Software Engineering

Kinect based 3D Reconstruction of Human Body

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Introduction

- Due to various applications in different domains the 3D scanners are extensively used, i.e human body scan
- There are variety of hardware to built a 3D scanner however Microsoft Kinect provides low cost solution for domestic as well as industrial applications
- Main objective is to develop a Kinect based system to scan human body and reconstruct 3D model.

3D Scanning process

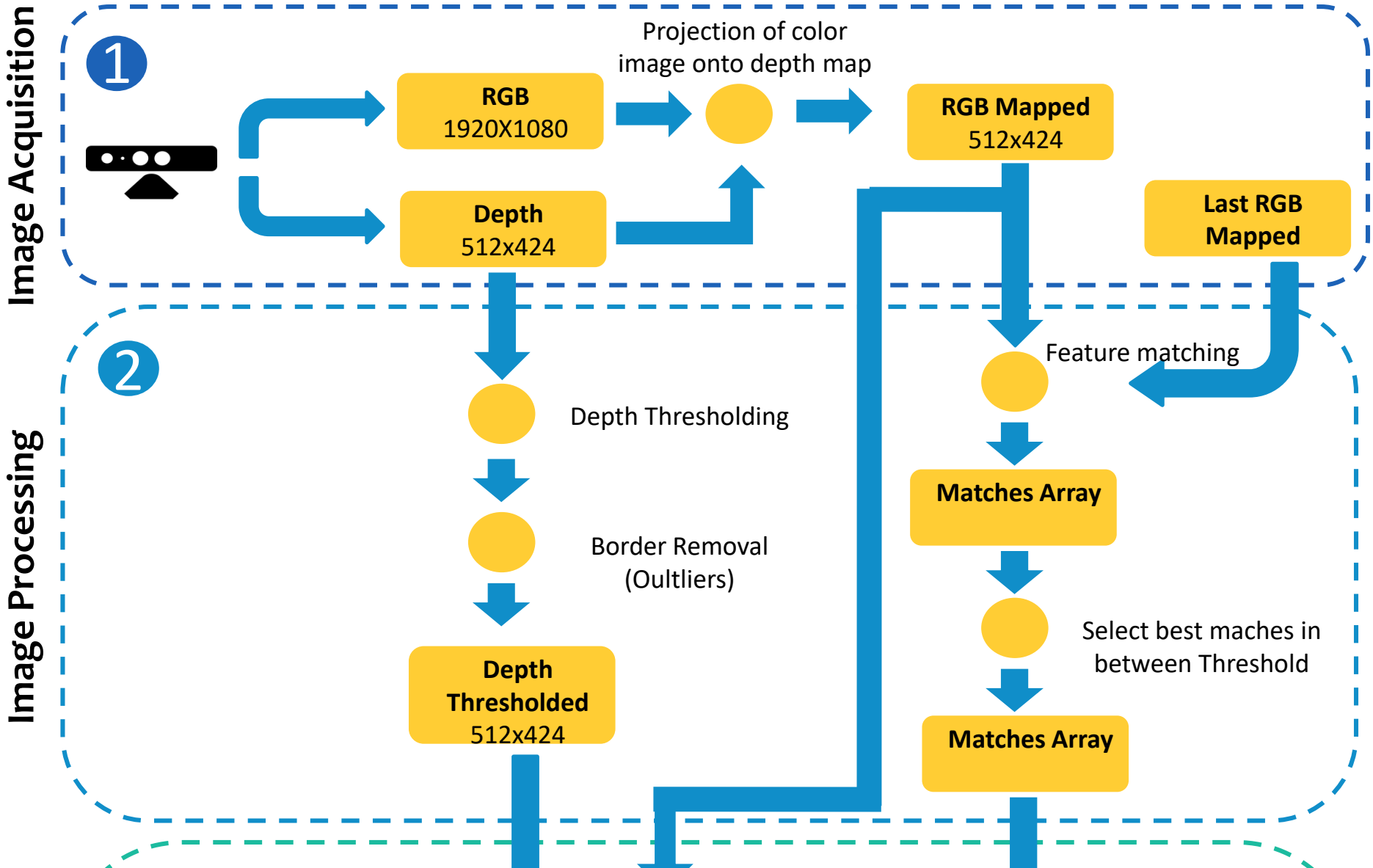

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Image Acquisition

RGB Image (1920x1080)

Depth Image (512x424)

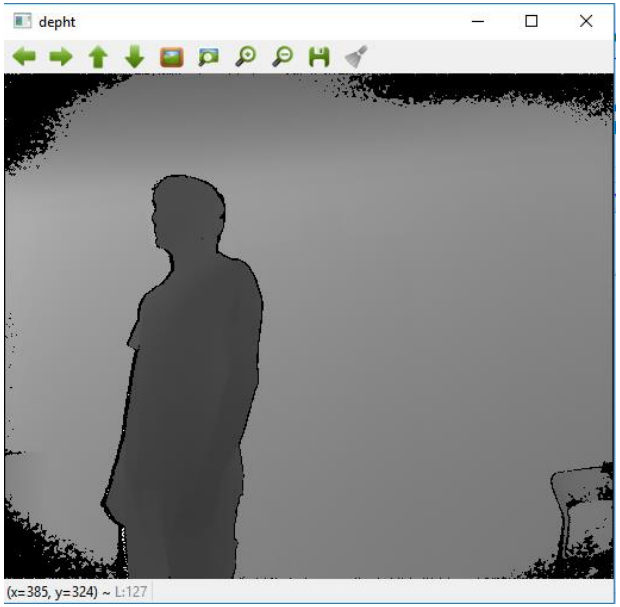
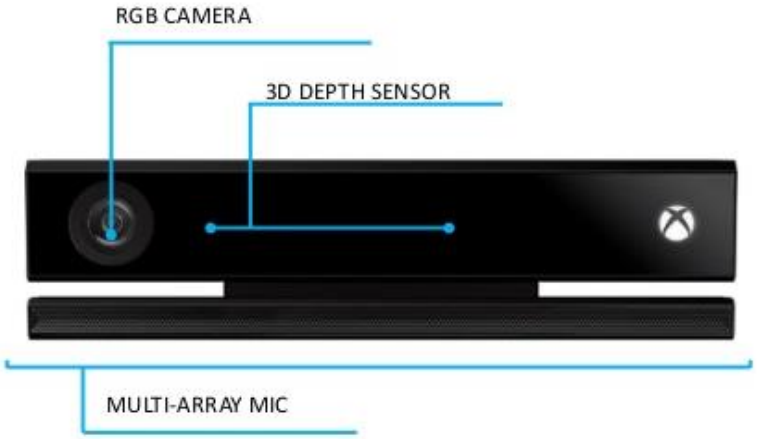


Image Acquisition



Hardware:

Depth resolution:
512×424

RGB resolution:
1920×1080 (16:9)

FrameRate:
60 FPS

Latency:
60 ms

Mapping from RGB to Depth space

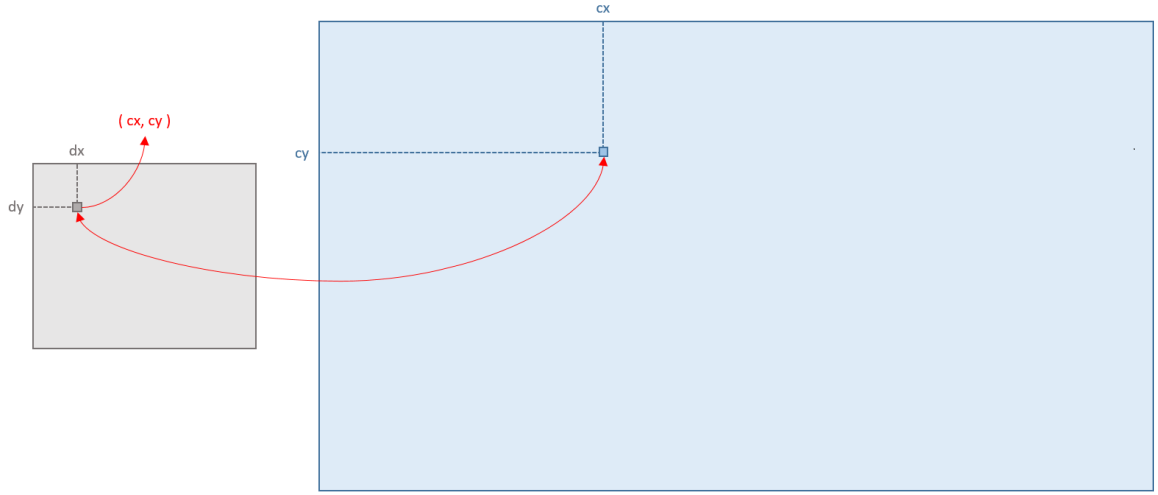
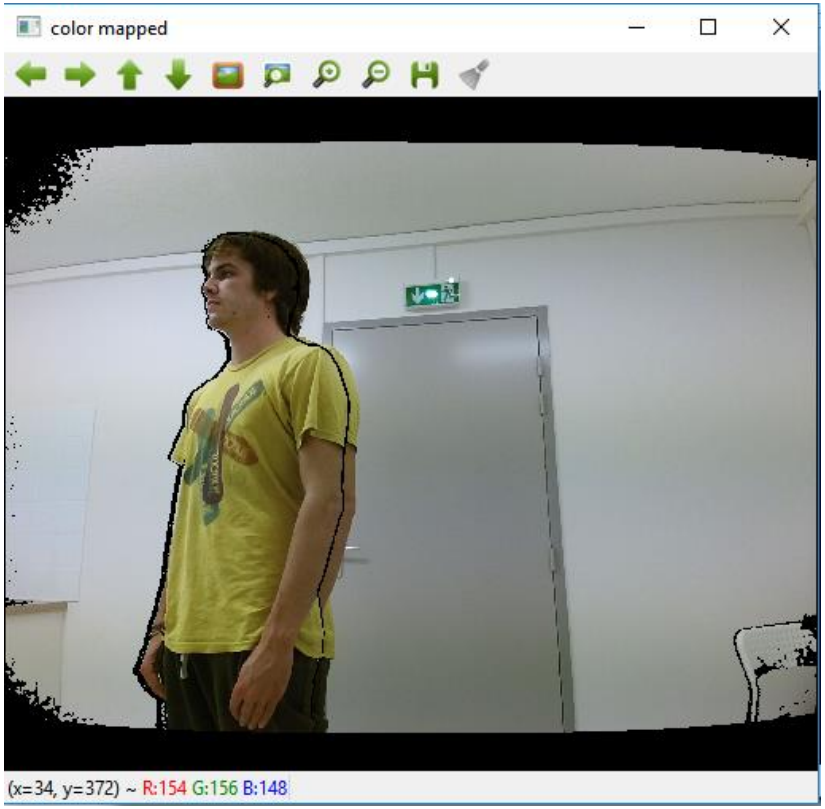


Image Acquisition

Mapped Image (512x424)



Depth Image (512x424)

