, R. (2010). Documentation of architectural scenes using a hierarchical method. *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences - ISPRS Archives*, 38, 293-298.

- Firzal, Yohannes. (2021). ARCHITECTURAL PHOTOGRAMMETRY: A Low-Cost Image Acquisition Method in Documenting Built Environment. *International Journal of GEOMATE*, 20, 100-105. 10.21660/2021.81.6263.

- Sefercik, Umut Aydin, Ilyas Nazar, Mertcan. (2023). Quality enhancement in digital twin production of complex architectures with integrated use of terrestrial and aerial images.

References (Continued)

Kurt, E., Çetin, İ. H., Sanli, F.B., Akpınar, B. (2023). 3D modelling of cultural heritage with point cloud generation by integratingUAV and terrestrial photogrammetry techniques. *Advanced Engineering Days*, 8, 83-85.

Bioresita, Filsa Hidayat, Husnul Kurniawan, Juan Purnomo, Setyo Grussenmeyer, Pierre. (2023). 3D Modelling of Sanggrahan Temple Using UAV Imagery and Terrestrial Photogrammetry Method. *IOP Conference Series: Earth and Environmental Science*, 1276, 012043. 10.1088/1755-1315/1276/1/012043.