3D Reconstruction in Real Time

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Background

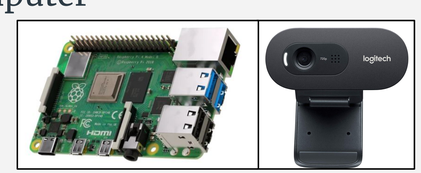
- 3D reconstruction is possible by solving the Correspondence Problem
  - Idea: triangulate pixel locations between multiple cameras and create a point cloud
- Motion tracking is limited with current VR technology, allowing for only hand tracking
  - Full body tracking can be possible through 3D reconstruction

Project Goals

- Post-processing and real-time 3D reconstruction
- Motion tracking through tracking model transformations
- Scalable system that can easily increase in cameras which increases resolution

Materials

- 2 Logitech Cameras C270, 720p x 30 fps
- 1 Raspberry Pi 3 Model B
- Computer



Diagrams

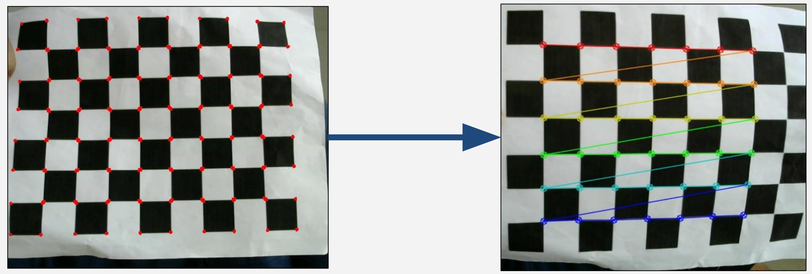


Figure 1. Harris Corner Detection finds all corners within the image (left image). This is used to find a checkerboard pattern (right image). These images will be used to find internal and external parameters

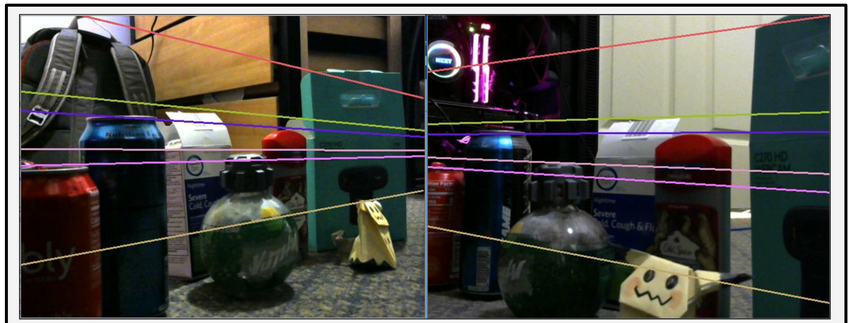
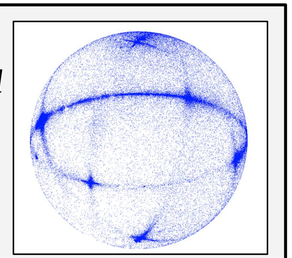


Figure 2. Epipolar Geometry can be used on a stereo system of synchronous cameras to help limit the correspondence problem

Figure 3. Point clouds are formed by matching pixels between cameras and calculating their distances through internal and external parameters



Progress

- **Week 1-2**: Create team and finalize plan
- **Week 3**: Gather and test components
- **Week 4**: Synchronize cameras on microcontroller and run Corner Detection
- **Week 5**: Run Checkerboard Detection and create program to calibrate cameras (find internal and external parameters)
- **Week 6:** Determine the fundamental matrix to calculate cameras' epipolar geometry

Next Steps

- **Week 7**: Find point correspondences using the epipolar geometry
- **Week 8:** Triangulate the point correspondences and create a point cloud
- **Week 9-10:** Create the meshes from the point cloud

References

- Ma, Yi, et al. *An Invitation to 3-D Vision: from Images to Geometric Models*. Springer, 2001.
- Hartley, Richard, and Andrew Zisserman. *Multiple View Geometry in Computer Vision*. Cambridge University Press, 2017.