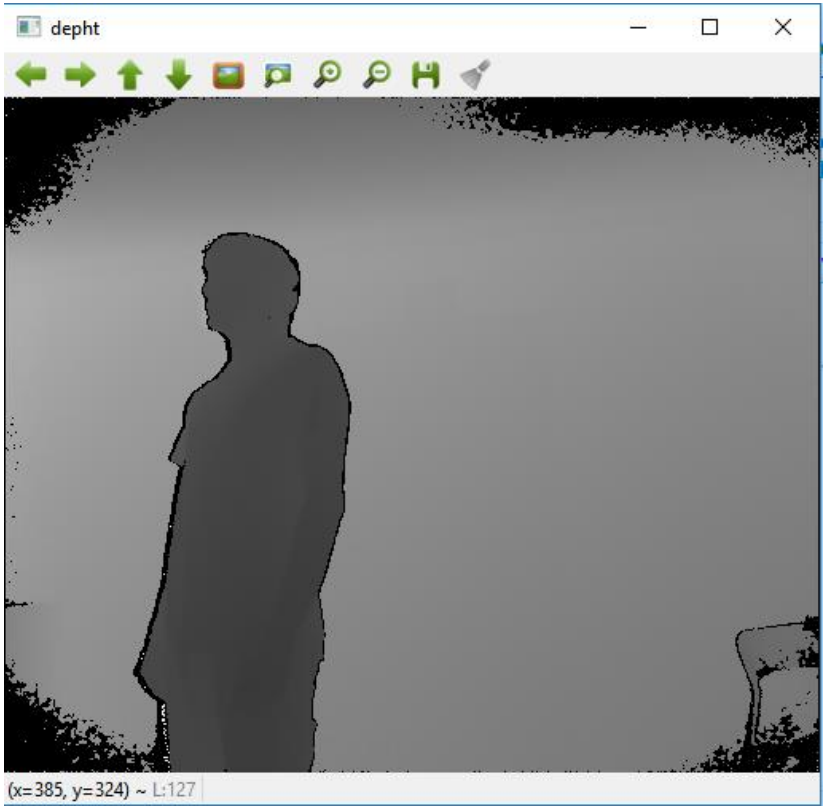


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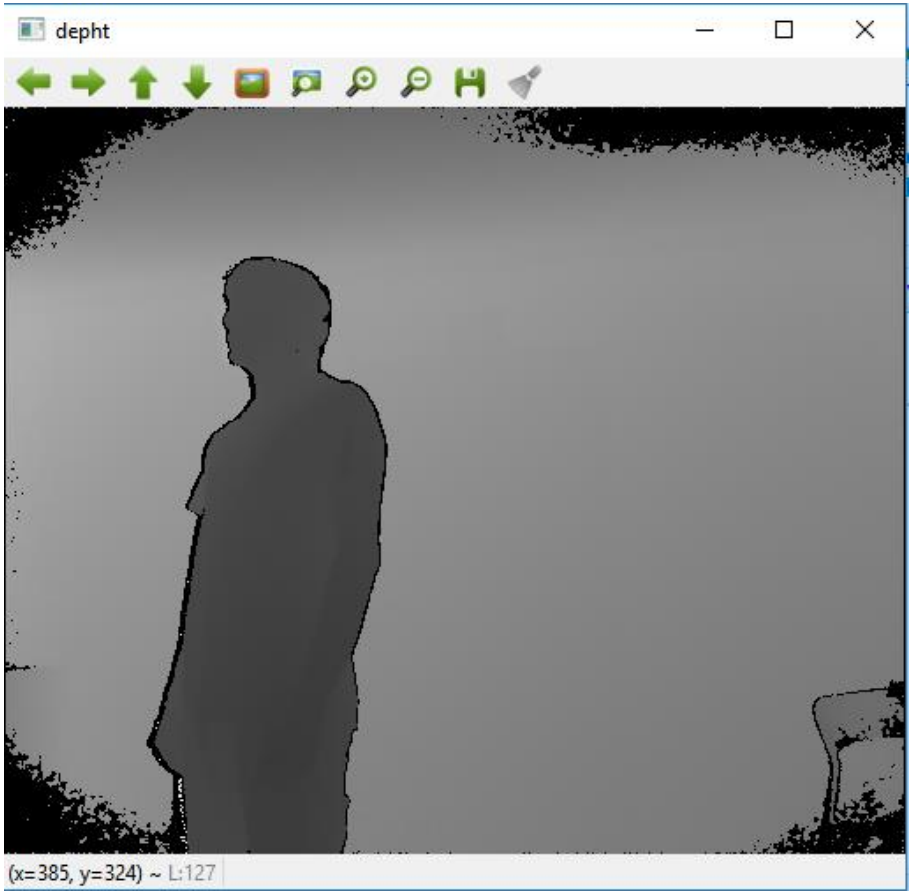
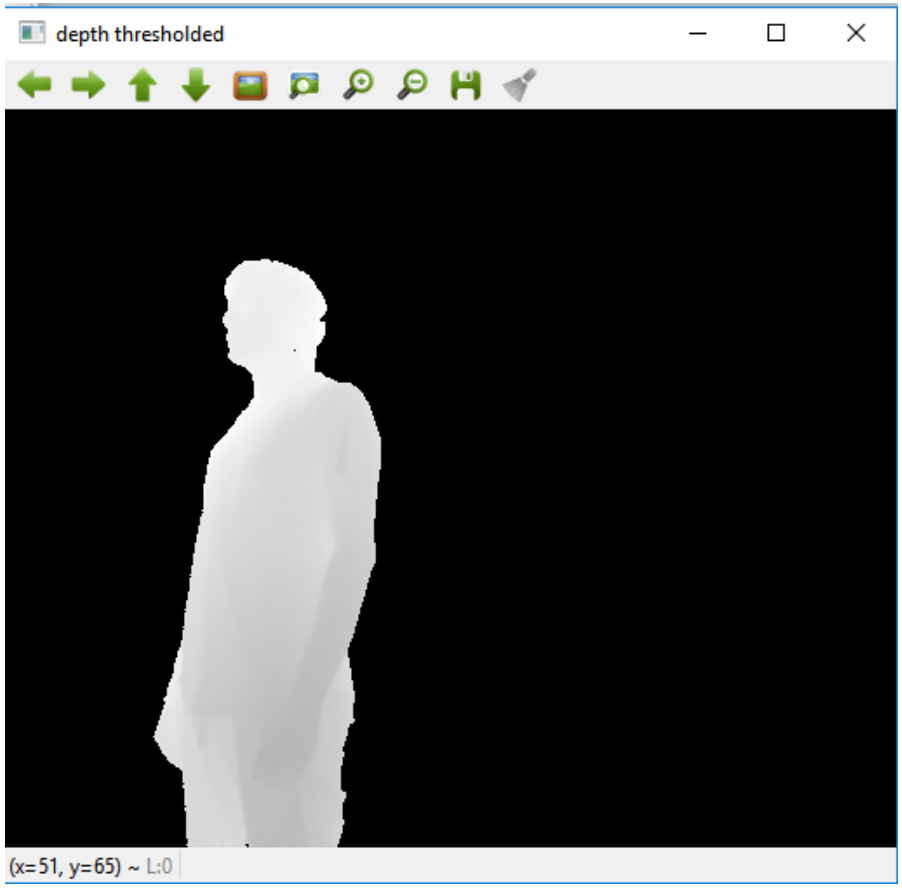
Image Processing

