PS1
HBCSE Presentation

Converting 2D Images to 3D Model

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INTRODUCTION

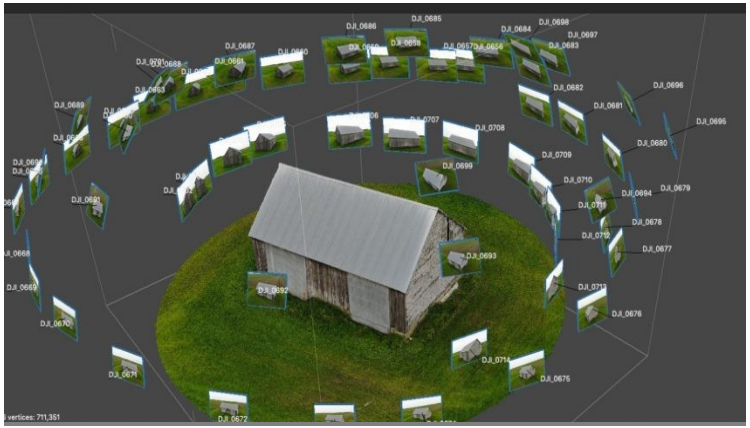
- What is Photogrammetry?
- How does it work?
- Comparison b/w openMVG-openMVS and Meshroom
- Code for extracting non-blurry frames from a video
- Turntable Design
- Controlling the turntable
- Insect Database
- Web app
- Documentation

Drawing

Light ⟸ Photo-gram-metry ⟹ Measurement

Aerial

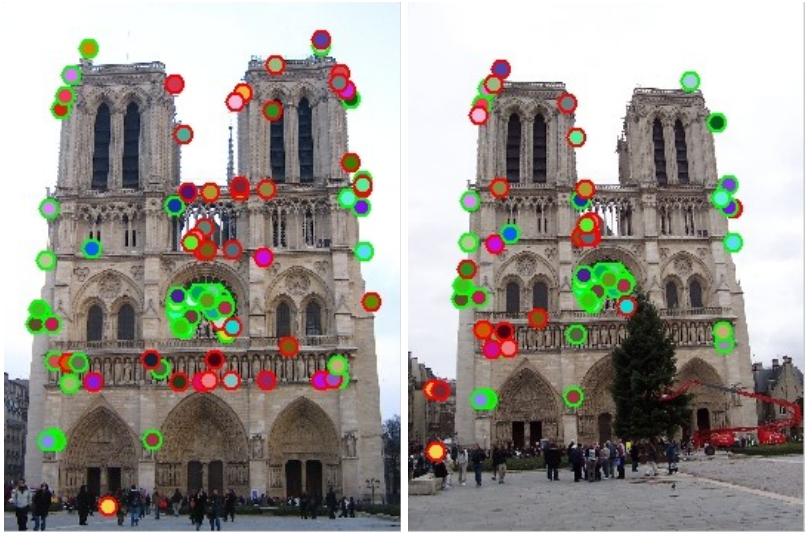
Stereo(Close Range)

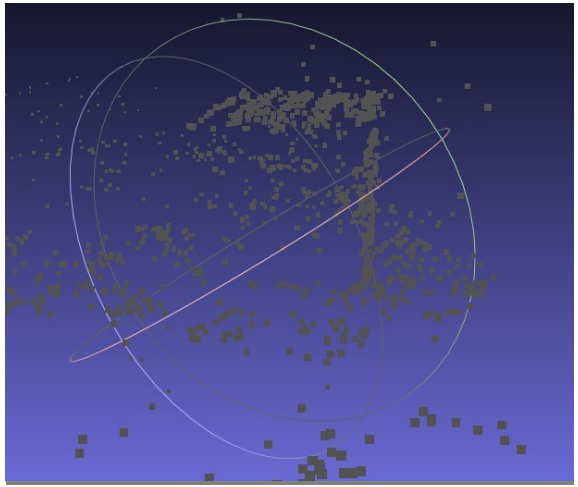


How Does It Work?

Step 1 - Feature Detection and Matching (SfM)

- Image Matching
- Structure from Motion

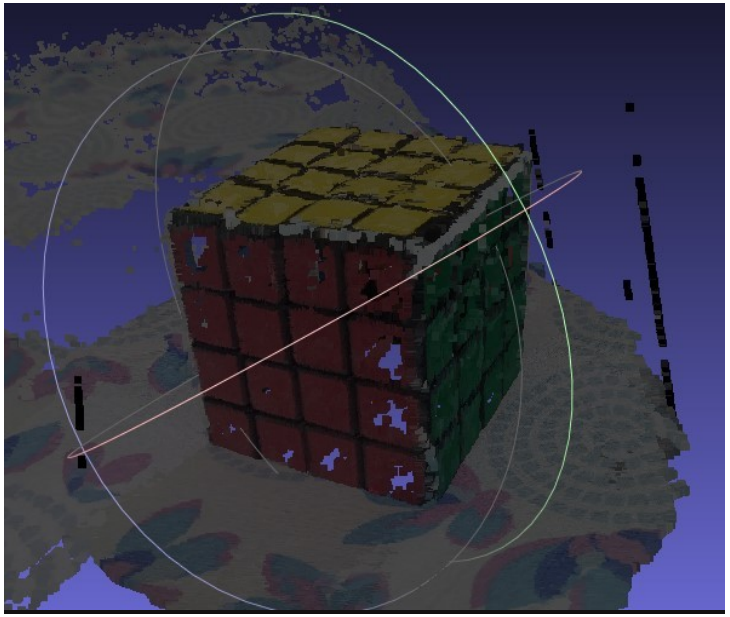




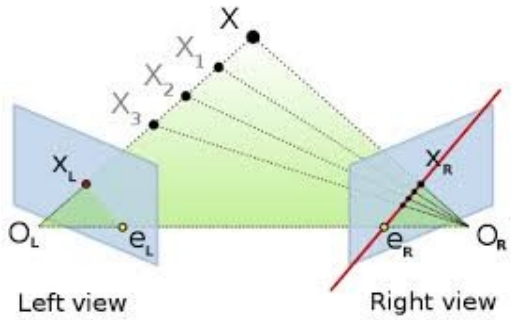
Step 2 - Point Cloud Densification

Outcome

- ➔ Increases number of points
- ➔ Gives clarity and detail



How?



