Faster and smarter photogrammetry capture

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Agenda

- Intro
- Other solutions
- Photogrammetry basics
- The camera rig
- How it works
- The equipment
- Where I am today
- Future work
- Questions

Intro

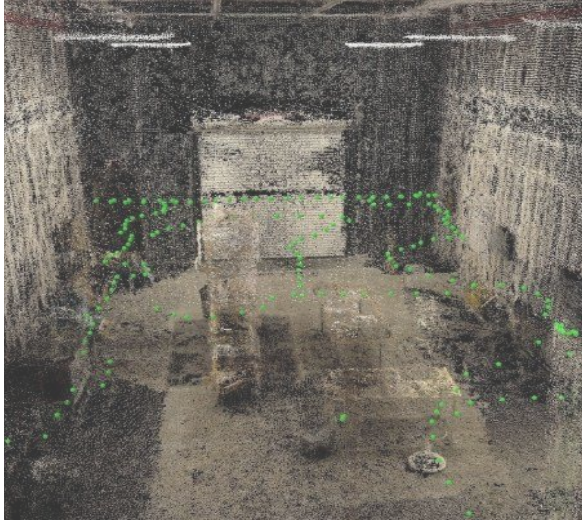
Capturing large spaces is more complex than small scale object photogrammetry.

Good images is key to good photogrammetry processing.

Three fundamental concepts are:

- Images have parallax/disparity.
- Image plane is parallel to the surface being scanned.
- Good image dataset contain consistent image overlap.

Intro



Taking photos manually can lead to inconsistent image overlap.

Outdoor or large space photogrammetry is challenging.

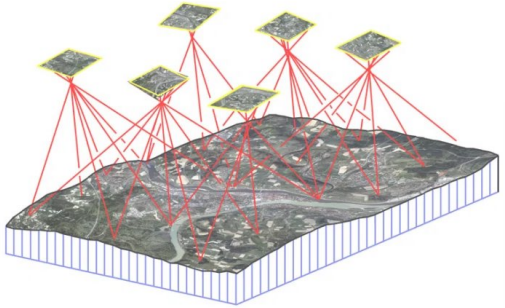
- Challenging to keep track of where you photographed and where you didn’t
- Challenging to be consistent in the distance between images
- Not having taken enough photos.
- Image capture is time intensive.

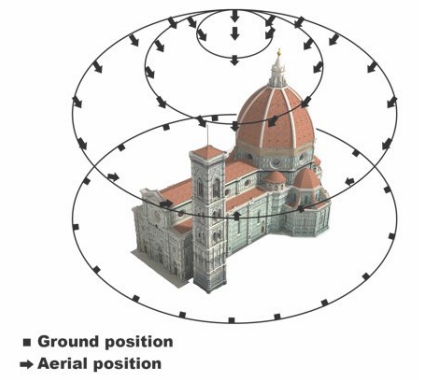
No feedback system.

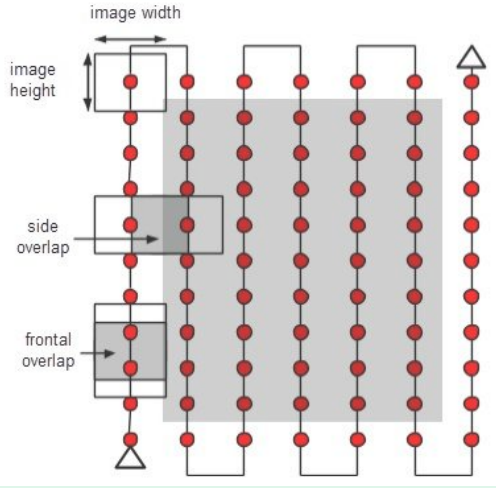
Existing solutions

Drone Images

- Great for large outdoors areas with unrestricted view of the sky
- Captures scale.
- Only good a top down photography.
- Not always possible to deploy a drone.
- No way to deploy in non-GPS areas.







Existing solutions

Lidar

- Great for context and scale.
- High accuracy
- Large range
- Poor for detailed textures.
- Expensive!

Camera Rig

Goals:

- Speed up the photography process.
- Bring a little more order to semi-random photography process.

Experiment and merge some technologies into something new.

Ability to capture a rough context of the space to tie together images of walls, floor, and the general environment.

Speed

Increasing number of cameras decreases scan time by same amount.

Camera positions should have a meaningful relationship to one another.

More cameras is not always better.

Image parallax

Overlap is governed by:

