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PRESERVATION OF ARCHITECTURAL MODEL INTO 3 DIMENSIONAL DIGITAL FORM WITH THE METHODS OF PHOTOGRAMMETRY

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ABSTRACT

Physical architectural presentation model is one of the most important mediums prepared by architects in order to provide a good immersion of visualized architectural details and massing of an architectural project. Ideally, good quality of physical architectural presentation models are done using a very high precision in detail, from the cuttings of the model to the small details of leaves in the scaled presentation model.

Unfortunately, these physical models throughout time will deteriorate, losing it's pristineness and finally have to be thrown into the garbage after a period of use. The cost of a single-scaled model can reach up to hundreds or thousands of ringgit if it is properly done and well made. Because physical models normally consume a lot of space, such as galleries or storerooms. Most of the older or non-important models are thrown away or recycled. In this research and implementation of the technology called 'photogrammetry', we find that it is a good idea to preserve these physical models into a digital 3 dimensional (3D) model instead of a photograph physical model. It has its distinctive advantages over normal portfolios by architects especially for job hunters in the same field. It is to show off their skills and talent in preserving their works in a digital format that are more impressive than common portfolios. Indirectly, photogrammetry methods are expected to drastically increase the immersiveness of a project than typical project presentation in boards and actual models.

The methods are to use digital hi-resolution camera (minimum of 5 megapixel) and to take as much as 60 to 70 percent overlapping images (minimum of 40 images) from elevations, top view and 360 degree of scaled architectural model and analysing it using photogrammetry generating software to develop the 3d mesh. From the 3d mesh, animations, simulations and even 3D orbit visualization of the model can be preserved and used for future needs such as presentations or analysis.

This method hasn't been applied to any architectural institution in Malaysia yet and it is one of the initiatives to preserve architectural models, whatever the quality is, as it has sentimental value for its designer. It is hoped that this method can be developed into a more comprehensive and easier equipment for these research objectives.

Keywords:
Architecture, Education, 3D Visualization, Modelling, Animation

INTRODUCTION

Architecture education has been discussed and improved throughout time by educators and practitioners all around the globe. Due to the NATIONAL POLICY ON INDUSTRY 4.01 announced by the government in 2018, it is crucial that by 2030 all digitalization in industries and education institutions will excel in every aspect. This includes how education and delivery of databases can be properly managed and make it accessible to all.

The education and architectural archive can be improved by using the new and latest technology of photogrammetry that is accessible to most modern devices available now such as digital smartphones with cameras, photography kits and sets and also softwares that can process the data. It has become a need now for almost everyone to have their own personal smartphone that can be used to scan and analyse any physical architectural model into 3 Dimensional data that can be preserved for future needs such as portfolio, architectural database (archive) and precedent study.

Physical architectural models done by architectural students through time will tend to deteriorate and become damaged. These models also need to use a lot of space within any facility or accommodation acquired by the students or the faculty itself. This will also increase the cost of renting or maintaining the space for these models. Perhaps only the exceptional models that are very important and impressive will be shown as exhibits. The need for more space to place all these models eventually will accumulate a large amount of spaces including its circulation for the exhibition.

Therefore, with the platform of photogrammetry that is accessible and affordable, it is believed that it will work to improve the collection of preserved architectural models into 3D form that can be stored in physical drive or cloud storage for future references. It is crucial for institutions such as architectural schools to acquire such technology for the sake of keeping all the data (model) into an accessible and yet reliable archive for the future.

LITERATURE REVIEW

Photogrammetry definition by Linder (2009), is measurement using light, mostly using photographs that have all the spectrum characteristics that define depth, distance and sizes that can be analysed into readable measurement and data. In short, photogrammetry is the science of measuring the world using images that are enough and can be calculated to create a 3 Dimensional data for digital usage for the third party. The accuracy of the measurements depends on the technology used, calculation methods and the availability of images that gives the information about the subject into a 3D space and realm.

Photogrammetry is widely used in many fields such as architecture, land surveying, industry and others that require measurements based on the real life structure or objects. It has been improved since the advancement of both hardware and software in the 21st century. It is important to understand as well that photogrammetry uses methods of mathematical measurement and calculations to create a database that is reliable and accurate. Lack of image accuracy such as distorted images or damaged images will affect the accuracy and readability of the measurements (Wolf, Dewitt & Wilkinson, 2014).