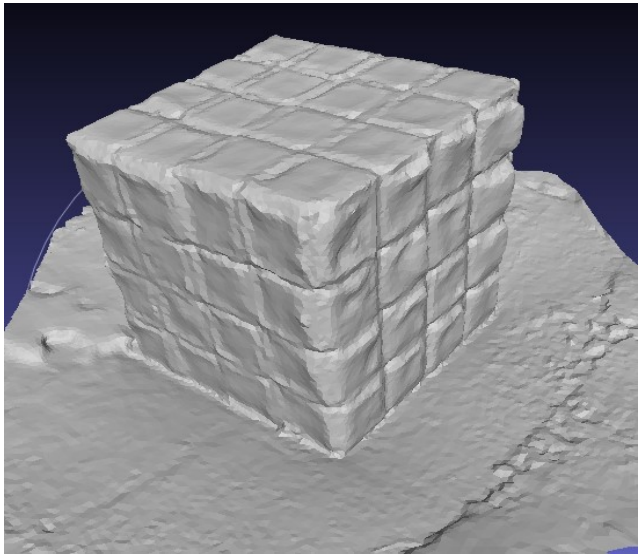
Step 3 - Mesh Reconstruction and Refinement

Reconstruction

- ➔ Any three points define a plane
- ➔ Group of planes defines a surface

Refinement

- ➔ Decimation of the mesh
- ➔ Lower computation time for texturing

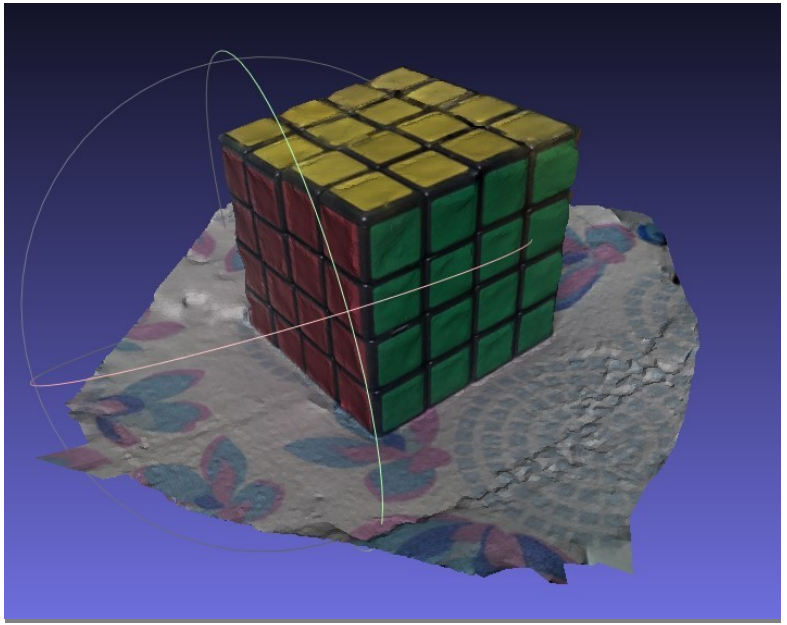


Step 4 - Texture Application

White Mesh

.png
file

Coloured Mesh



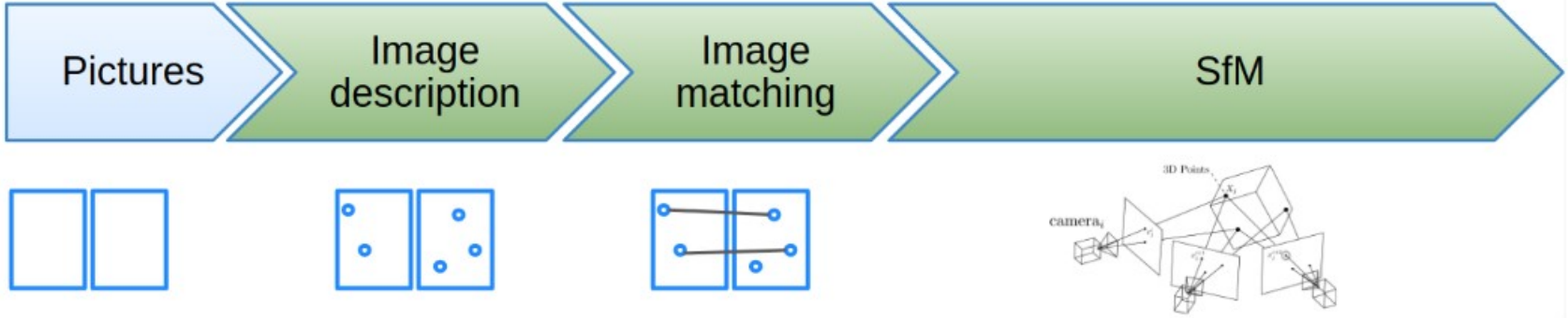
Software/Libraries

- openMVG and openMVS
- Meshroom
- COLMAP
- VisualSFM

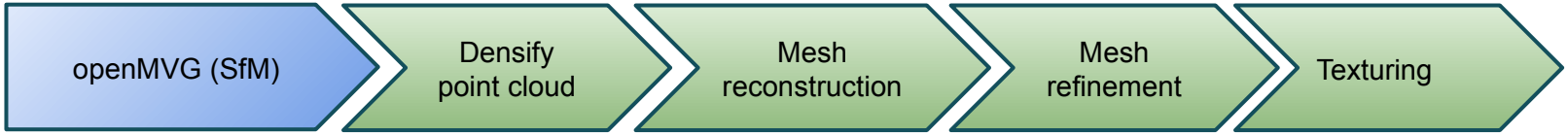
openMVG - openMVS

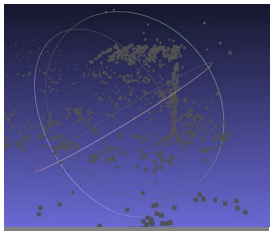
openMVG - open Multiple View Geometry

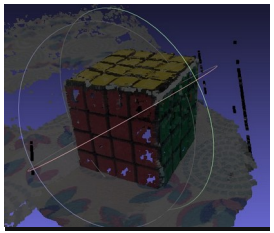
- Provides an end-to-end 3D reconstruction from images

