A2_9 Sprint 1 Presentation

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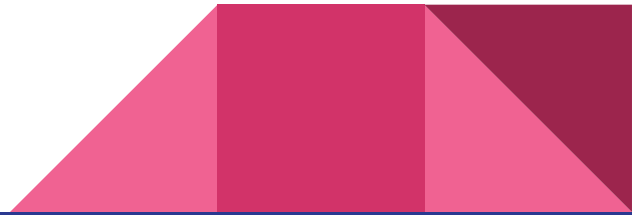
Product Mission

- Certain algorithms and techniques involved in the generation of point clouds can use too much resources or are inefficient depending on various elements.
- Our project mission is to evaluate the technologies involved in the generation of point clouds and optimize a factor in its pipeline
- Our main interest is to improve the performance of reconstruction using deep learning
- Our focus at large is to allow field scanning work in heterogeneous environments to either be sped up or for computation on the edge to be adequate



Users

- Users who are well versed in the field of photogrammetry
  - Researchers, Students, Professors, Universities
  - Field personal
  - Start up companies
- Users who are not well versed in photogrammetry
  - Investors
  - Manufacturers
  - Restoration enthusiasts
  - Architects
  - Farmers
  - Land Surveyors

User Stories

- For Students/Universities
  - Builds a more direct webview to show the directions on campus. The students could gain a better idea of where their class will be and what the classrooms are going to look like prior to a new semester start.
  - Showing accurate details about the campus, useful for the university to advertise their campus online; the applicants could get a campus tour online, and the view could be as vivid as they are physically on campus.
- For Farmers
  - Using a drone to have an overview of their ranches for some specific items. Also get a more explicit 3D reconstruction image of the whole situation of the farm.
- For Old People
  - An app on their phone would help reconstruct virtual images of their family members who are far from home. Let them talk as if they are at the same space and bring some comfort.

Literature Review

- In response to current problems of poor 3D reconstruction and the inability to guarantee the quality, nowadays researchers are focusing on 3D reconstruction methods based on drone aerial photography sequences.
- The needs of 3D reconstruction technology in the fields of urban development, cultural relics protection, virtually reality, industrial and geographic surveying are becoming intense.
- At present, UAV image sequence structure to improve speed, compressing the feature points of each image into three principal component points, and analyze their relationship. And dense point cloud uses texture map fusion method to achieve fast 3D reconstruction.
- Mapping relationship based on sparse point cloud features and dense point cloud features were used in a parallel optimization framework.
- Recent models based on PointNet, real-time inference is still challenging.
- Moreover applying Deep learning techniques on 3D point clouds is also still challenging due to the small scale of high quality datasets to train on, higher dimensionality and unstructured properties of 3D point clouds.

Deep Learning algorithm for photogrammetry

- **CNN, SO-Net, Ellipsoid Net, pointwise CNN, ECC, PointNet, SGMNet, PAT, Spec-GCN, PointGrid, Point CNN, DGCNN, PCNN, Point Conv, A-CNN, Point2 Sequence, PointNet++, PointASNL and so on.**

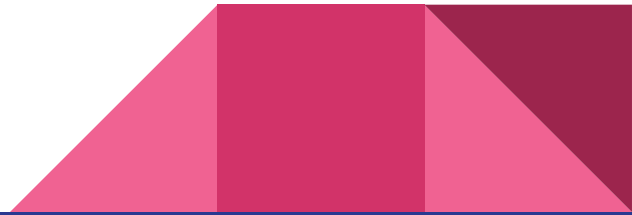
- **Using pytorch to initially test existing algorithms above, and PCL to generate 3D point clouds data and then try to improve the performance.**

Open source code for 3D point cloud

- GitHub - udacity/SFND_Lidar_Obstacle_Detection
- https://github.com/sshaoshuai/PointRCNN
- https://github.com/chenhsuanlin/3D-point-cloud-generation

MVP

- Our MVP is to improve the performance of a factor in the photogrammetry pipeline using machine learning
  - Optimistically, we would like to create this machine learning method in Pytorch as its a very mature machine learning framework
    - One of our group members also owns a powerful Nvidia graphics card so local development would be a lot easier on Pytorch
  - As we explore the world of photogrammetry we will update the MVP with our preferred factor in the pipeline to optimize. For now, we are interested in mesh reconstruction

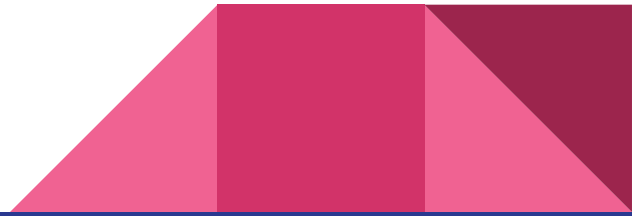


MVP User Stories

- As a researcher, I would like to have all the necessary information to install the script in an easy to access repository to evaluate our groups testing methods for optimization of the photogrammetry algorithm.
- As an employee in a startup company, I would like to run this software (preferably as a .exe) and have the script explain how well the optimization of a factor in the photogrammetry pipeline worked

Technologies to evaluate

- Pytorch 3d and PCL library in the generation of 3d point clouds and the reconstruction of images to 3d models
- Lidar sensor technology and algorithms involved in reconstruction of 3d data on the edge with drones
- Deep learning methods in predicting mesh models from point clouds
- Study common Photogrammetry software like 3df zephyr



Next Sprint Goals

- Research what aspects of the photogrammetry pipeline can feasibly be optimized
  - Research the various ongoing deep learning developments with 3d reconstruction
- Set up Development Environment for our members
  - Have group members install Python if not already installed
  - Have group members install C++ if not already installed
  - Install Pytorch 3d
    - Run Pytorch 3d tutorials
      - (reach goal) Start tutorials specific to 3d model reconstruction
  - Research PCL and potentially install
    - Run PCL tutorial
      - (reach goal) Start tutorials on generation of point clouds specific to 3d models.
  - Research current photogrammetry software like 3df zephyr
    - Start free trial and test software out

References

- Linking Points With Labels in 3D: A Review of Point Cloud Semantic Segmentation
- Deep Learning for 3D Point Clouds: A Survey
- Deep Learning on Point Clouds and Its Application: A Survey
- 3D point cloud data processing

Thanks for watching