- Thresholding



Depth Image



Thresholded Depth Image

Image Processing

- Outlier removal

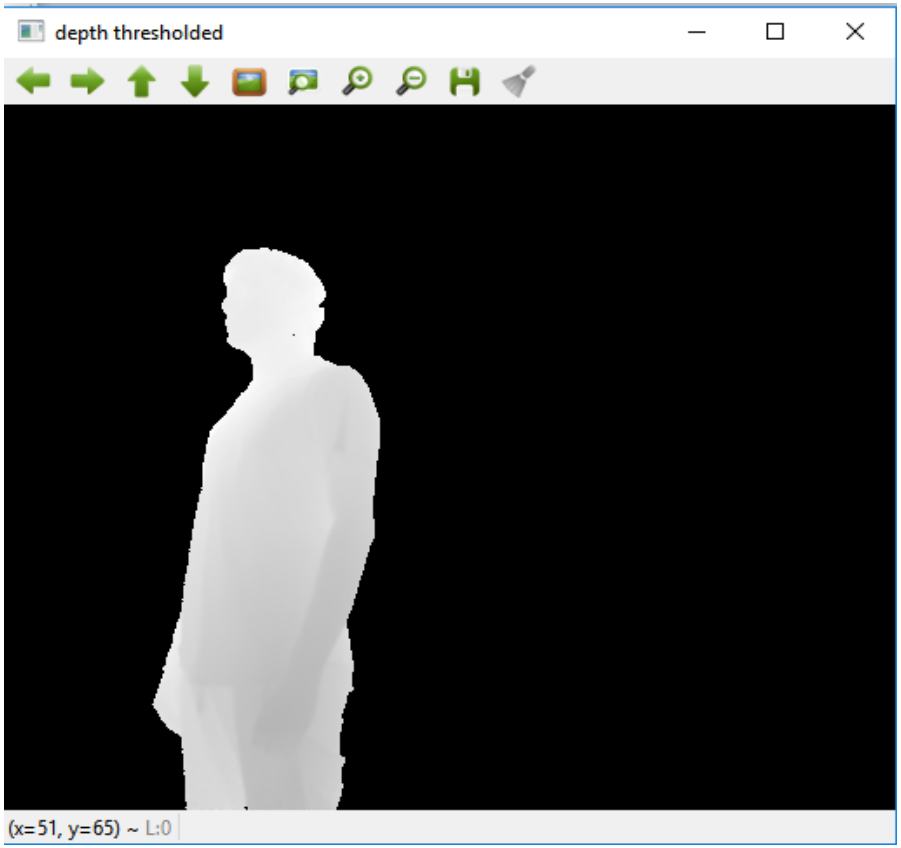


Image before outlier removal

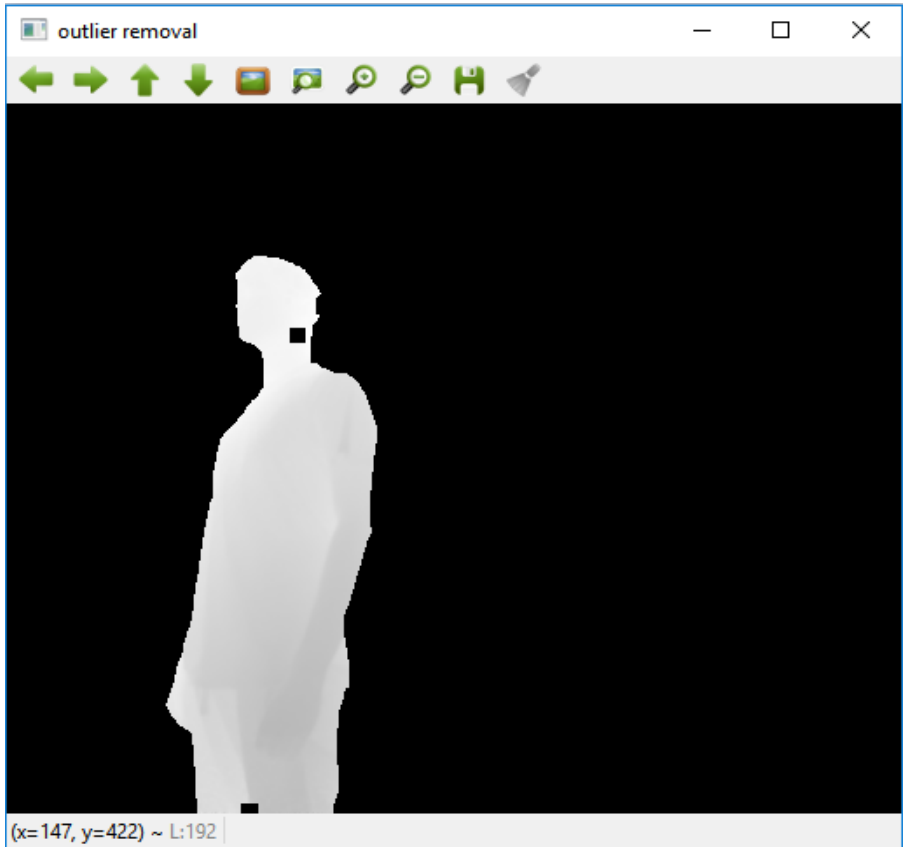
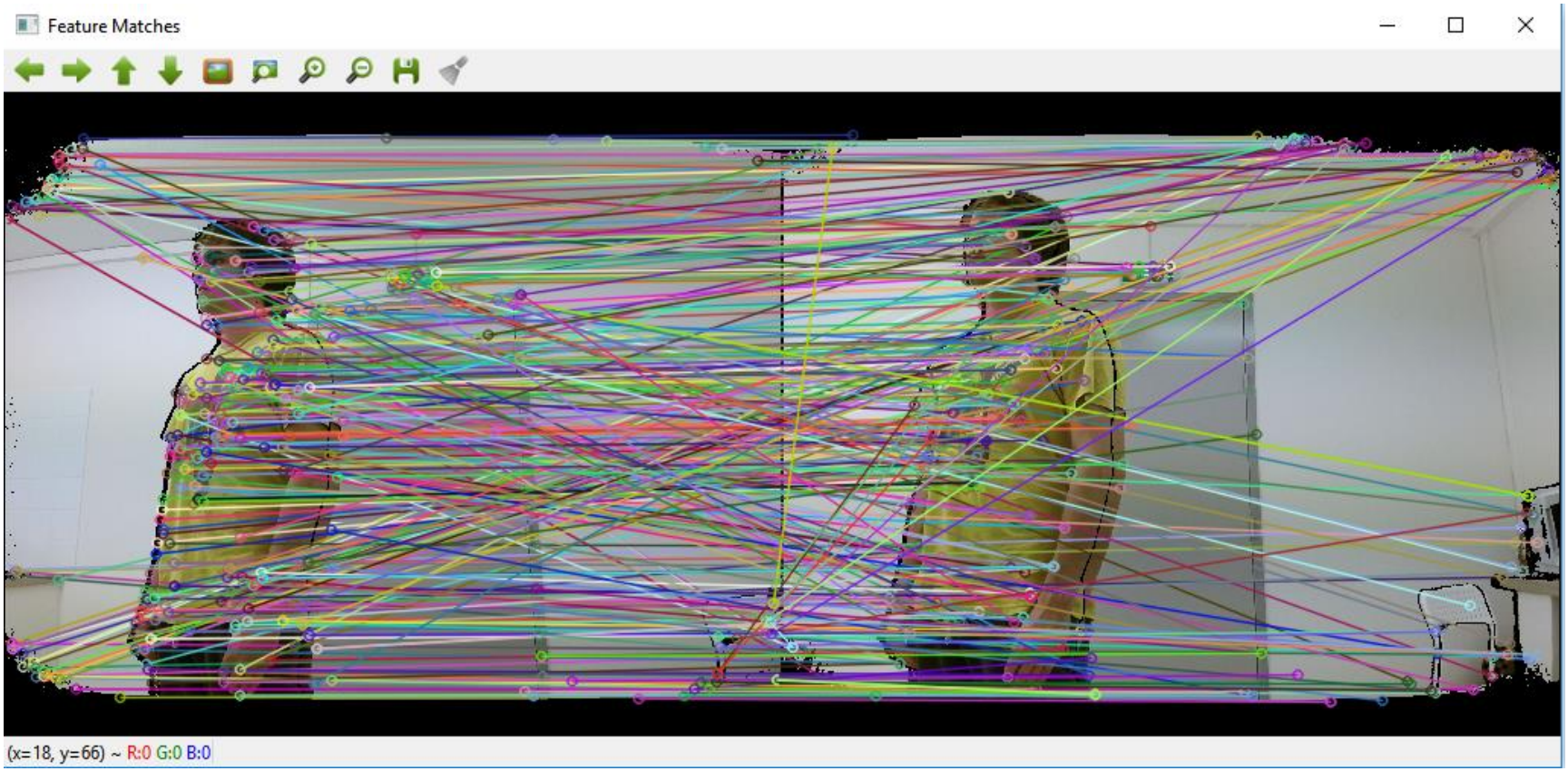