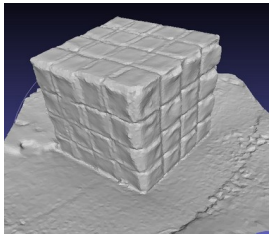


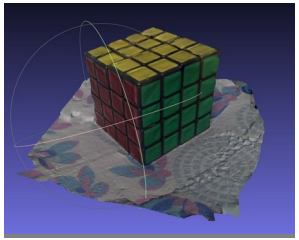
openMVS - open Multiple View Stereo





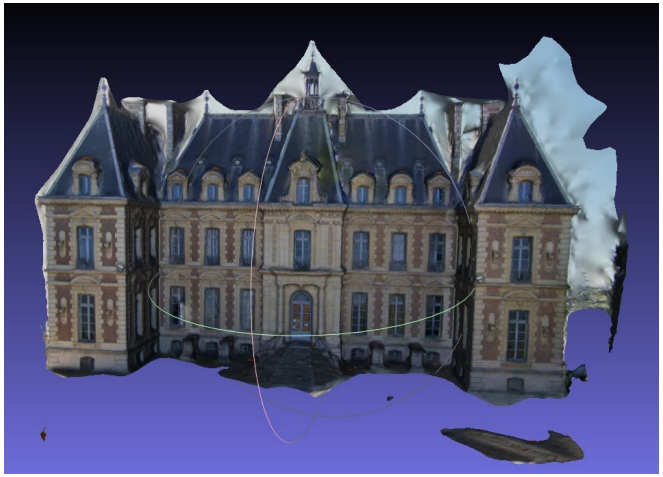






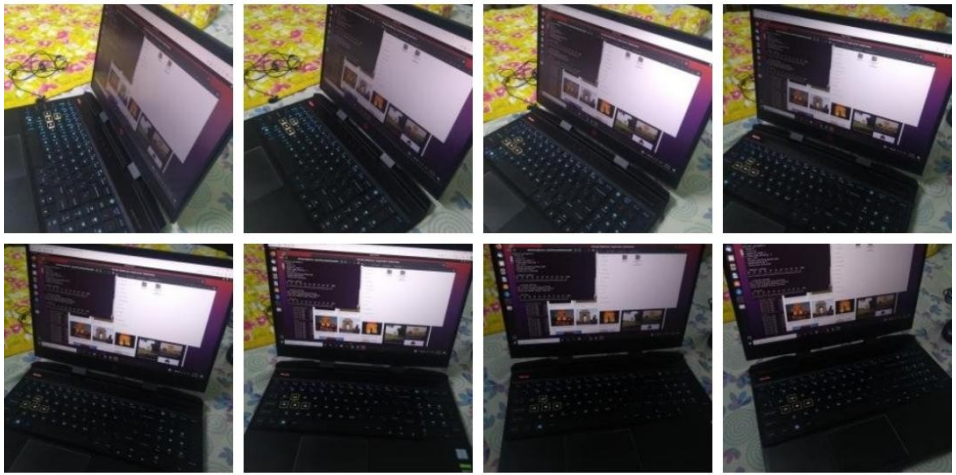
Sceaux Castle Dataset

Learnings: Familiarity with using openMVG-openMVS

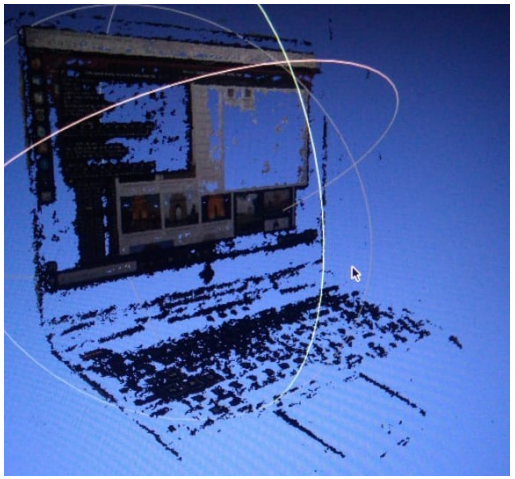


Laptop Dataset

Learnings: More number of input images required with object in focus