- Distance to object
- Distance between cameras/images
- Lens Field of view

Ideal image overlap is 60% - 80%

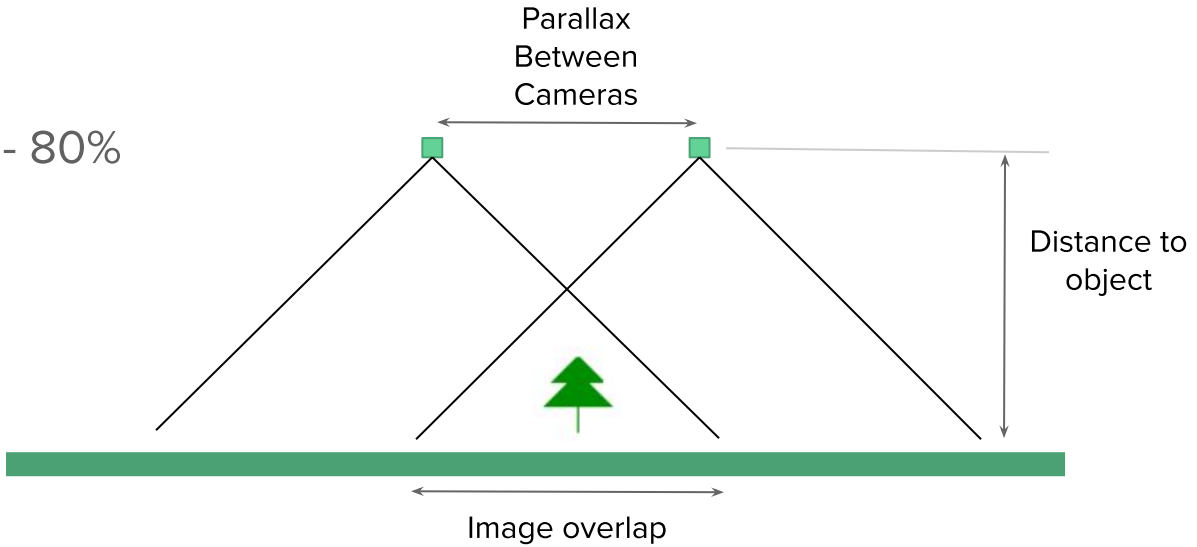
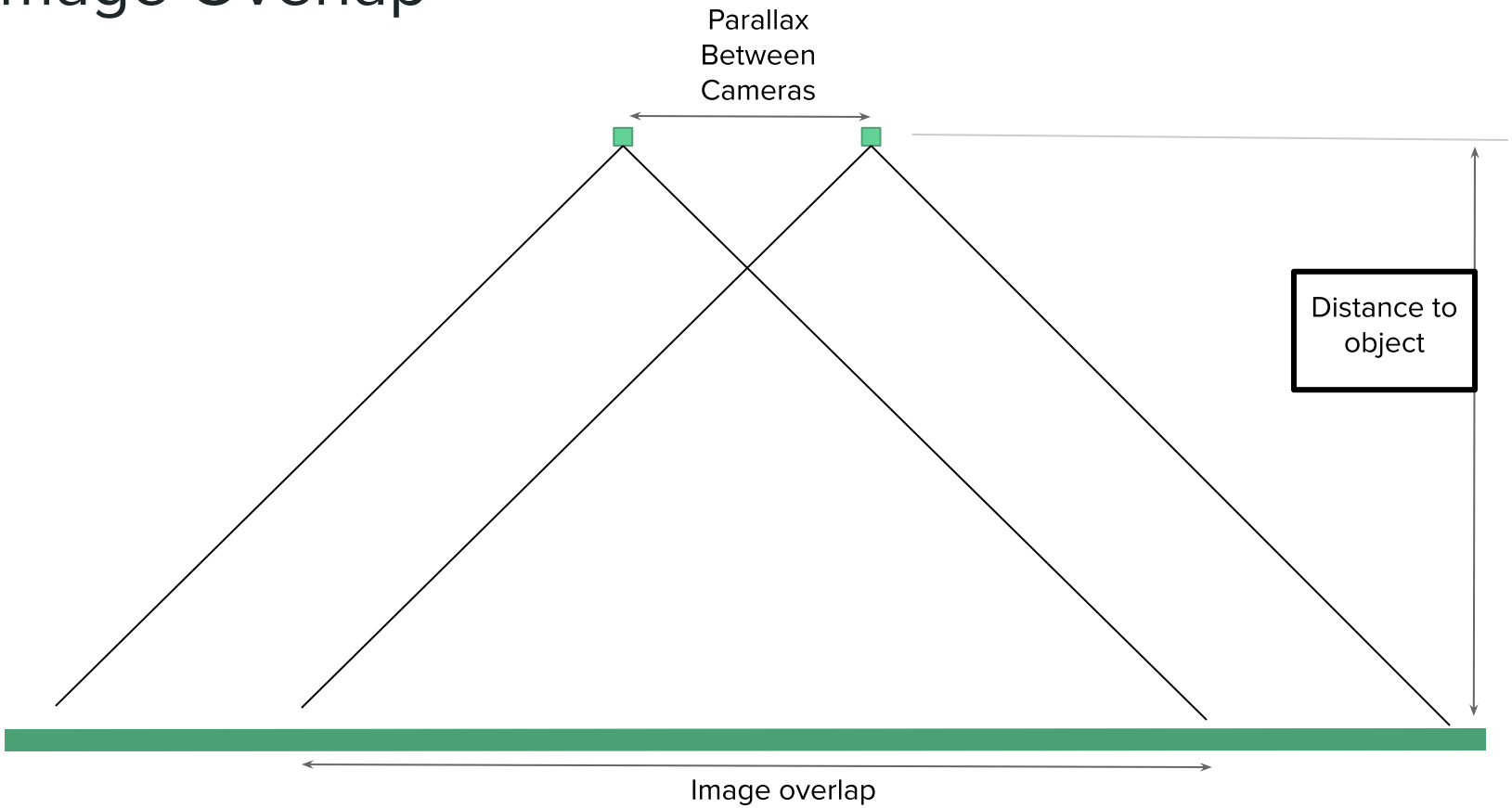
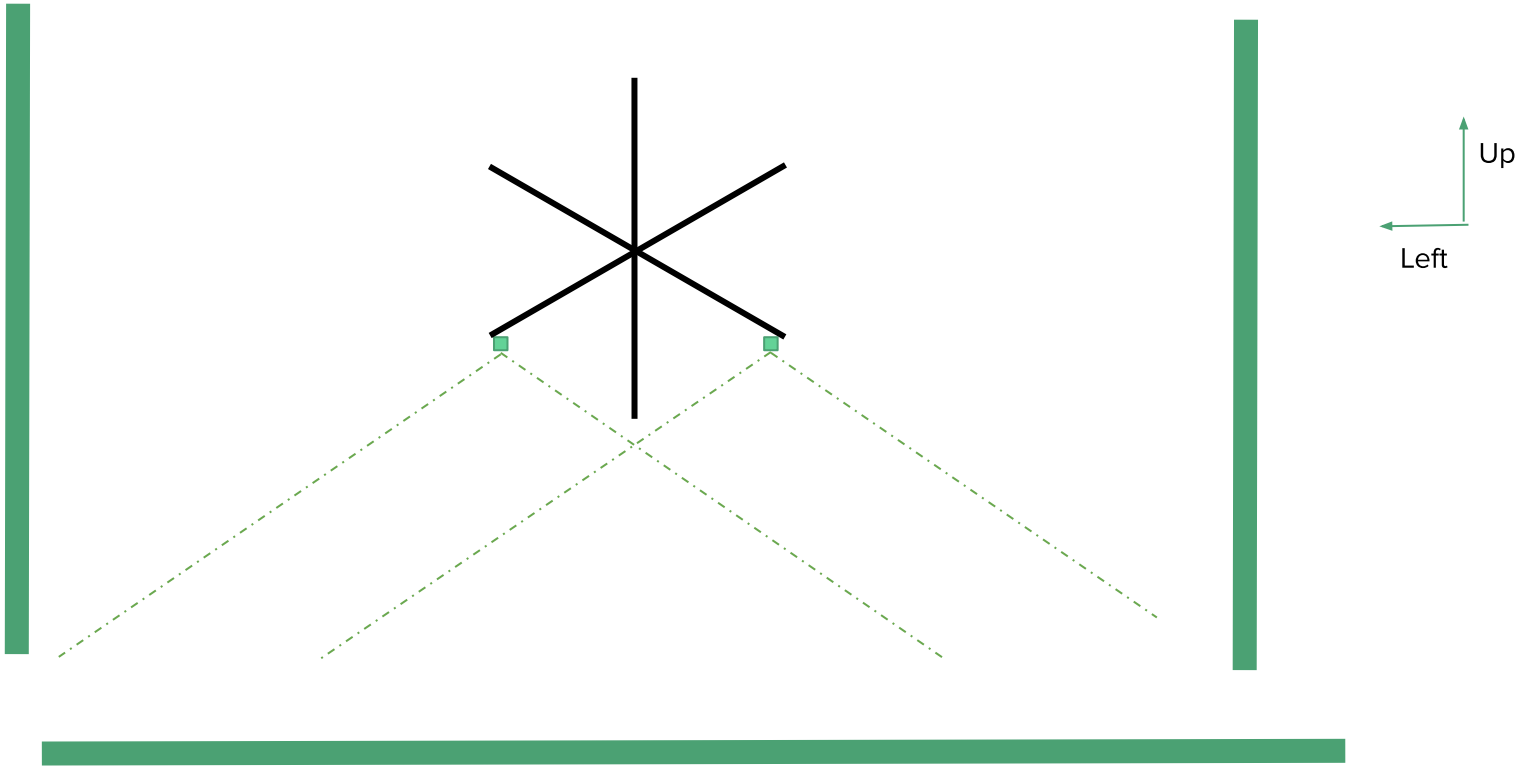