Image after outlier removal

Image Processing

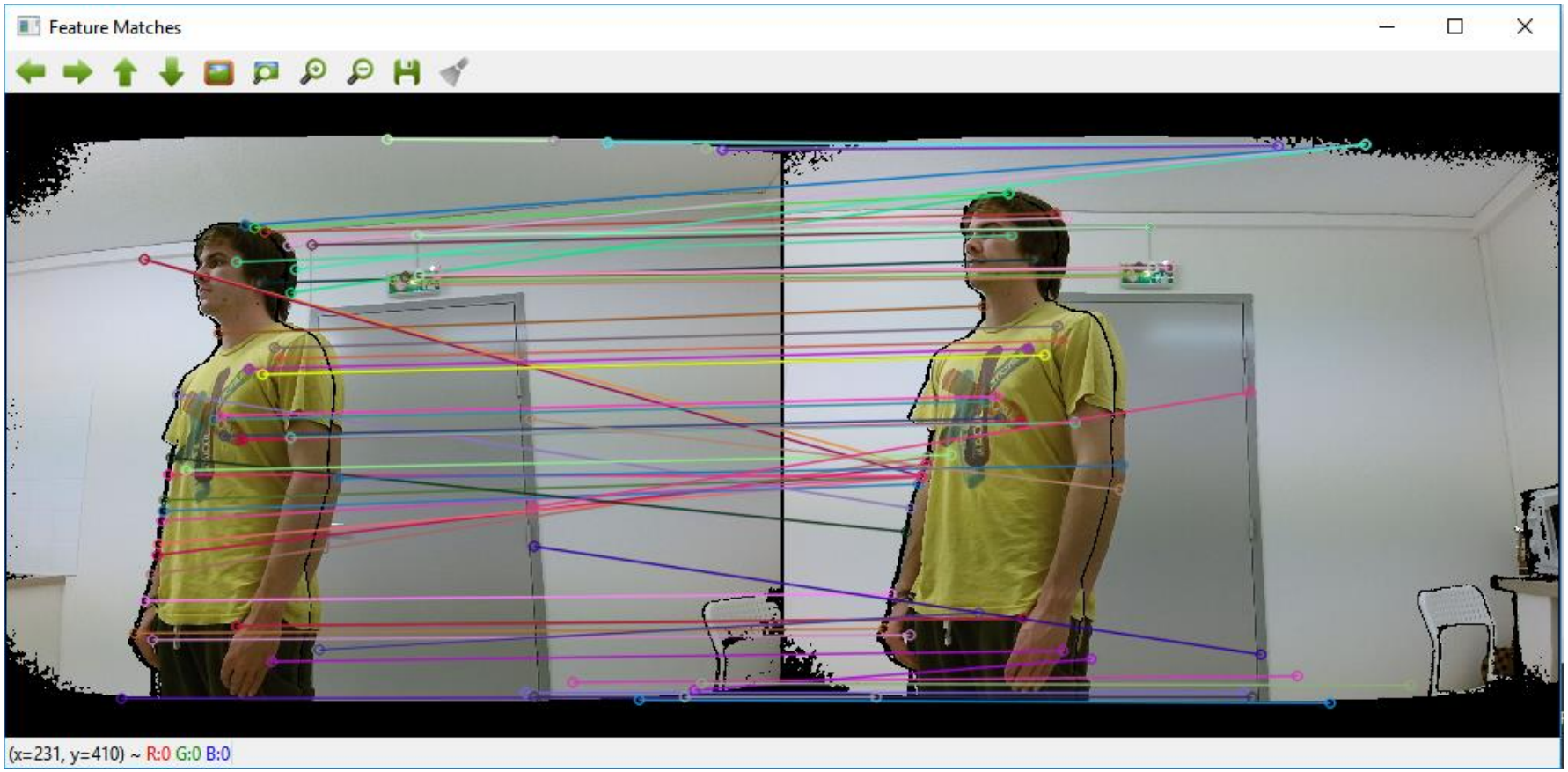
- Feature Matching



Simple Feature Matching

Image Processing

- Feature Matching



Robust Feature Matching

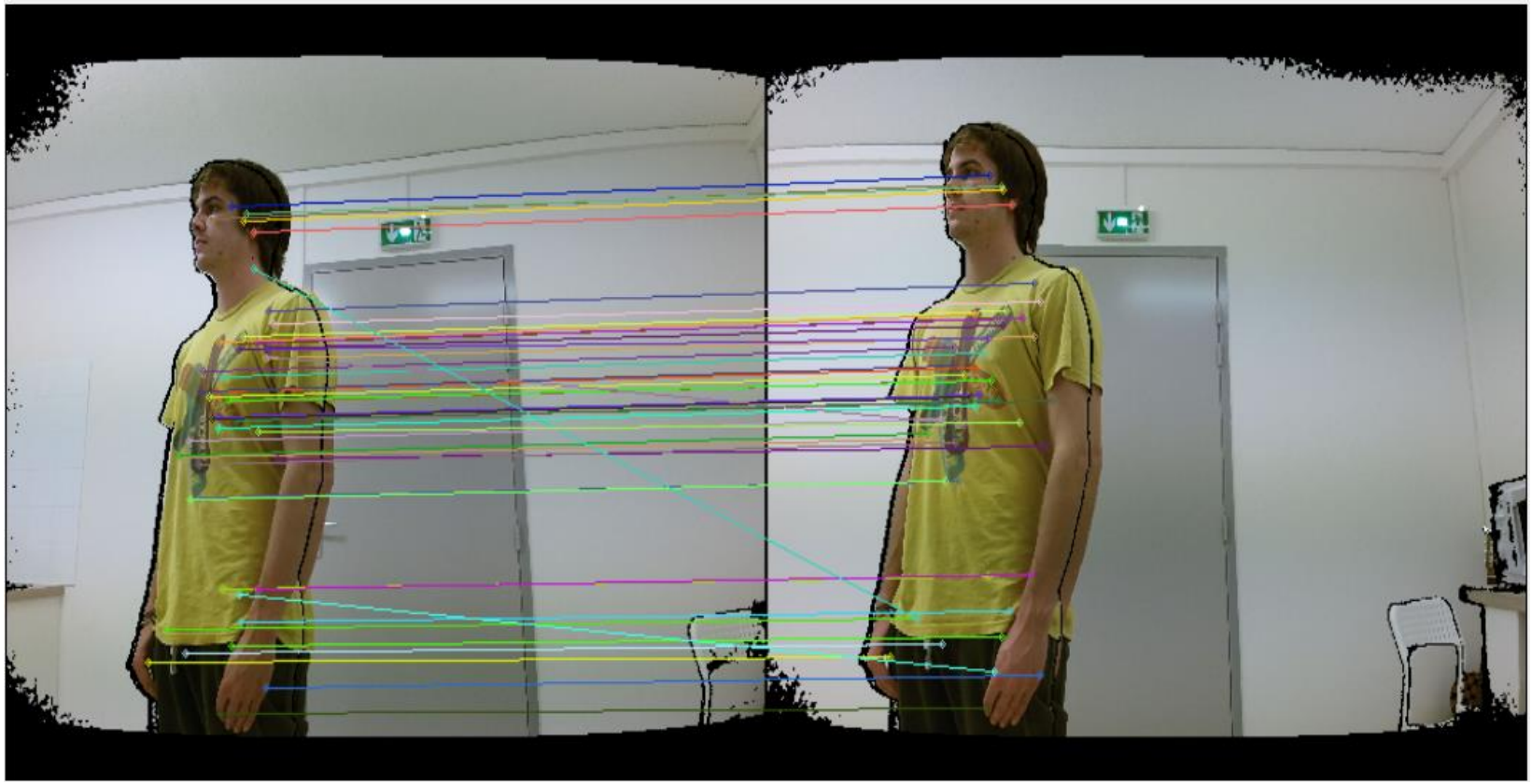
Image Processing

- Feature Matching

Feature Matching using Thresholded color images

Image Processing

- Feature Matching



Mask Based Feature Matching

Image Processing

- Feature Matching