Application of photogrammetry in small scaled models can be improved with proper lighting and condition (such as dedicated photo studio) to improve the gradient and colour data accuracy for the software to the analysis to generate a more accurate and reliable 3D modelling for architecture Hallert (2016). Therefore, a proper setup, camera, lighting calibration and background are important in data collection (photoshoot) that can be used by the software to generate a more accurate and detailed 3D model. This can be seen in the proper setting used by a YouTube content creator, Grzegorz Baran (2021) in his testing of 'Photogrammetry Setup for Indoor 3D Prop Scanning' using sculpt model in his small studio setup. This shows the magnificent digitalization in photogrammetry to acquire a very good and acceptable detailing in 3D models for data preservations.

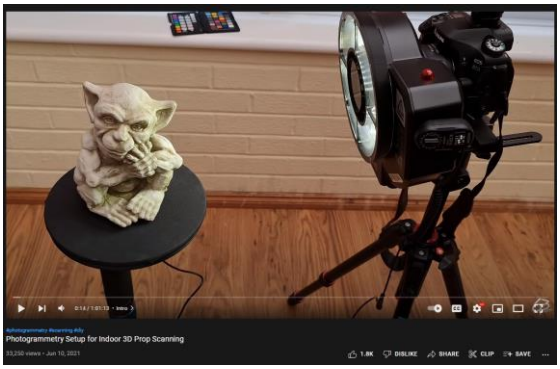

Figure 1.0 Screenshot of Indoor Photogrammetry Test Imagery by Grzegorz Baran (2021).

The same software and technology is used for aerial photogrammetry by surveyors when they need to acquire data for example, real-estate analysis and estimation. Such techniques have been widely used because clients can explore and analyse the land more accurately when using photogrammetry for their estimation input.

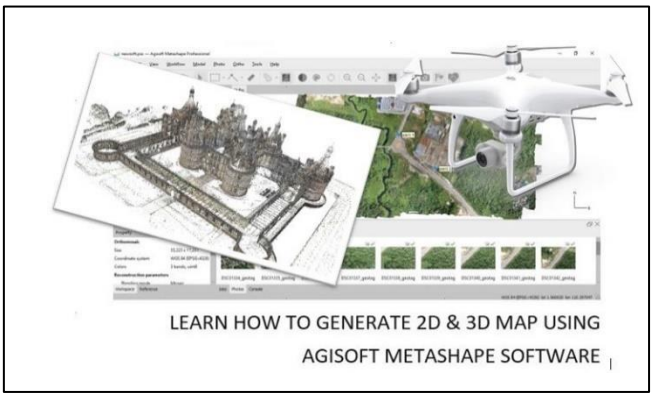

Figure 2.0 Screenshot of Photogrammetry using Drone by Suriyadil Mohamad (Kelab Drone Malaysia (2021).

METHODOLOGY

A free source software called Agisoft Metashape Professional (64 bit 2020 Version) is used for this experiment and data analysis of images taken in a small studio setup with proper artificial lighting to generate 3D models. Sets of images took using Sony Smartphone Camera that has proper image stabilization and image processing is used to took images (minimum overlaps of 60 to 70%) taken from all angles of the model (front, left, right, top, 360 degrees perspectives) transferred into the personal computer with the software to analyse.

Then, under the workflow tab, the 'align photos' process is done to analyse all the photos taken. This process uses the analysis of colours, shapes and patterns into 'align' settings before the next process takes place. This process sometimes takes about 1 hour to 5 hours to complete depending on the number of images, complexity and processing power of the respective computer.

After that, the process under workflow - 'build mesh' has been done to connect the 3D mesh analysed by aligned photos and a 3D model can be acquired for this. This 3D mesh then can be exported to other software such as sketchup, 3D Max or others that can be used later.