Image Overlap



Camera arrangement



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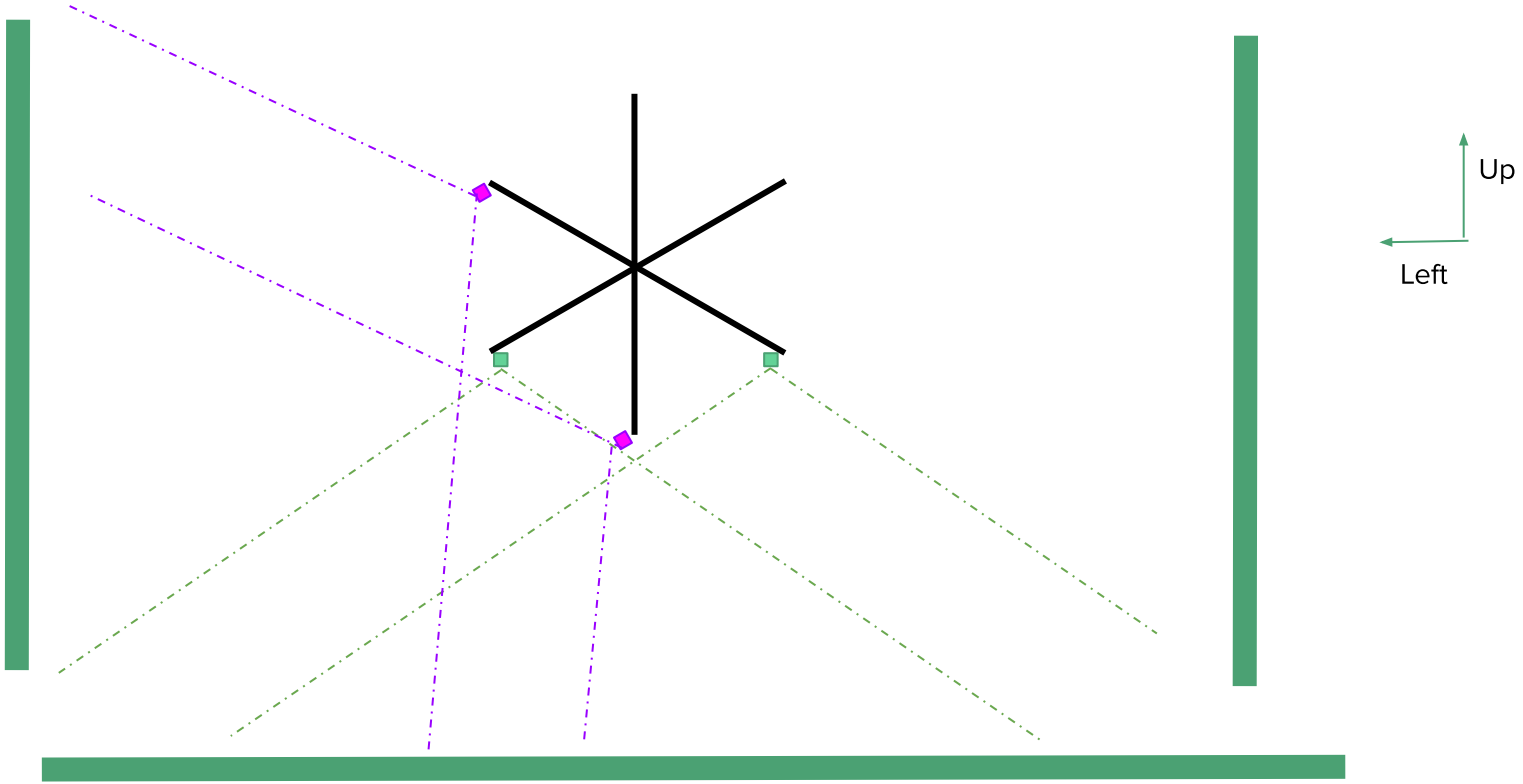