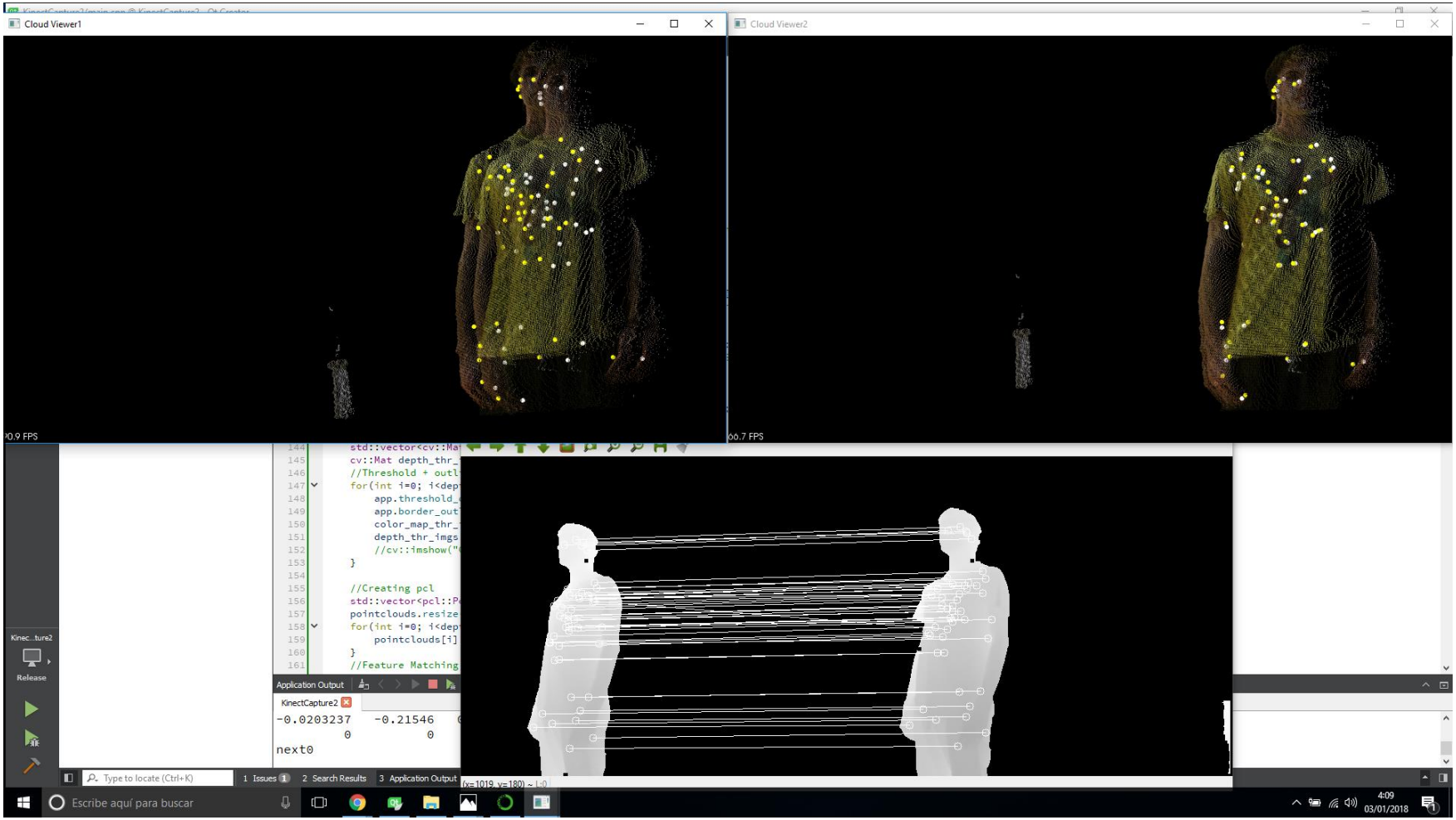


Image Processing

- Feature Matching

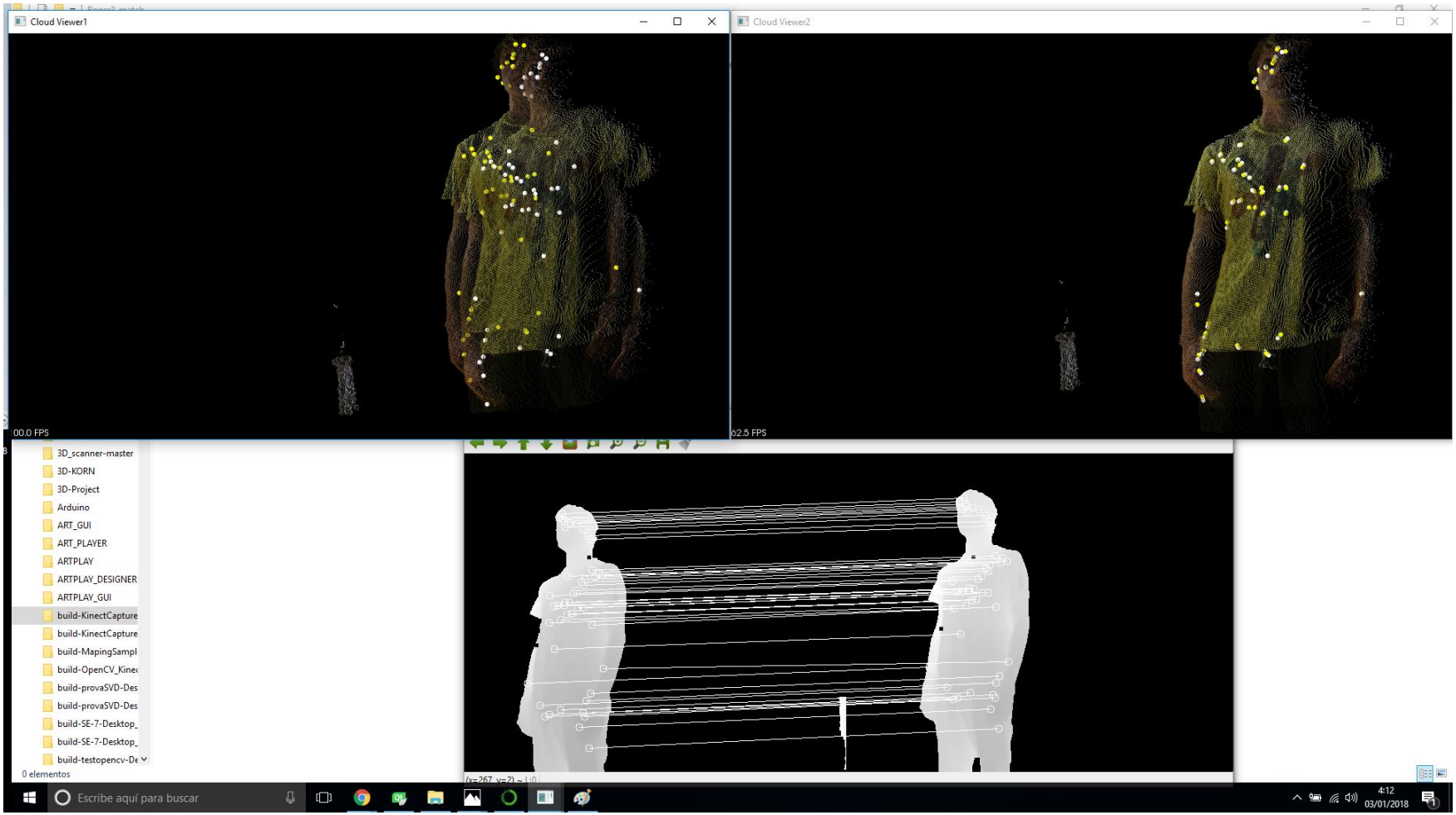


Image Processing

- Feature Matching

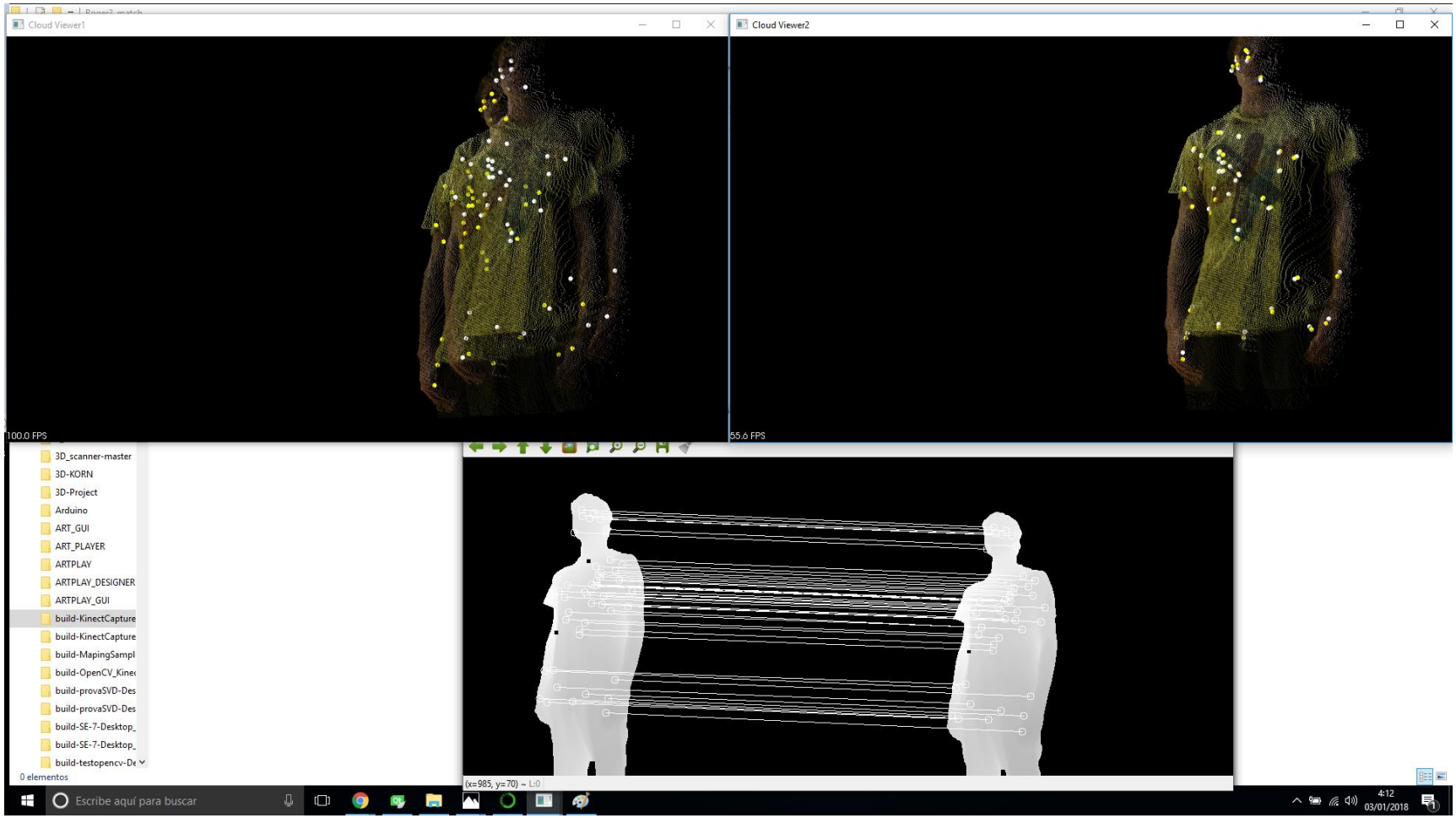


Image Processing

- Feature Matching

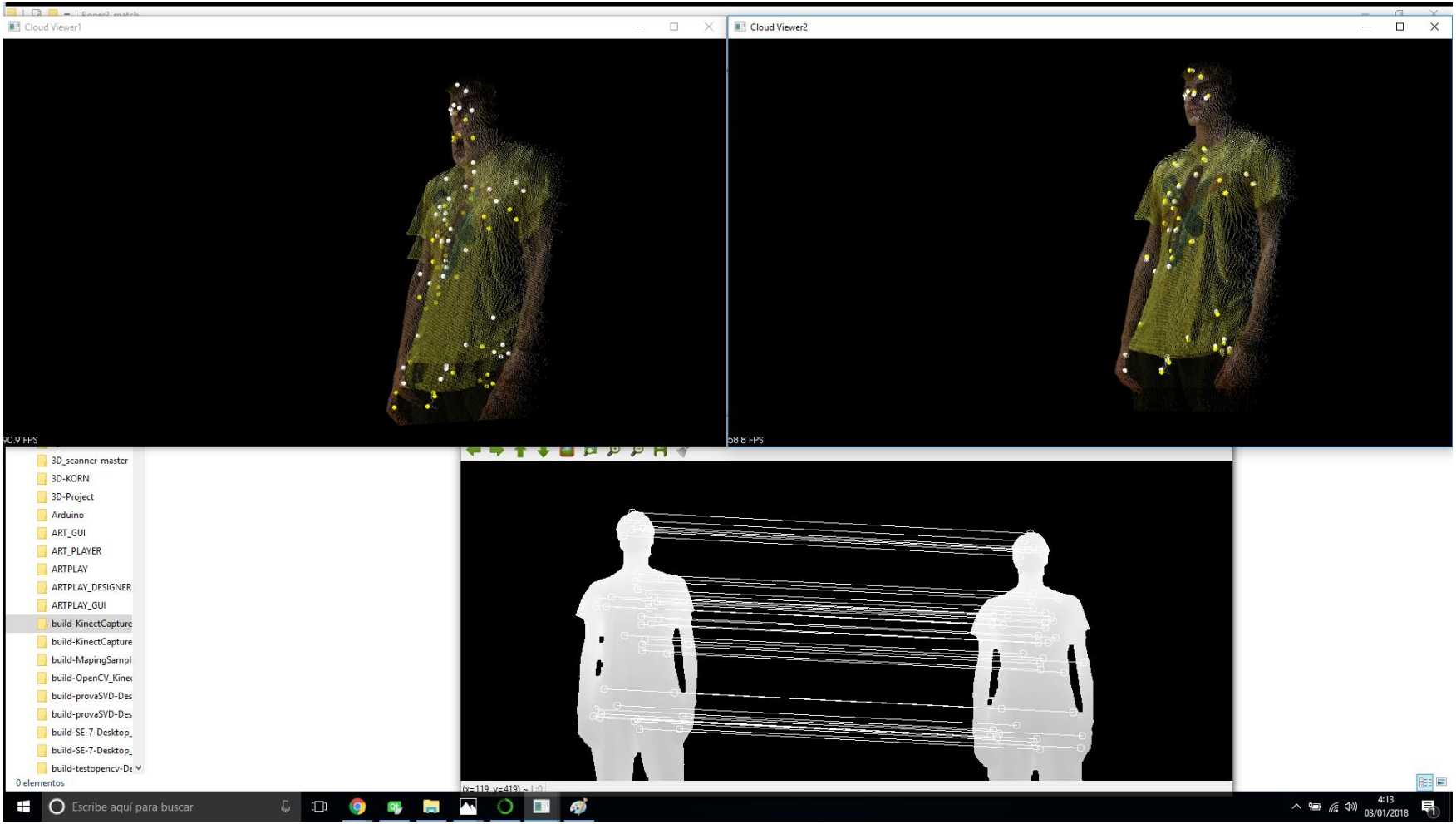


Image Processing

- Feature Matching

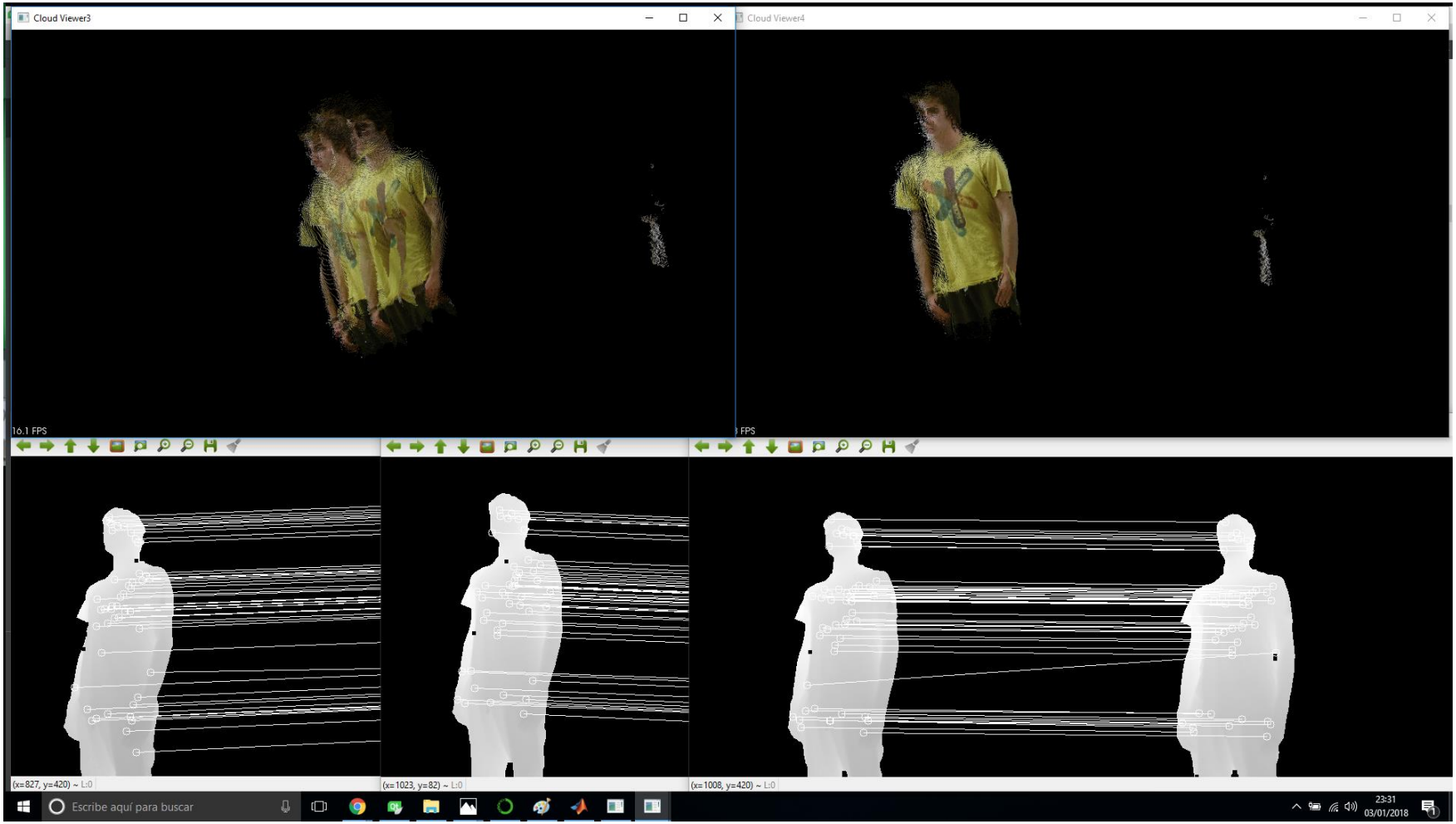


Image Processing

- Feature Matching

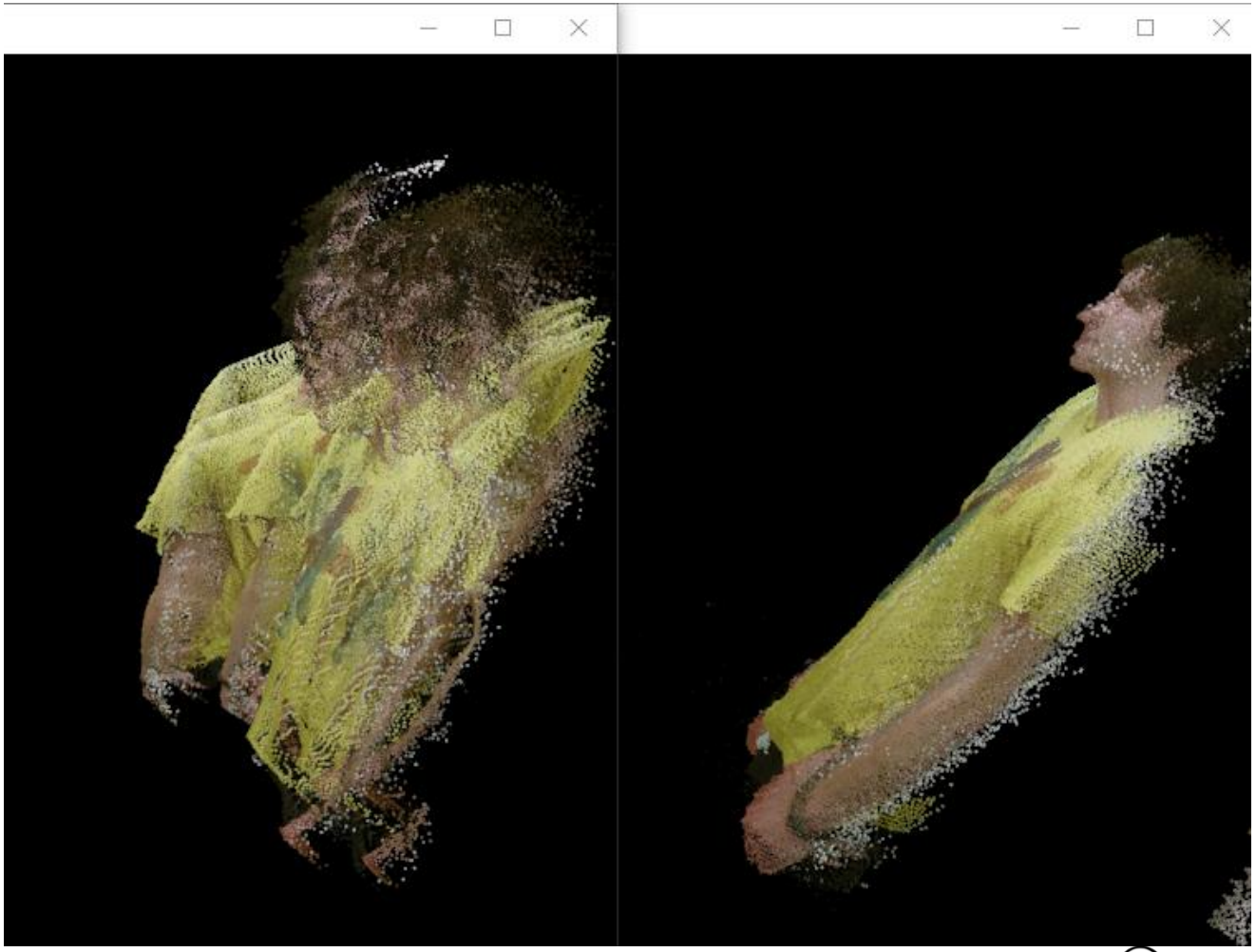


Image Processing