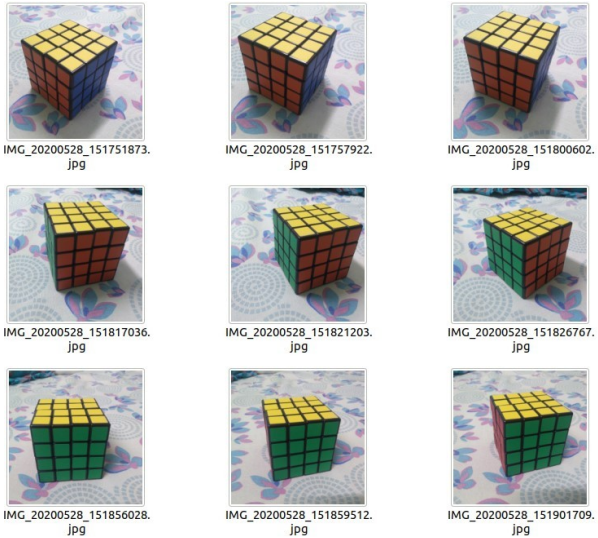
Input Images clicked with phone

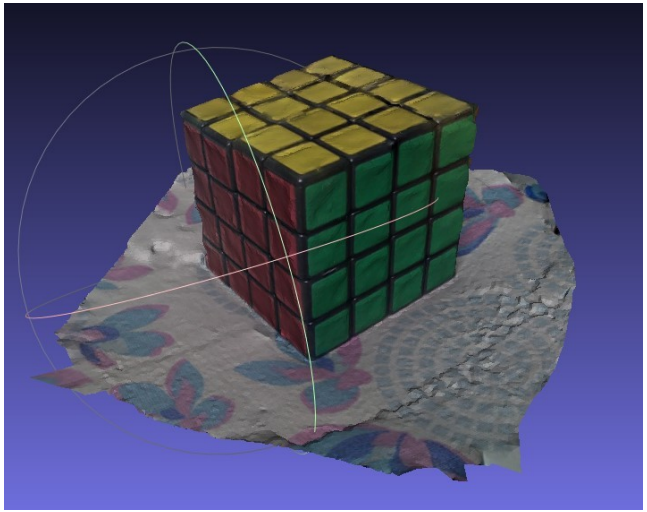


Output

Rubik’s Cube Dataset

Learnings: Good lighting conditions and maximum overlap



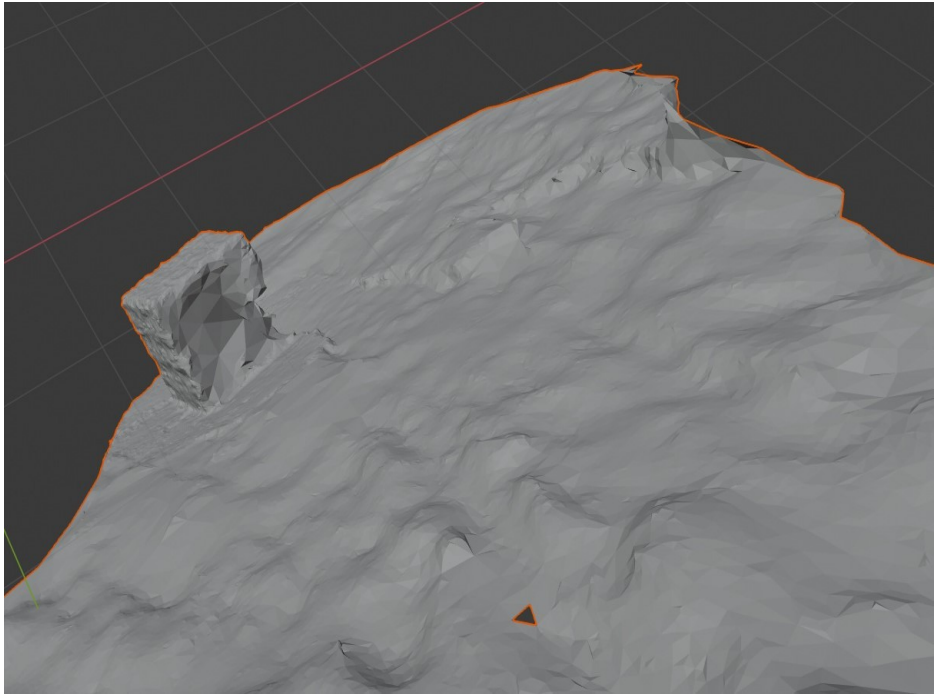


Pre-conditions for Images

- Acquiring a large data set
- Object well in focus
- Maximum overlap b/w consecutive images
- Maintaining constant height and distance from object
- Good Lighting Conditions