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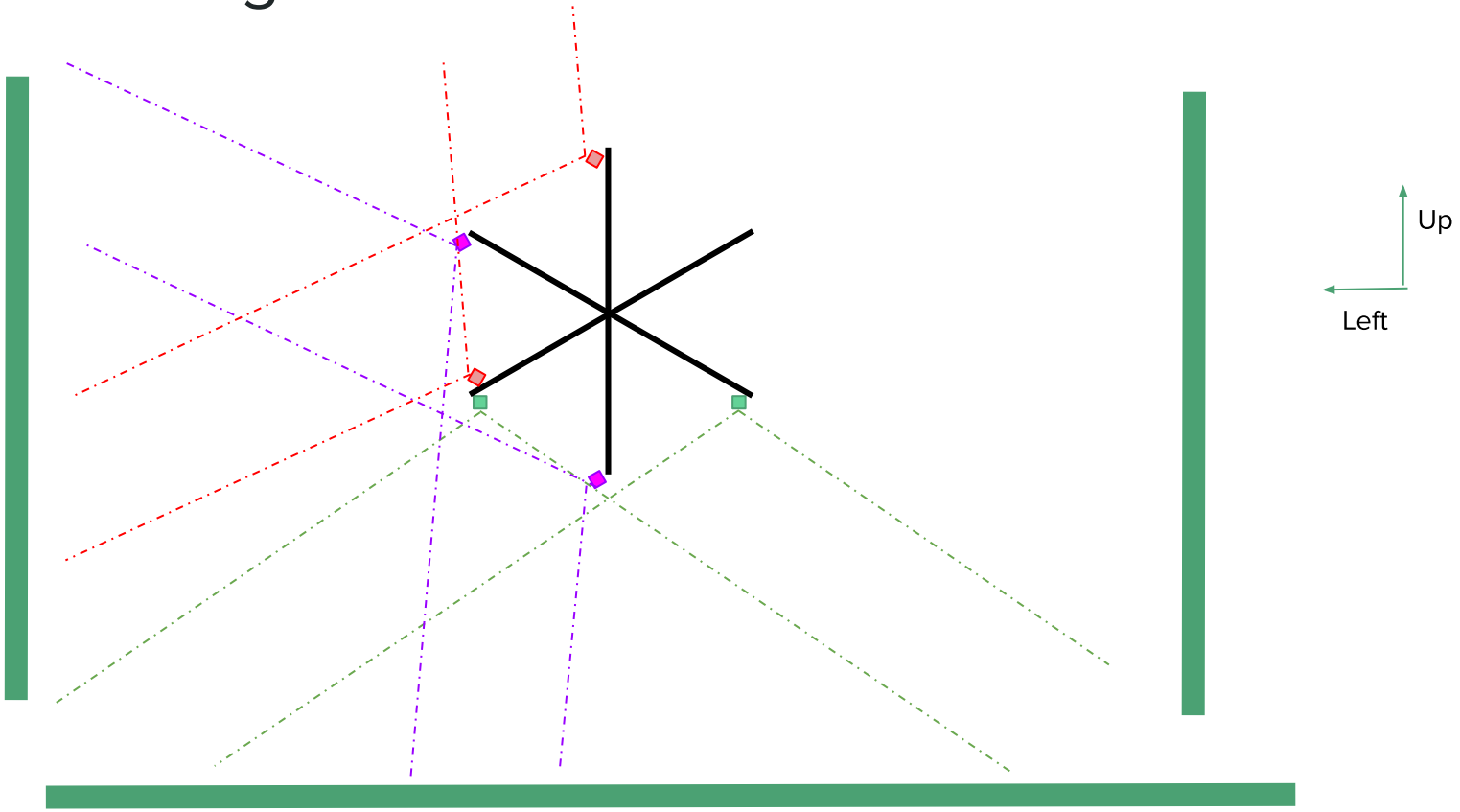

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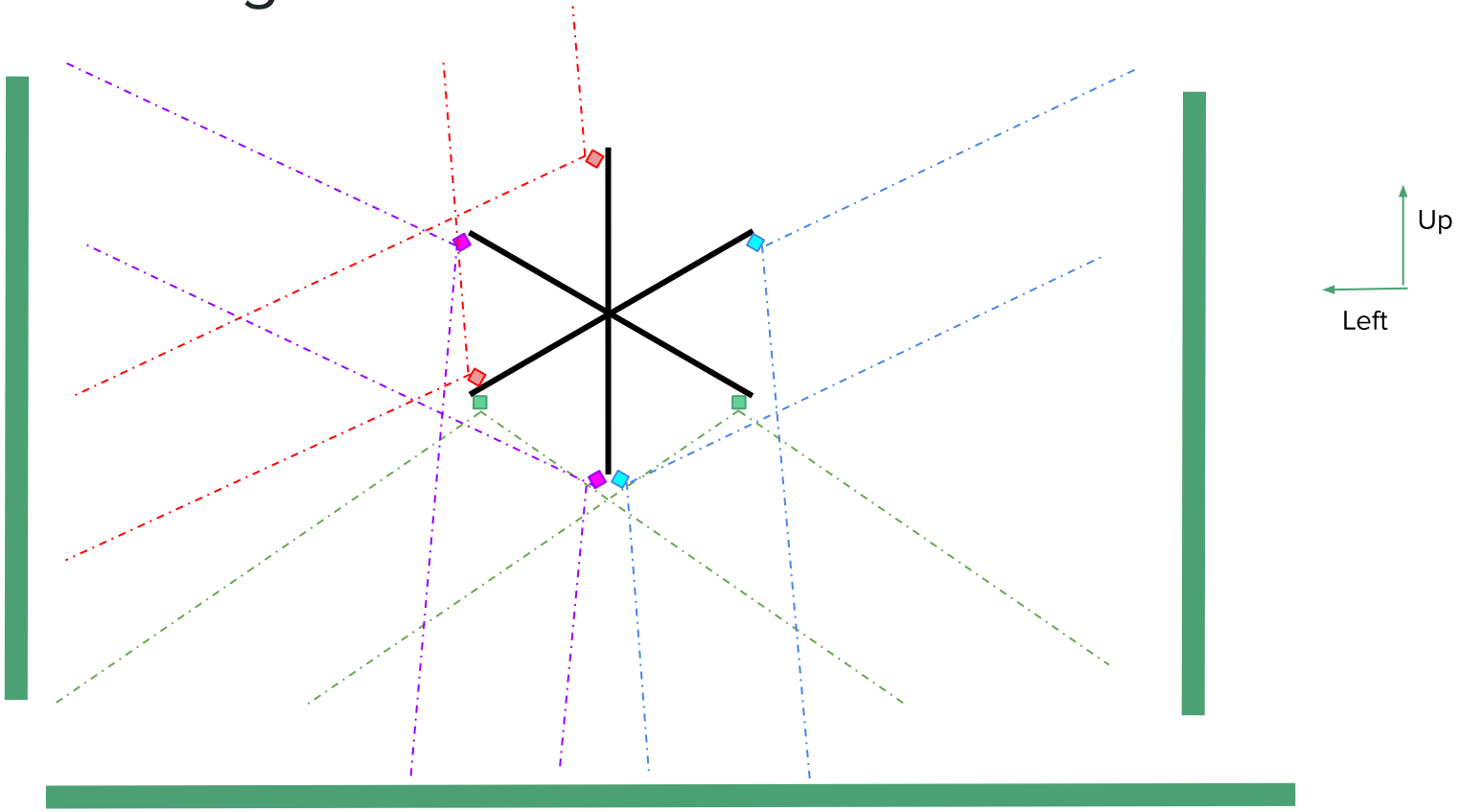