- Feature Matching

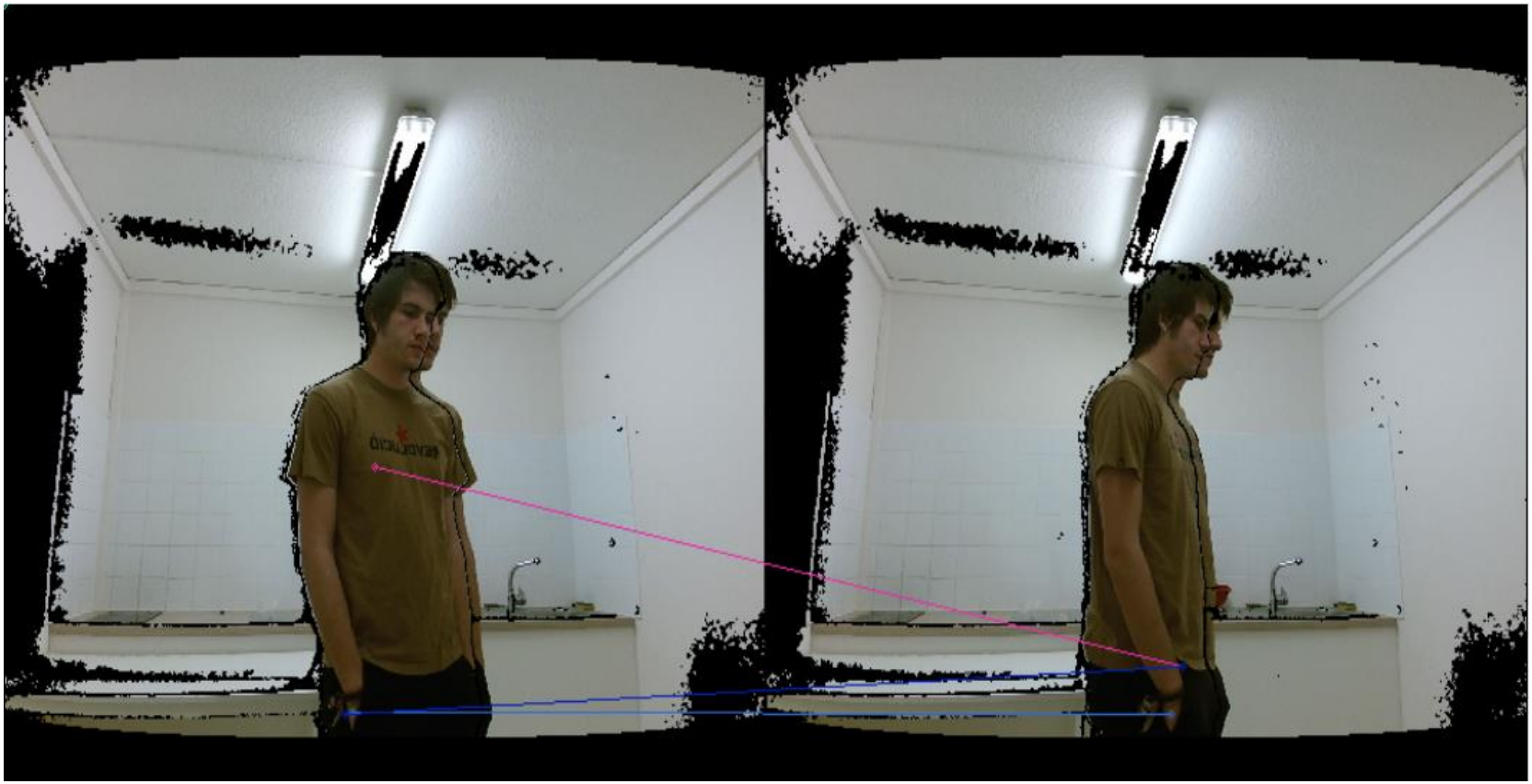


Image Processing

- Feature Matching

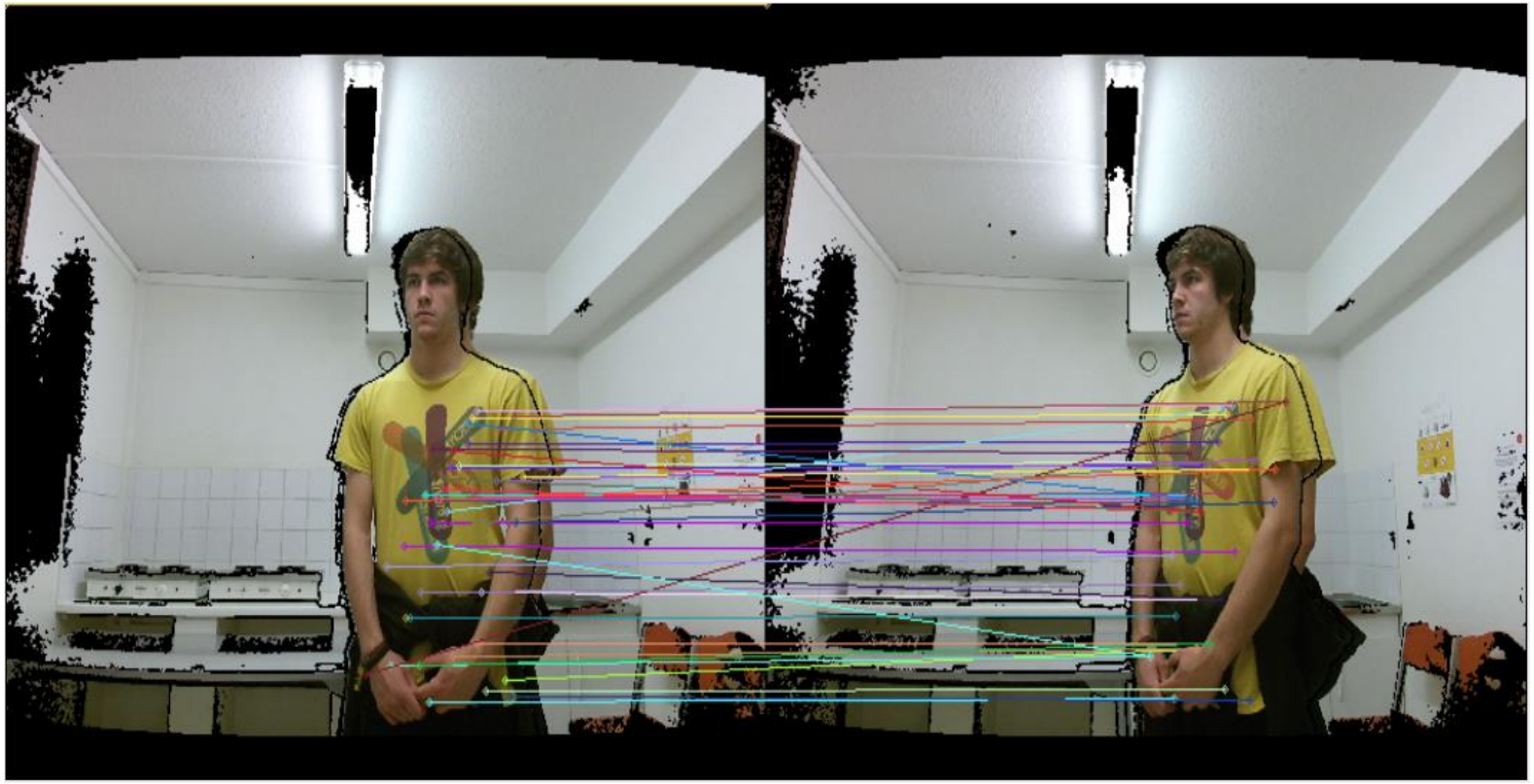


Image Processing

- Feature Matching

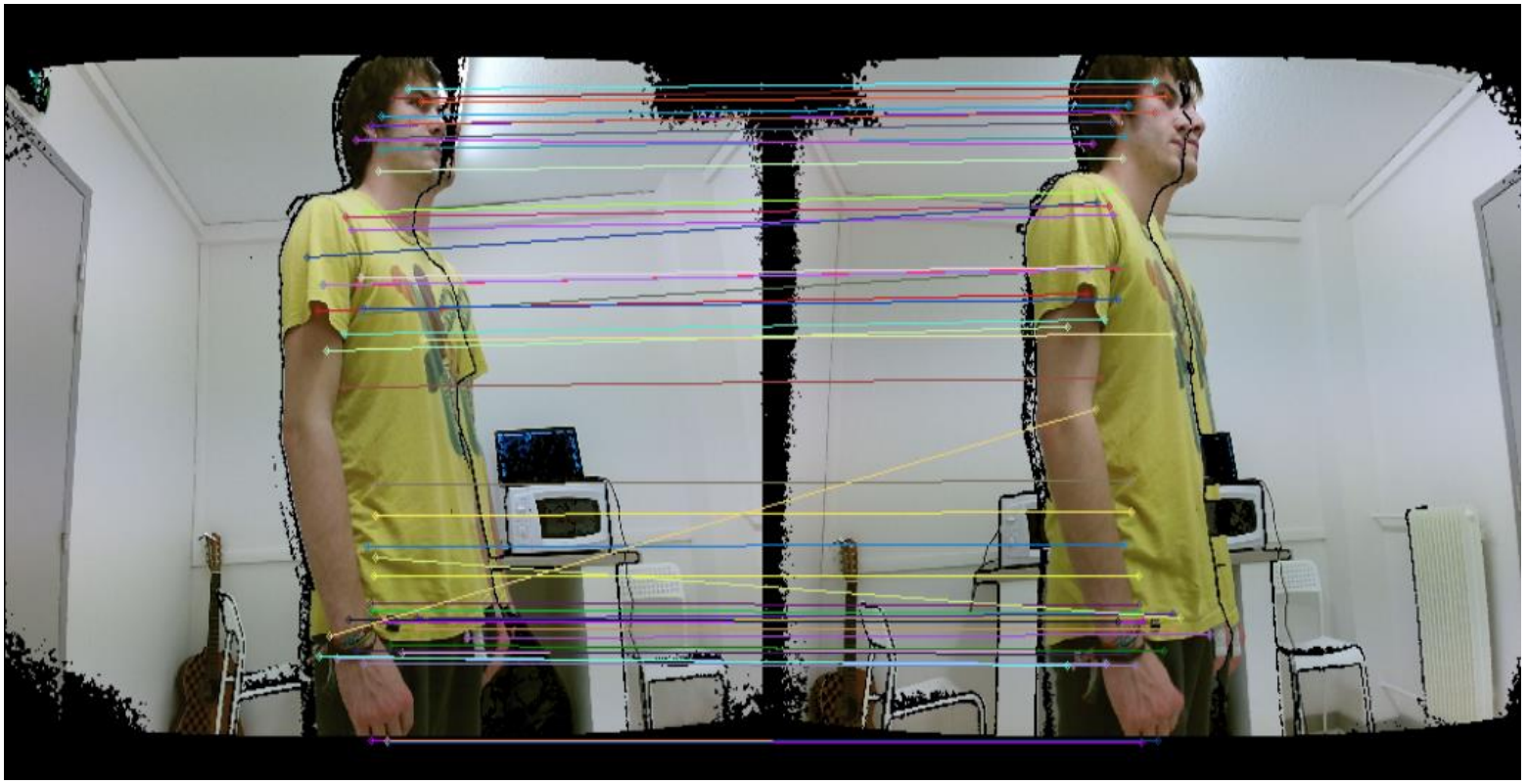


Image Processing

- Feature Matching

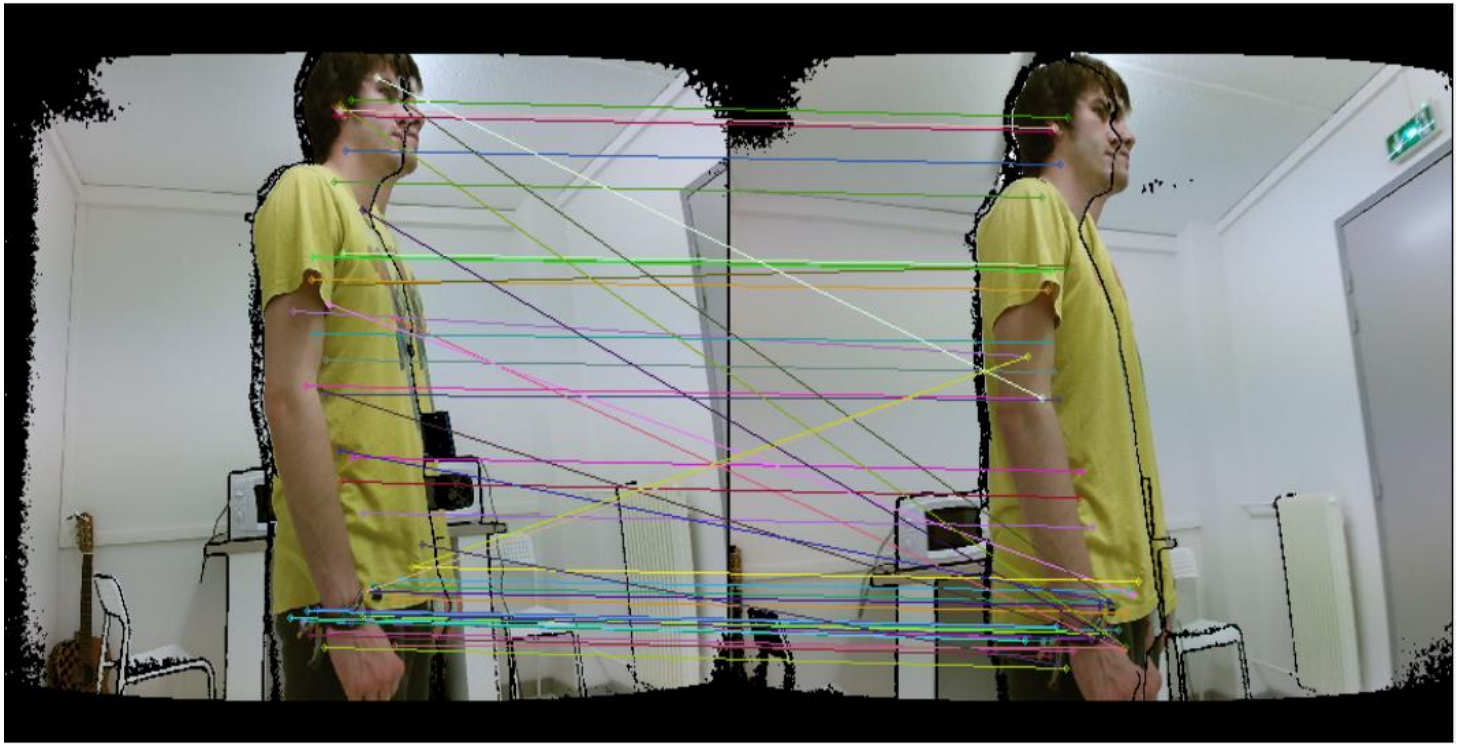


Image Processing

- Feature Matching

Image Processing

- Feature Matching

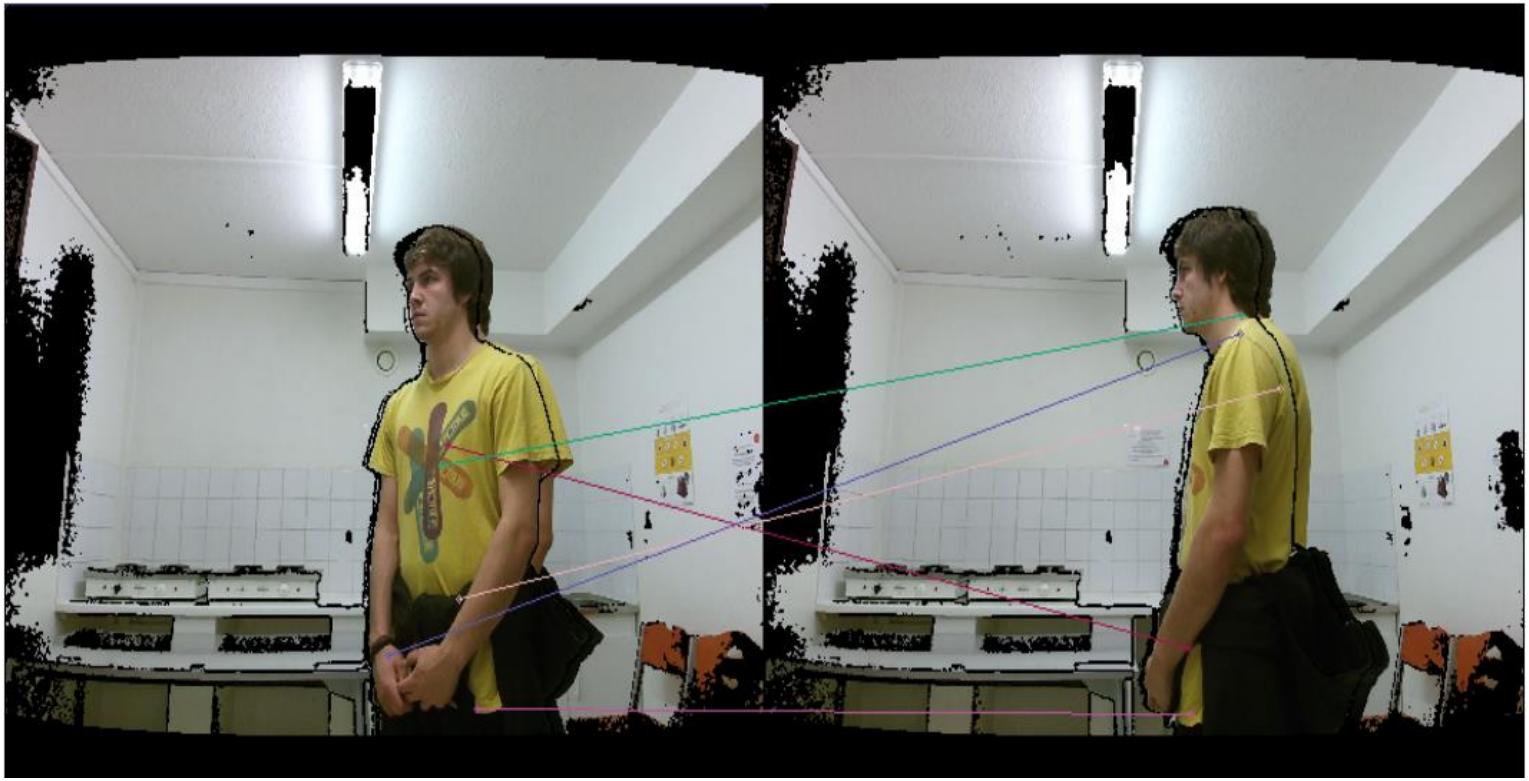


Image Processing