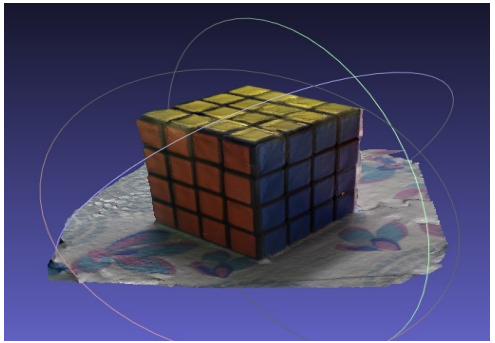
OpenMVG-OpenMVS Vs Meshroom

Meshroom Output



Conclusions

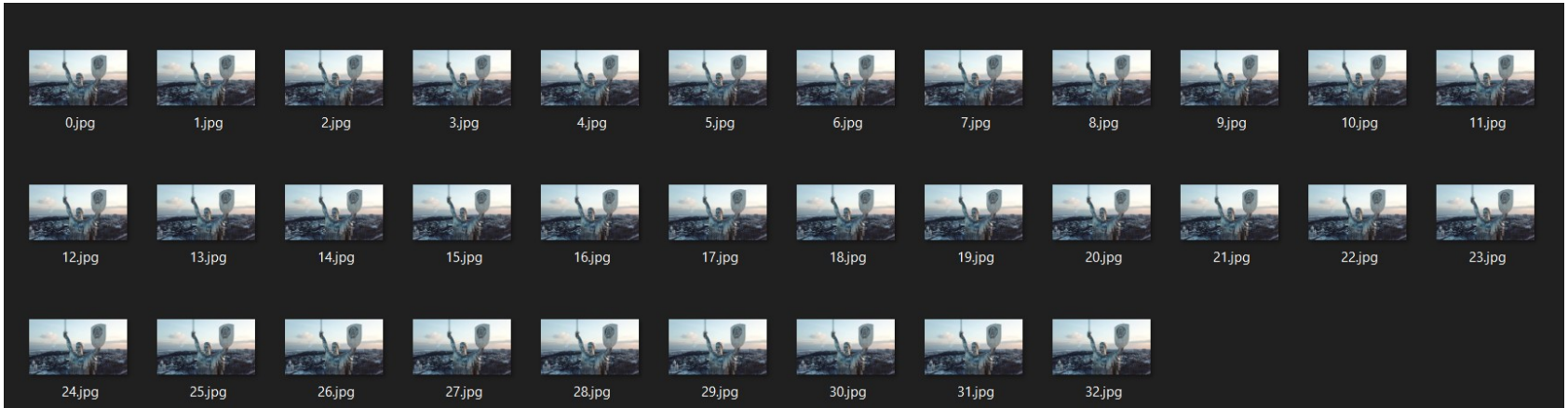
- Meshroom output was quicker(3-6x), but broken and not as good as openMVG-openMVS
- Only suitable for High resolution images
- To be used an intermediary for identifying deficits



OpenMVG-
OpenMVS

Script for extracting images from videos

- Not feasible to take hundreds of photos
- Extracting images from a 360° video eases data collection task
- OpenCV used for extraction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Designing The Turntable

Idea
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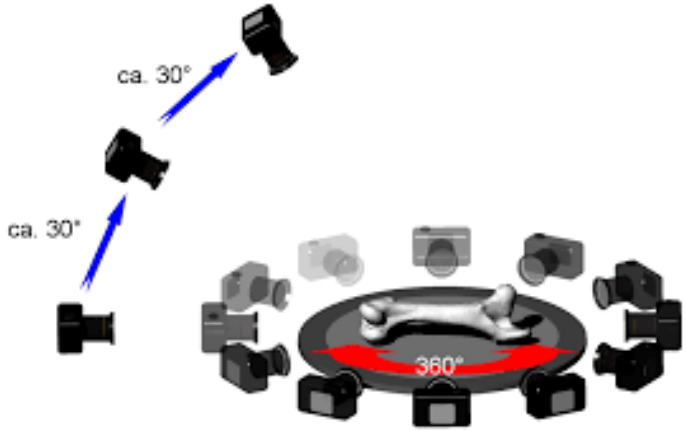
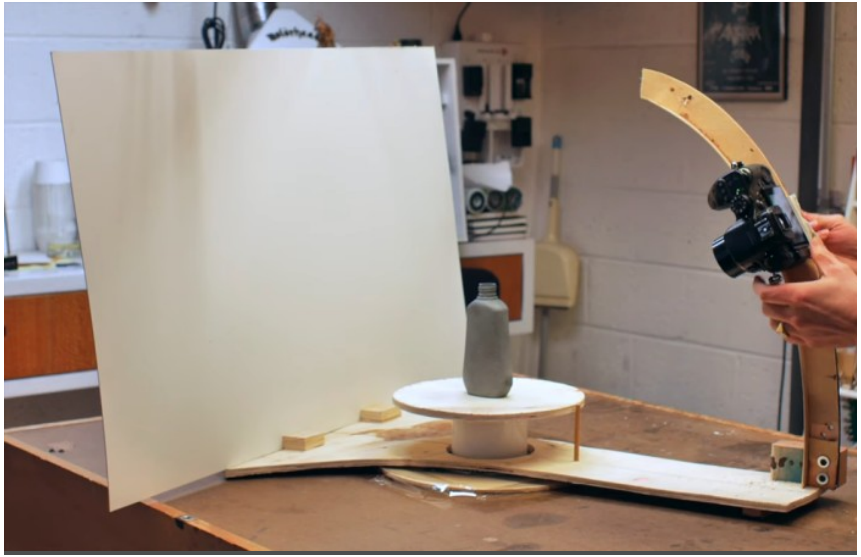




Revolving Camera

Idea s

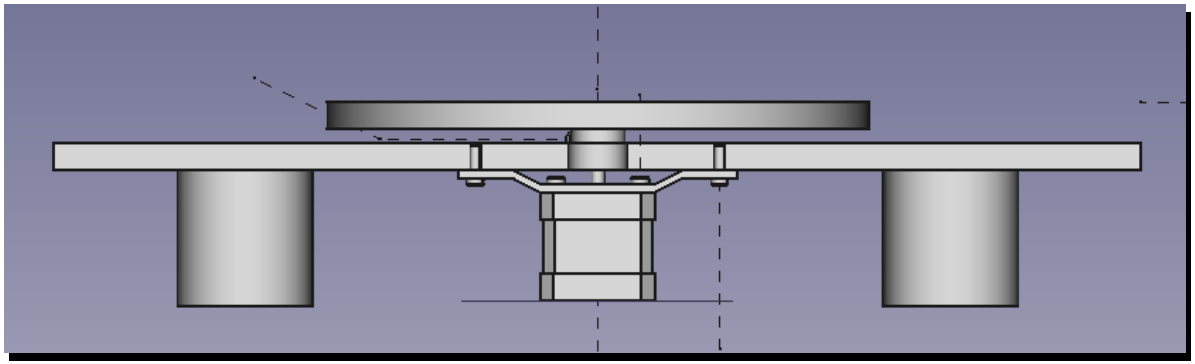
- No human interaction required
- Greater Stability
- Less space required
- Easier to assemble
- Camera remains stationary