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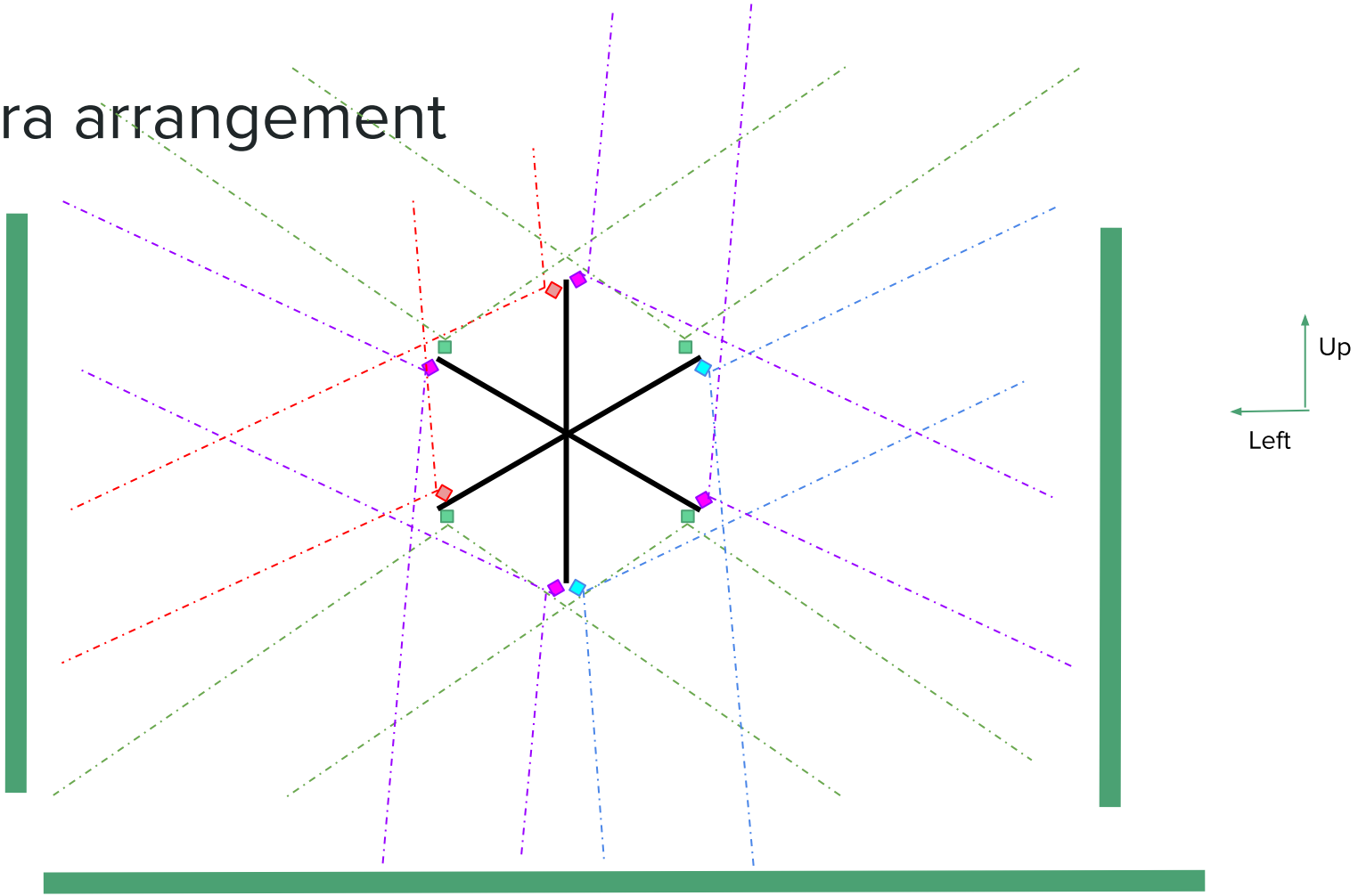
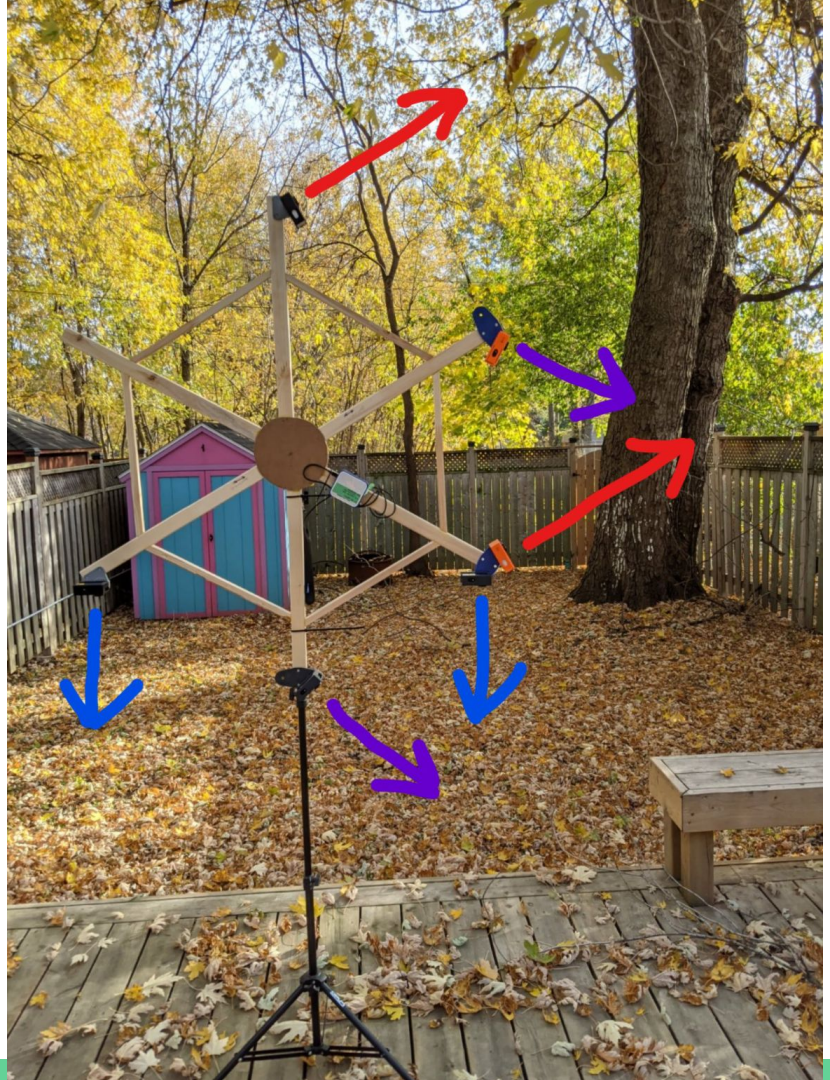
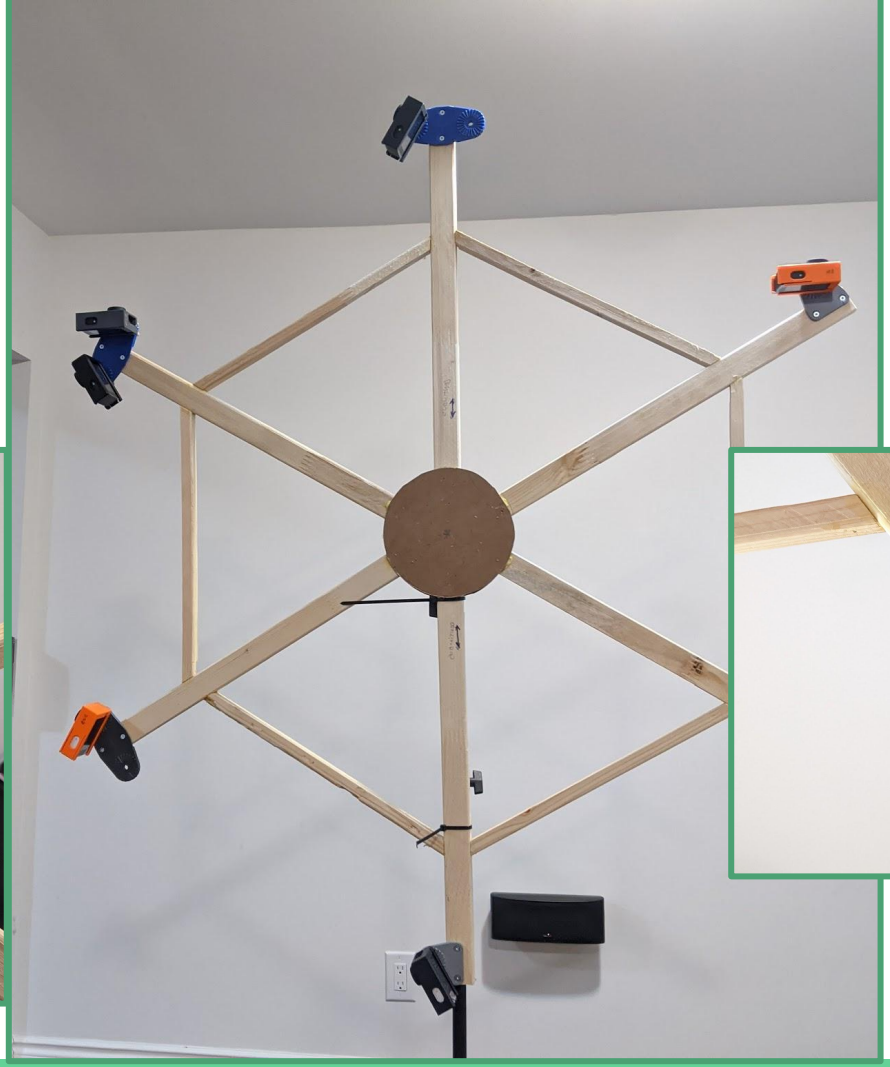