- Feature Matching

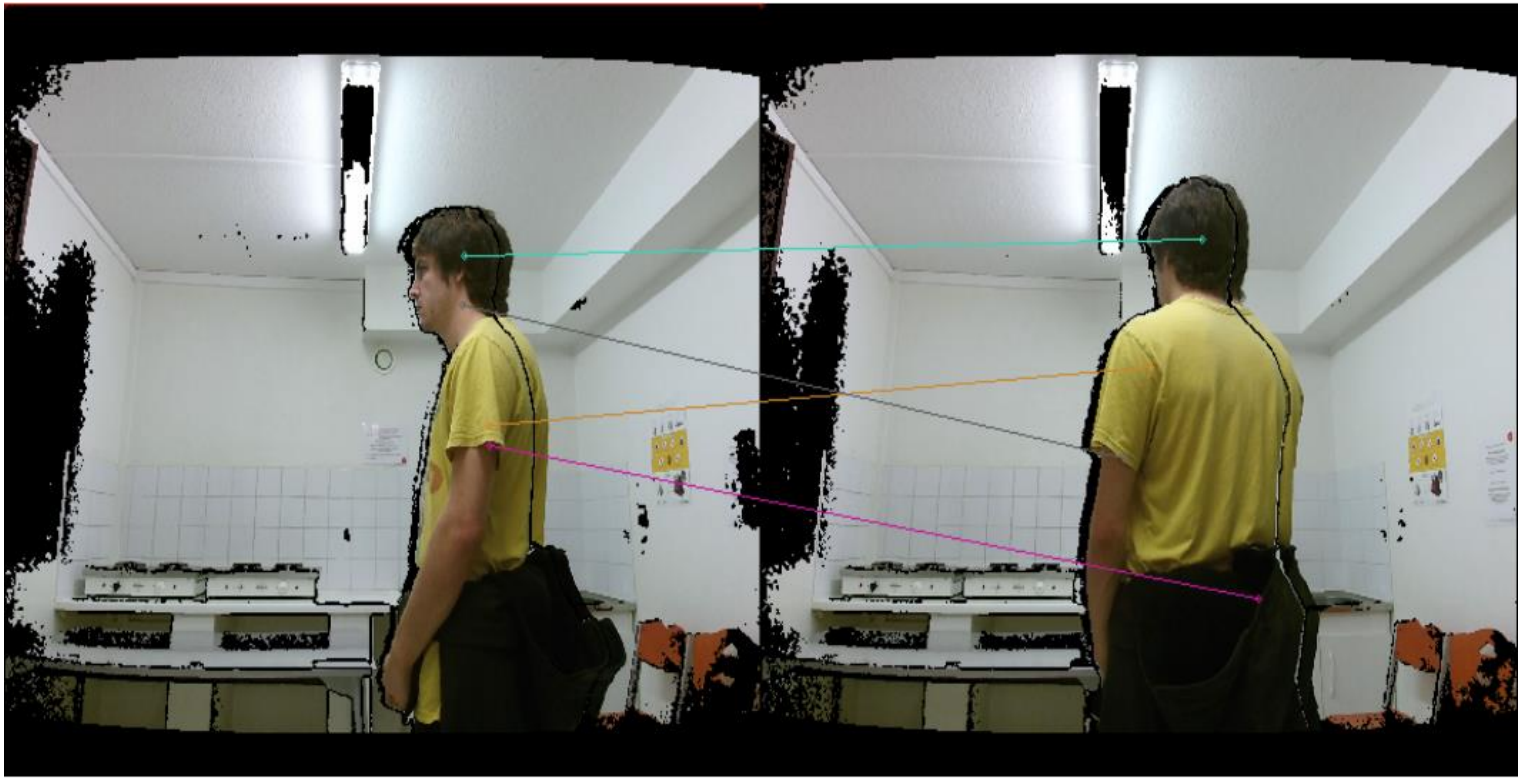


Image Processing

- Possible Variants

  - Speed Up Robust Features (SURF)
  - Binary Robust Invariant Scalable Keypoints (BRISK)
  - Fast Retina Keypoint (FREAK)
  - Fast Local Descriptor for Dense Matching (DAISY)
  - Video tracking as Optical Flow tracking (OpenCV)

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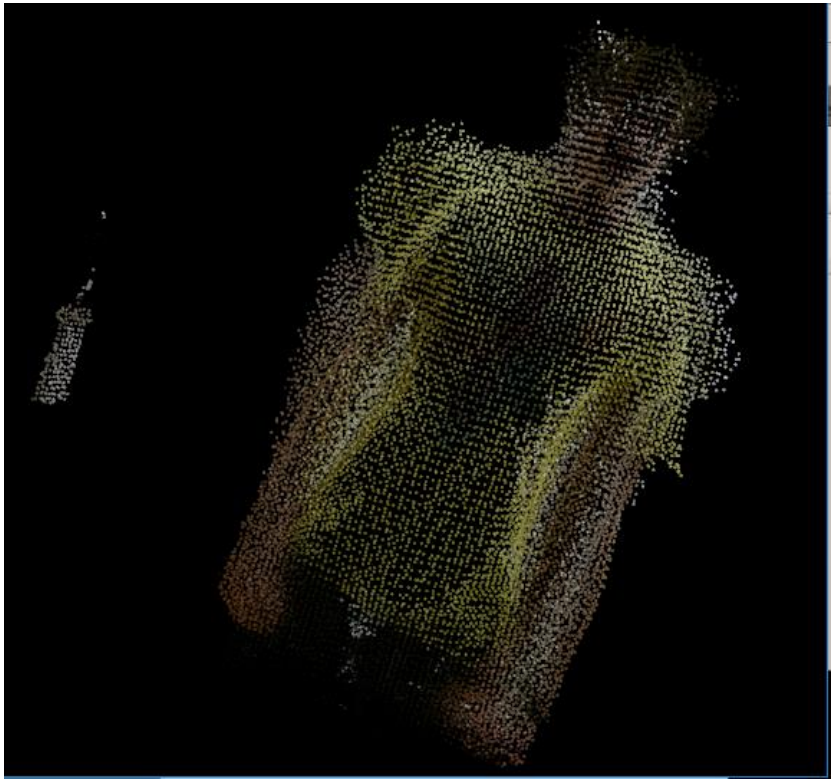
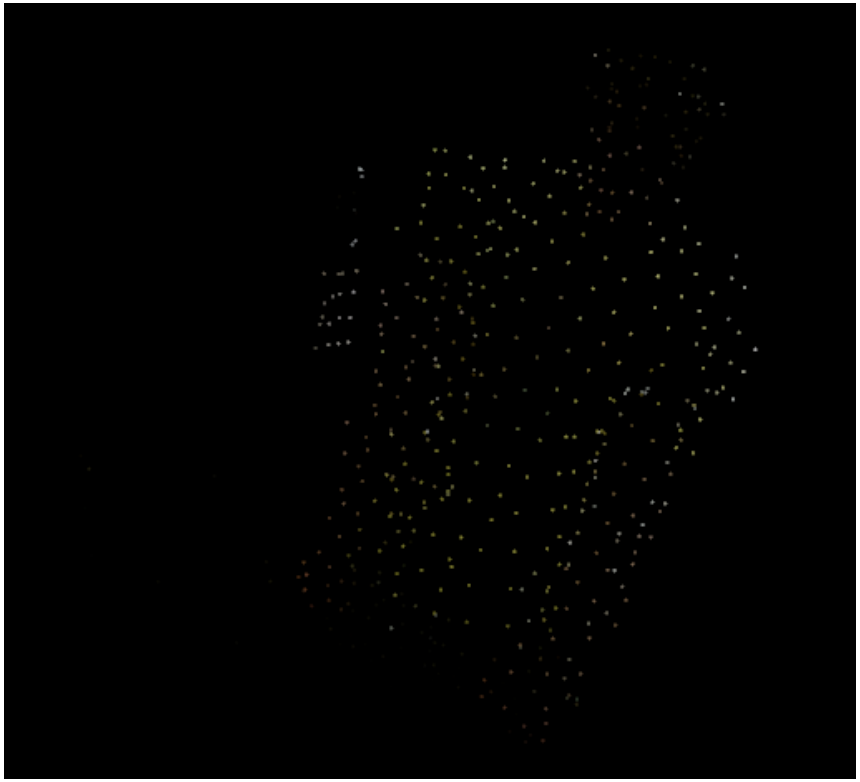