Rotating Object

Designing The Turntable

Components

- Stepper Motor
- Clamp
- Shaft Coupler
- Turntable
- Fasteners
- Base

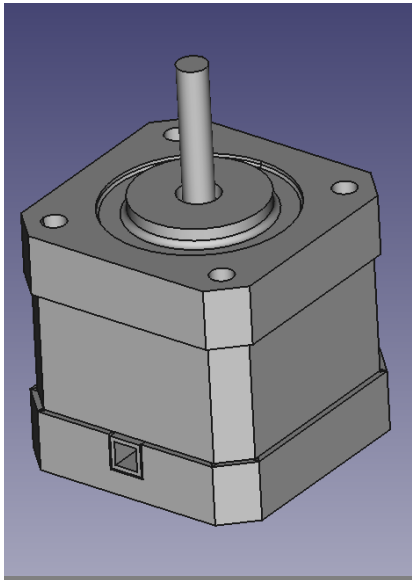


Stepper Motor Specs

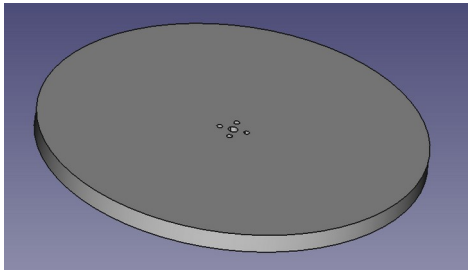
Nema 17 Stepper Motor

Model No. - SY42STH47-1206A

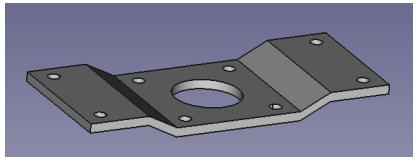
- Holding Torque : 31.1 N.cm
- Rated Voltage : 4.0 V
- Rated Current : 1.2 A
- Motor Length : 40 mm
- Shaft Diameter : 5 mm
- Step angle : 1.8°