Rig Prototype



Rig Prototype

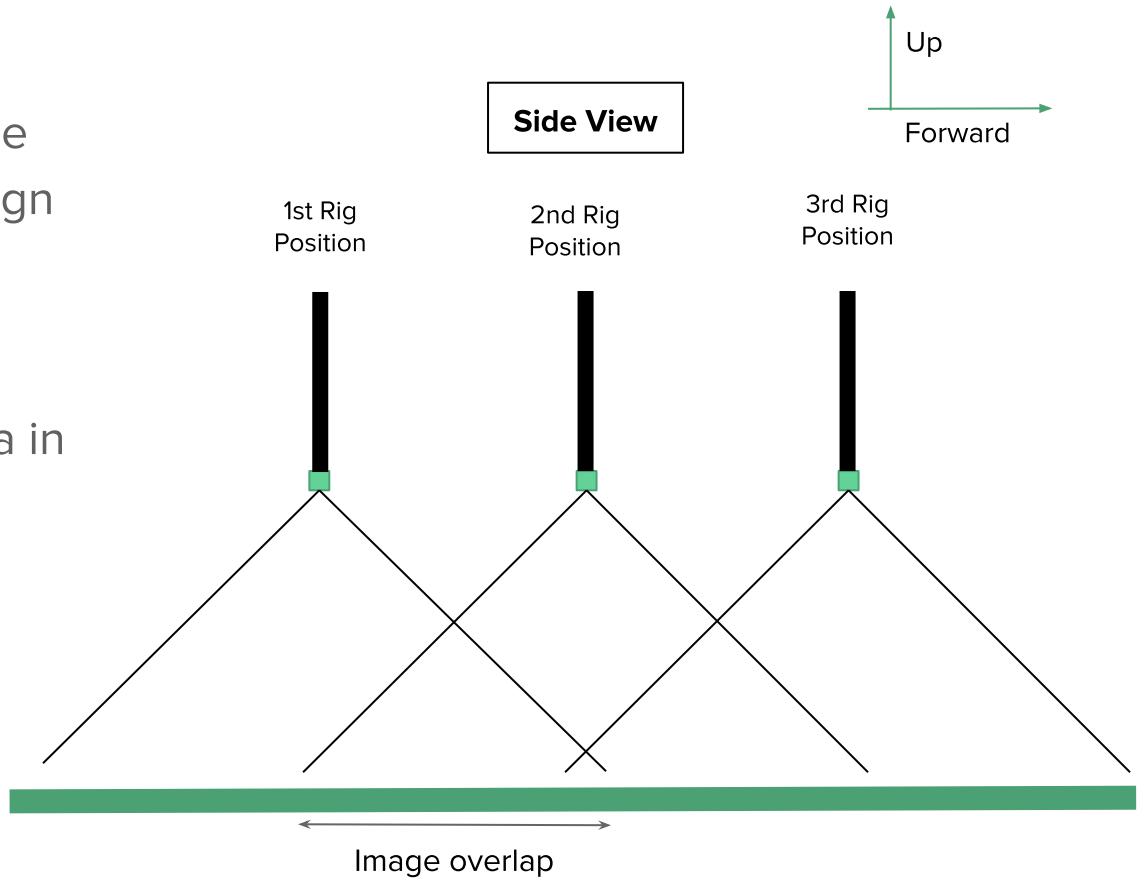


Moving forward

To achieve a complete scan of the area, all rig positions needs to align to their neighbours.

All cameras at each rig positions need to align to the same camera in a neighbouring rig position.

How to ensure image overlap between scan locations?

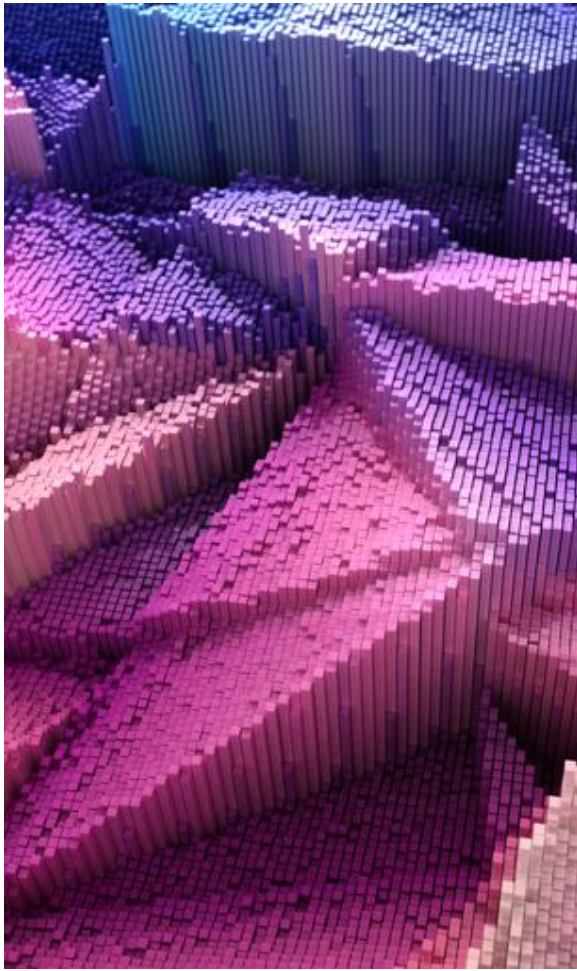


VSLAM / Visual odometry

Visual SLAM (Simultaneous localization and mapping)

Devices are available which track their positions through a vision system.

Provide the user with position data in 3D space.



Motion Optimization

Be systematic about the image capture.

- Rig consists of 12 cameras spread around a hexagon frame.
  12 images are taken from each scan location.
- Relative position of each camera to (each other) is know.
- Each scan location pose is recorded by a VSLAM system.

Other benefits

Since the location of all 12 image cameras is know relative to the VSLAM unit, the position of each individual image camera can be calculated.

Benefits:

1. Speeds up image alignment step since image location is already know.
2. Scale is added to the 3d model.

Operation

User selects desired image overlap.
System ensures desired image overlap is maintained.

User sets up initial rig location and initiates data capture.

- 12 images are recorded.
- VSLAM guides user to next rig position.
- Repeat

Experiments

Experiments

Scans

3D capture of my back yard.

https://construkted.com/asset/avgcnh5g1mu/

3D capture of a nearby park.

https://construkted.com/asset/a4pgbgx77ey/

Camera

Camera is a Yi4k action Cam. Controlled through WiFi.

- Cheap
- Light weight
- 12 megapixels
- DNG RAW
- 12mm (35mm eq) focal length
- 112 x 90 deg field of view

VSLAM pose data

Intel RealSense T265 is a VSLAM vision+IMU integrated system which outputs a 200Hz stream of pose date.

Pose data consists of x,y,z position in space (relative to starting point) as well as rotations (around the x, y, z axis).

The pose data is saved each time an image capture event is triggered.

https://www.youtube.com/watch?v=NonBIt-wKCI

Compute

Raspberry Pi controls everything.