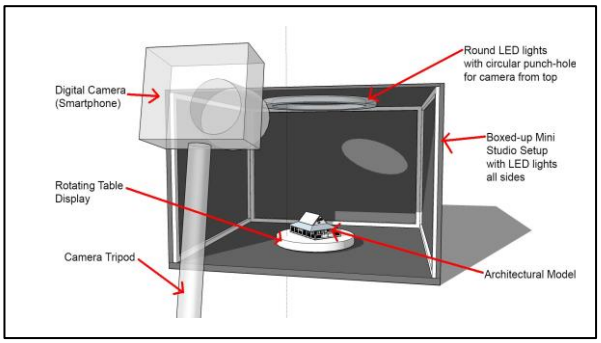

Figure 3.0 Architectural Model Mini Photogrammetry Booth Setup

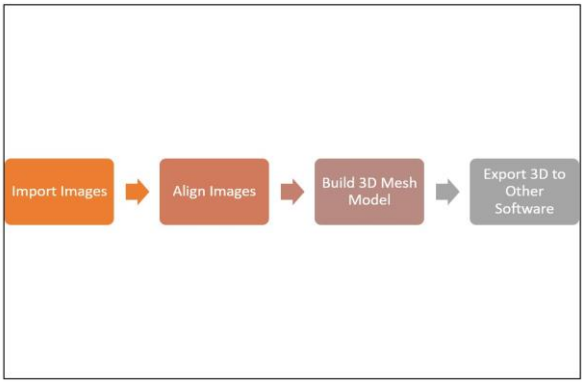

Figure 4.0 Flow of Process to Generate 3D model using Agisoft Metashape Software

FINDINGS

The 3D reproduction of the analysed photographs of the architectural model is 80% to 90% accurate with dimension. The 3D model accuracy and detailing can be improve by below methods:-

a) improving the image sharpness for every photos taken
b) number of photos taken (to get most information about the model)
c) 'depth' area of certain model that has inner details need to be taken photos as well to improve the model details
d) lighting fixture to enhance (stable and constant lighting)
e) software Random Access Memories (RAM) and processor (Computer Processing Unit, CPU) to speed up the mesh and images processing for 3D model construction.

Figure 5.0 Equipment used in the 'Mini Studio' setup for photography session

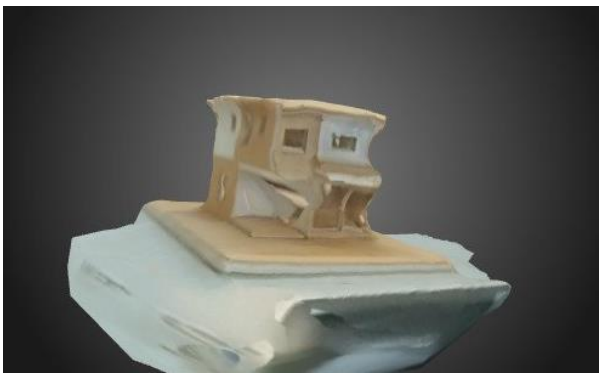

Figure 6.0 3D Images Result from Agisoft Metashape after the experiment (1st Trial)

The above Figure 6.0 shows the 3D mesh and mapping from Agisoft Metashape software after the 1st trial. It shows important data and analysis of 3D models and mapping even though not 100% - it is about 80% and the problem of 'melting images' effects due to the lack of images or triangulation process done.

Better equipment and image processing hardware and software are needed to improve this data collection process to obtain the objectives of the research. This experiment proves that with proper technique and devices, an archive of architectural 3D models can be stored and used for future research and references.

CONCLUSION

As education has evolved and achieved a greater level due to the improvement of both hardware and software, photogrammetry is a science that has a very good potential to produce a good result and achieve the objective of preserving architectural models created by architectural students. Thus, it improves the understanding of photogrammetry and skills of photography among lecturers and students as a whole.

Proper installation of the devices for this project research can enhance the result and all the methods can be used not only in architecture but also other fields such as arts and crafts. The possibility is endless and within proper time given to do more testing and fund, this can be a product that can be used by any other architectural institution to preserve their architectural model not only in a static photo for portfolio but also in a more immersive experience of the model.

It is believed that with this application, it can also be used in Virtual Reality (VR) and Augmented Reality (AR) platforms.

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