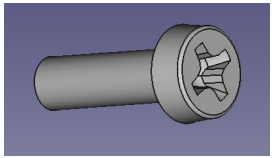
Other Components



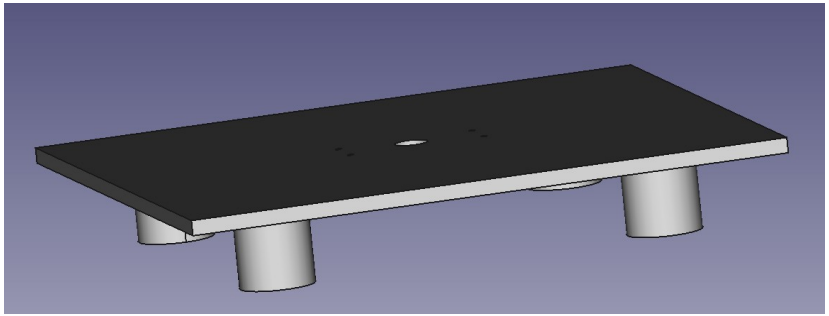
Turntable



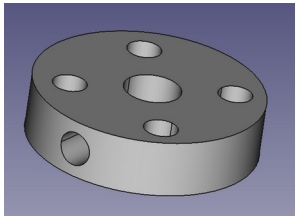
Clamp



Fastener

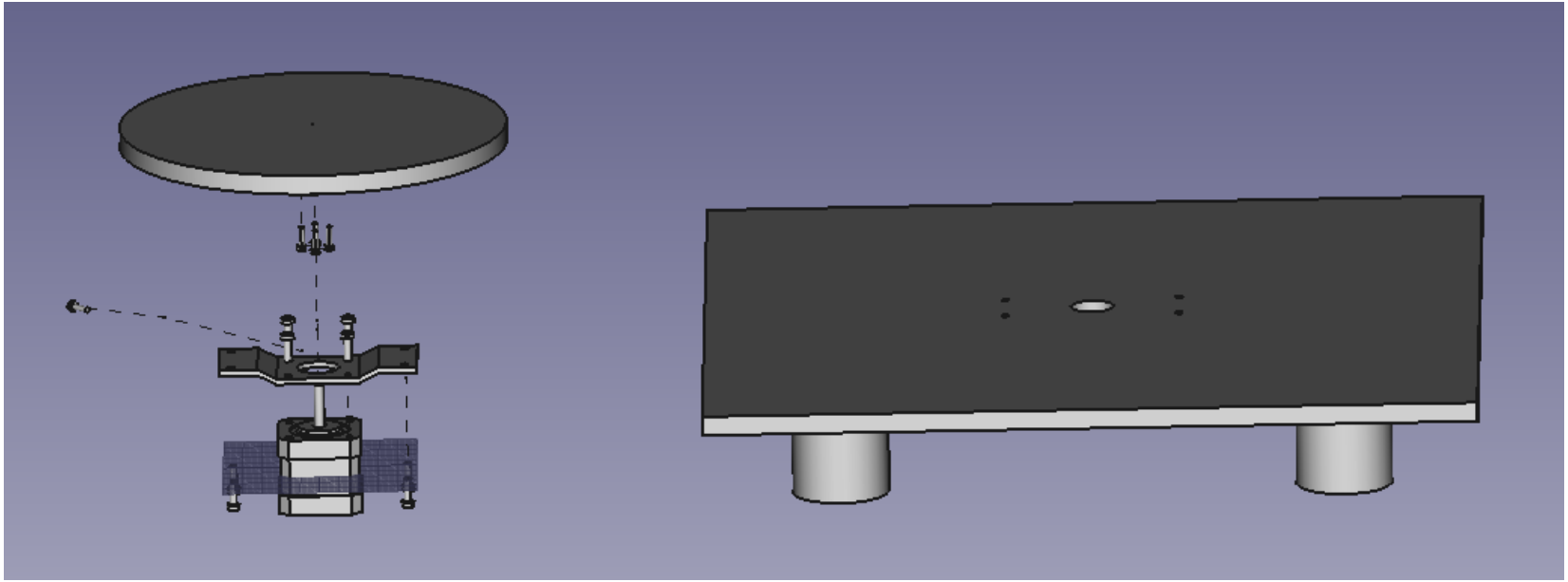


Base



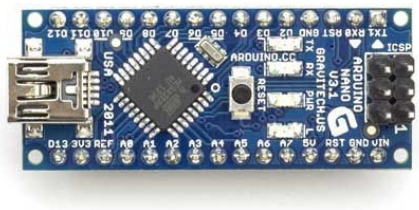
Shaft Coupler

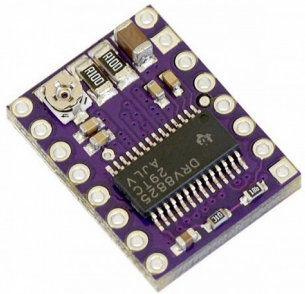
Exploded Assembly



Controlling the turntable

- The turntable would be controlled using a NEMA 17 stepper motor
- The motor will be interfaced with a microcontroller(Nano) and driven using a DRV 8825 stepper motor driver





Testing 3D reconstruction on insects

Dataset

- Over 90 images of a spider were collected on a regular phone, at various angles
- Larger dataset was chosen due to low resolution of the insects body
- Photos were taken manually due to reduction in resolution from taking a video

Results

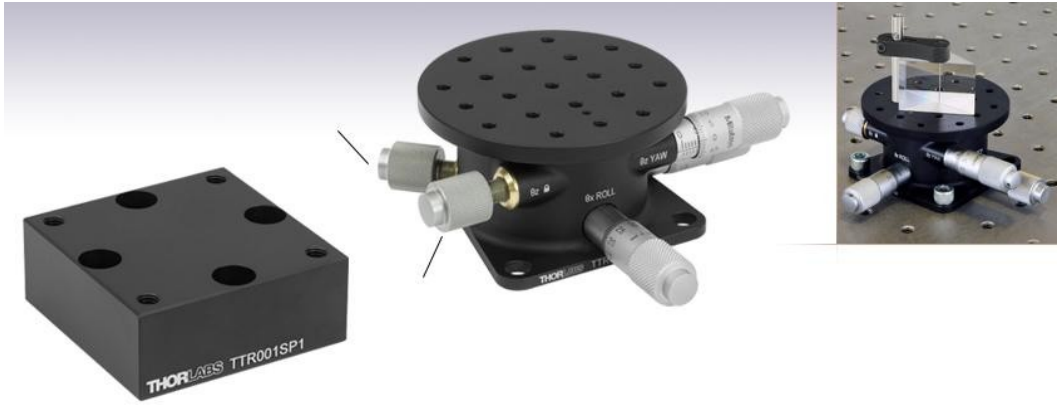
- The output, even after manual configuration, wasn’t good due to low resolution of the insects body
- There was also a lack of background landmarks for the software to use for feature matching
- The result was only a couple of points being generated from the entire datasets, and a dense reconstruction failed due to less number of vertices
- For better results, one would need access to a high detail camera, which we didn’t have access too

Microscope Stage

Producing Digital Terrain Models of microscopic images

Tilt Stage :