The RPi receives the T265 pose data

Guides the user as to how much they should move to achieve desired image overlap.

History of all rig positions is recorded.

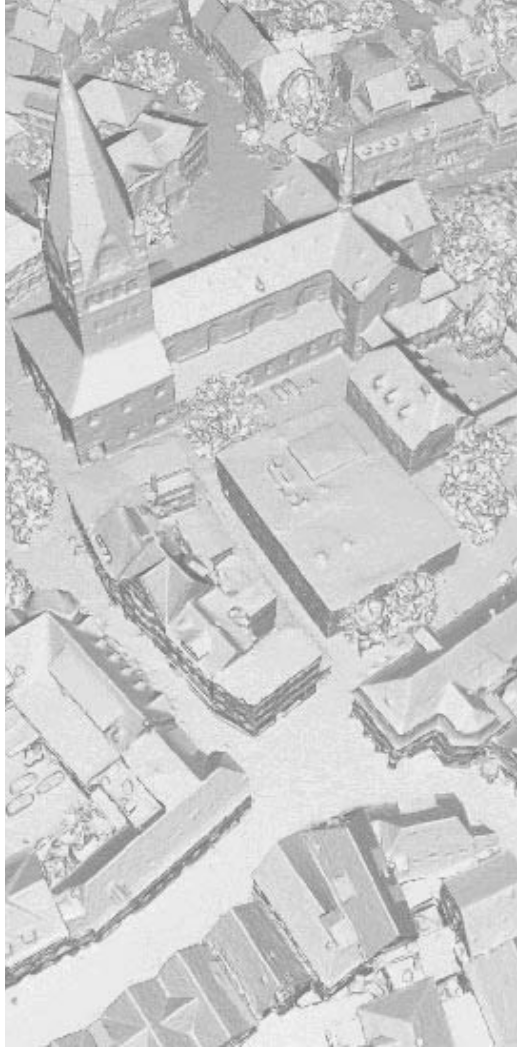
Current state of affairs

Working

- Image capture
- Yi4k cameras can be configured and triggered remotely
- Wifi communication to cameras
- Rig to mount all cameras
- All electronics powered from USB power bank

Not working

- Raspberry Pi and T265 not playing nicely.
- No GUI setup on the Pi display to guide user.



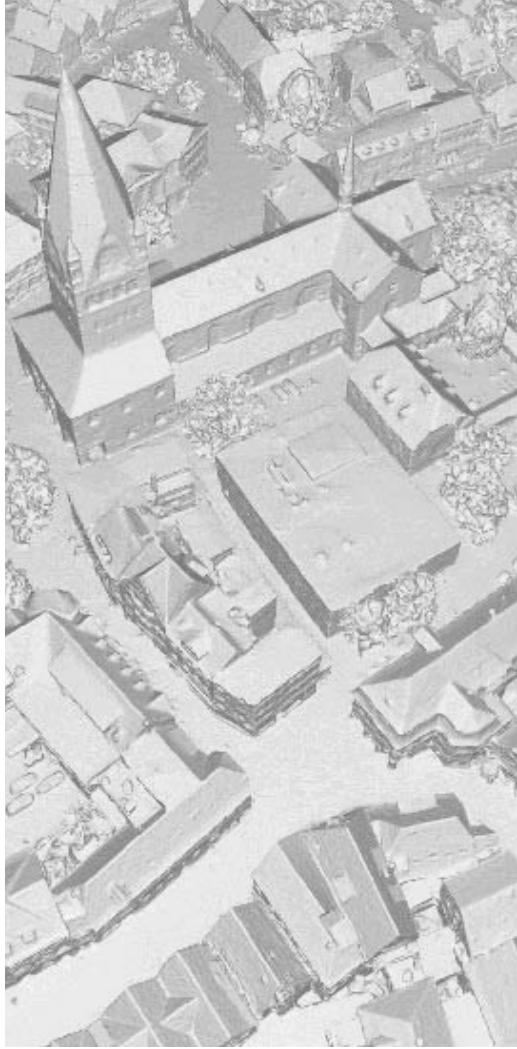
Next iteration

Allow for various cameras

- Raspberry Pi Zero W with HQ camera module.
- Any generic action cam/small mirrorless camera

Foldable and lighter weight frame (CF tubes?)

Include GPS and magnetometer for absolute position and orientation.



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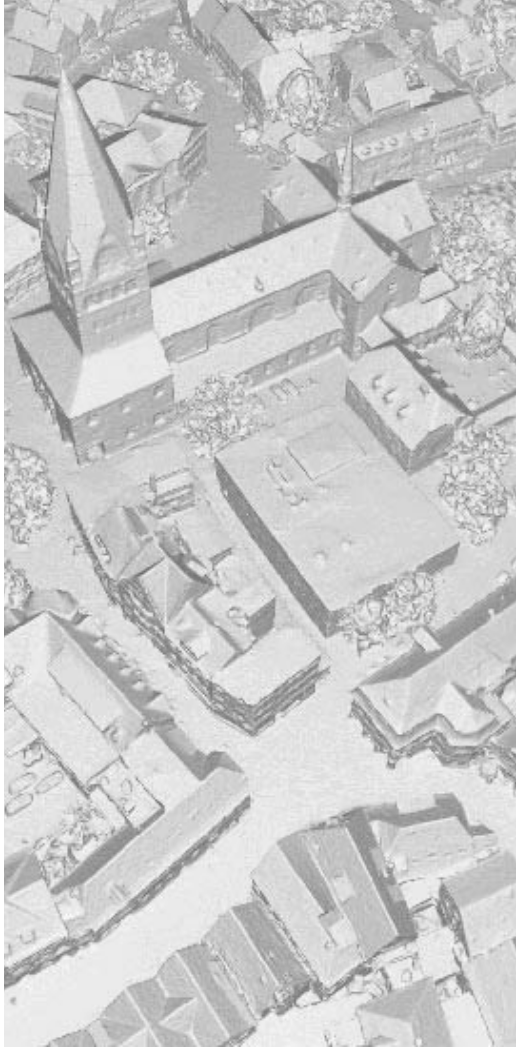
Comments and suggestions are welcomed!



Questions?