PS1

HBCSE Presentation

Converting 2D Images to 3D Model

Abhishek Kumar
Aryesh Harshal Koya
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
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

Coloured Mesh

.png file
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

- openMVG (SfM)
- Densify point cloud
- Mesh reconstruction
- Mesh refinement
- Texturing
Sceaux Castle Dataset

Learnings: Familiarity with using openMVG-openMVS
Laptop Dataset

Learnings: More number of input images required with object in focus
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
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
Designing The Turntable
Idea

Revolving Camera
Idea

- 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
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
Photo Grammetry

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
Documentation

Link to our GitHub Repository

https://github.com/AbhishekKumar102K/Photogrammetry

Algorithms Involved

Structure from Motion

Takes some images as input and outputs the camera parameters of each image as well as a rough 3D shape of the scene, often called the sparse point cloud. This is done by identifying features in each input image and matching these features between different pairs of images. The feature identification and matching step is crucial in photogrammetry.
“Thank You”