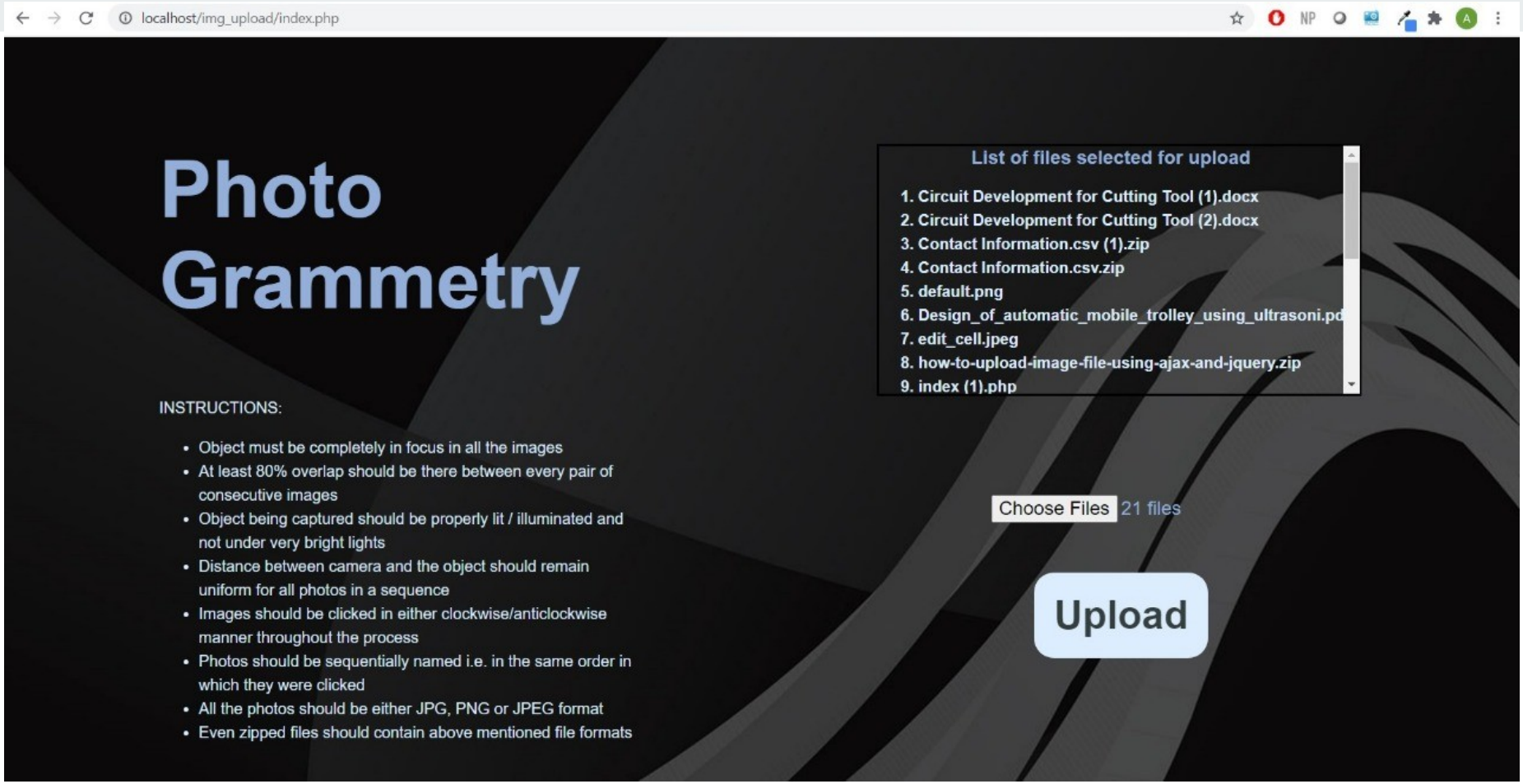
- ± 5° Tip and Tilt
- ± 10° Rotation
- Micrometer Positioning



TTR001

WHAT NEXT?

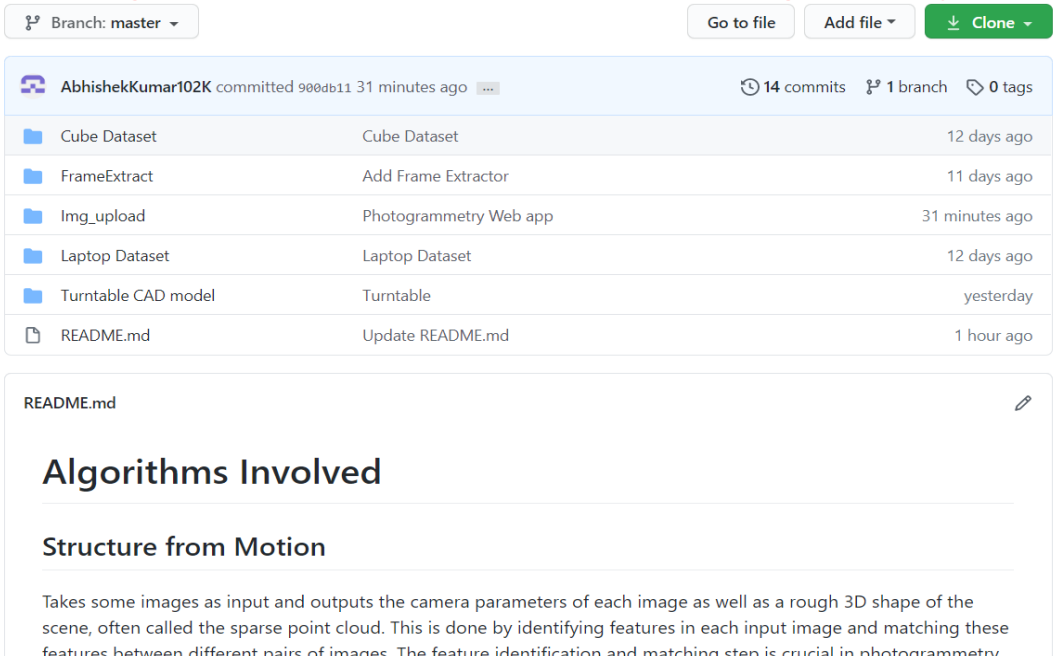
Web Application


localhost/img_upload/index.php
Photo Grammetry
List of files selected for upload
1. Circuit Development for Cutting Tool (1).docx
2. Circuit Development for Cutting Tool (2).docx
3. Contact Information.csv (1).zip
4. Contact Information.csv.zip
5. default.png
6. Design_of_automatic_mobile_trolley_using_ultrasoni.pd
7. edit_cell.jpeg
8. how-to-upload-image-file-using-ajax-and-jquery.zip
9. index (1).php
INSTRUCTIONS:
Object must be completely in focus in all the images
At least 80% overlap should be there between every pair of consecutive images
Object being captured should be properly lit / illuminated and not under very bright lights
Distance between camera and the object should remain uniform for all photos in a sequence
Images should be clicked in either clockwise/anticlockwise manner throughout the process
Photos should be sequentially named i.e. in the same order in which they were clicked
All the photos should be either JPG, PNG or JPEG format
Even zipped files should contain above mentioned file formats
Choose Files
21 files
Upload

Documentation

Link to our GitHub Repository

https://github.com/AbhishekKumar102K/Photogrammetry



“Thank You”