Ruiwen Wang

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Dr. Osama Olshaykh

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Photogrammetry: From Images to 3D Point Clouds

**Problem Statement**

Photogrammetry helps people gain a better view of the physical objects despite the geometrical distance between people and the object. Expanding people’s vision by turning the picture into a 3D point view. Generally speaking, photogrammetry collects data from the pictures that were token from different angles, allocating the points in the pictures, and calculating the changes in different position. It builds up the model by rendering an abundant data set and presents people a vivid view of things through the screen.

While photogrammetry can be widely be applied to different fields and facilitates people to build the projects in an efficient way. There are some disadvantages of the photogrammetry, the amount of time required to process the data collected from the pictures are tremendous. Also, the mapping from a 2D image to a 3D vision could be costly. Thus, to find a high efficiency algorithm to run the program while the accuracy of the model is accurate is going to be a challenge for this project.

**Applications**

Creating models through photogrammetry has eliminate abundant obstacles for people to build their projects, such as, time constrain, and terrible geometric condition that will prevent people to go on a fieldwork. It could also be a useful tool to detect the circumstances during natural disasters. Photogrammetry has definitely added a lot more flexible ability to people as well. The application of photogrammetry is extremely broad, areas like real estate, construction, entertainment business, civil engineering, geophysics and so on. Photogrammetry has definitely added a lot more flexible ability to people as well.

The transformation of images to 3D views provide a convenient and efficient life for human beings in multiple ways. It could be useful for research purposes, business and commercial purposes; it forms a user-friendly platform for people from different fields to gain a better view of things. A better vision for people to see things on the screen from a direct, vivid and multidimensional point of view.

**Literature Review**

Several approaches were found while researching online. One of the approaches was to assure the number of images. To be specific, taking a large number of images from different angels and measuring from points to points. Always move while taking the pictures, so that we could collect as many details as we could from different angles. Complete the loop while taking the pictures, which mean to make the starting point and the ending point the same. The more details of the object capture, the easier to produce a precise model. However, while improving the quality of the product by taking as many photos as we could, the data processing time at backstage could be a real problem for us. Finding a reliable data structure to adapt to the project would be useful.

**Open Source Research**

Other approaches were using database method to reduce the time complexity while processing the data of the images. One of the project name was called “3D Point Could Reduction using Mixed-integer Quadratic Programming” by a group of people from the Carnegie Mellon University. They tried to estimate the 3D pose from the camera by “finding the correspondence between 3D points from a database and 2D points from the image captured by the camera”. Their algorithm was able to reduce the database of the 3D points, sorting the correspondence they found into a query and ensured user to get the desired output.

**Conclusion**

Machine learning techniques are also considered in apply to this project. Seeking methods that could be implemented in point generation. Also, a better way to scan the view with more detail but less time. The research of different approaches will be continued as the time goes. Getting to know more about the machine learning techniques such as, CNN(Convolutional Neural Network), shared MLP(Multilayer Perception), and PointNet++.

**List of Open Sources:**

<https://planningtank.com/geographic-information-system/applications-advantages-disadvantages-of-photogrammetry>

<https://guidehouse.com/insights/healthcare/2022/blogs/what-can-digital-twins-do-for-healthcare?utm_source=google&utm_medium=cpc&utm_campaign=digital_twins&gclid=Cj0KCQjw6_CYBhDjARIsABnuSzrjgqQo1f51PACDLrlkwuVbDbkh_yxgC4nApGHb0_GBZnL2vIwSpIkaAvUzEALw_wcB>

<https://www.takeoffpros.com/2020/06/16/what-is-photogrammetry/#:~:text=Photogrammetry%20gathers%20measurements%20and%20data,ground%20or%20from%20the%20air>.

<https://info.vercator.com/blog/speed-vs.-accuracy-do-you-need-to-compromise-when-it-comes-to-point-clouds>

<https://www.cs.cmu.edu/~hyunsoop/cvpr13.pdf>

https://www.scitechnol.com/peer-review/photogrammetry-is-used-in-surveying-and-mapping-by-using-photography-NBr6.php?article\_id=11683

<https://www.quora.com/What-is-the-importance-of-photogrammetry>

https://www.analyticssteps.com/blogs/deep-learning-overview-practical-examples-popular-algorithms