Point Cloud Processing

- Downsampling



Downsampled with 1cm distance

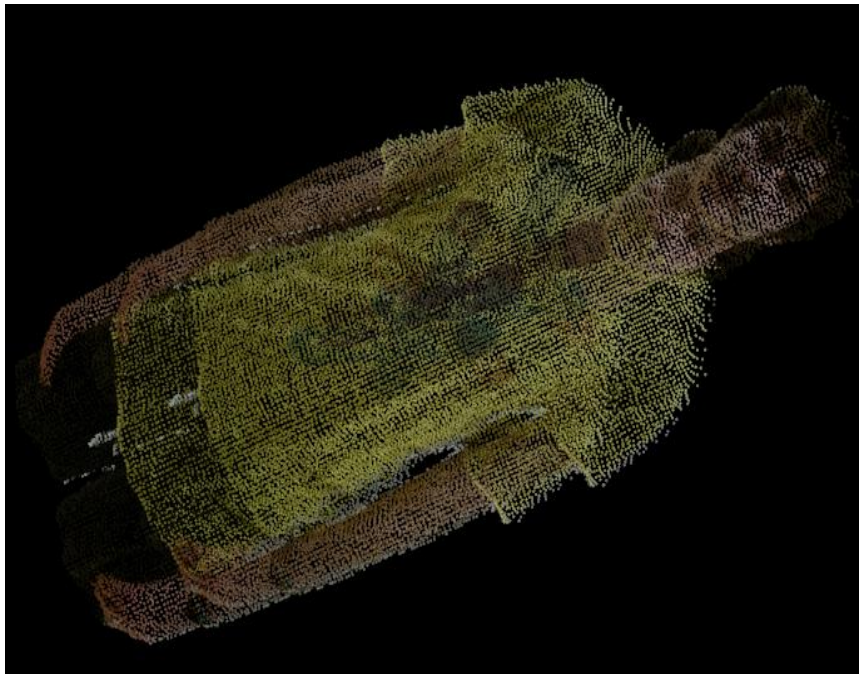


Downsampled with 5cm distance

Point Cloud Processing

- Iterative Closest Point (ICP)

ICP test 1



ICP test 2

Point Cloud Processing

- Outlier Removal

Final result before outlier removal

Final result after outlier removal

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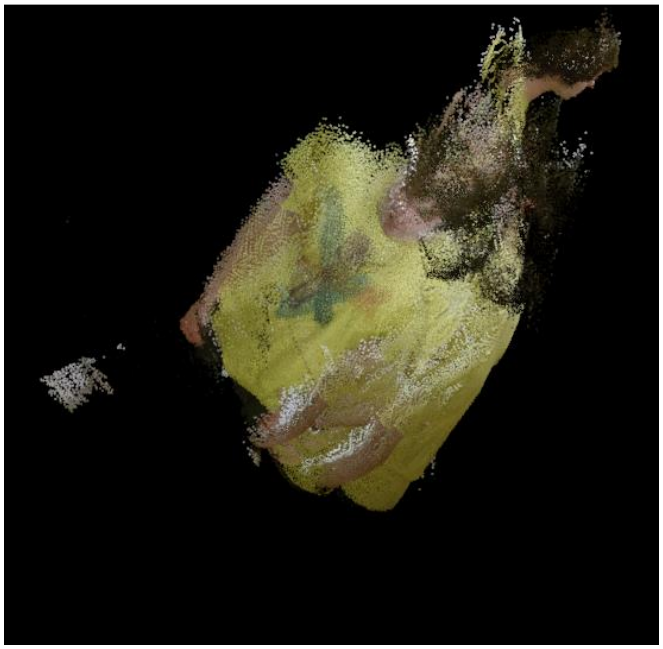
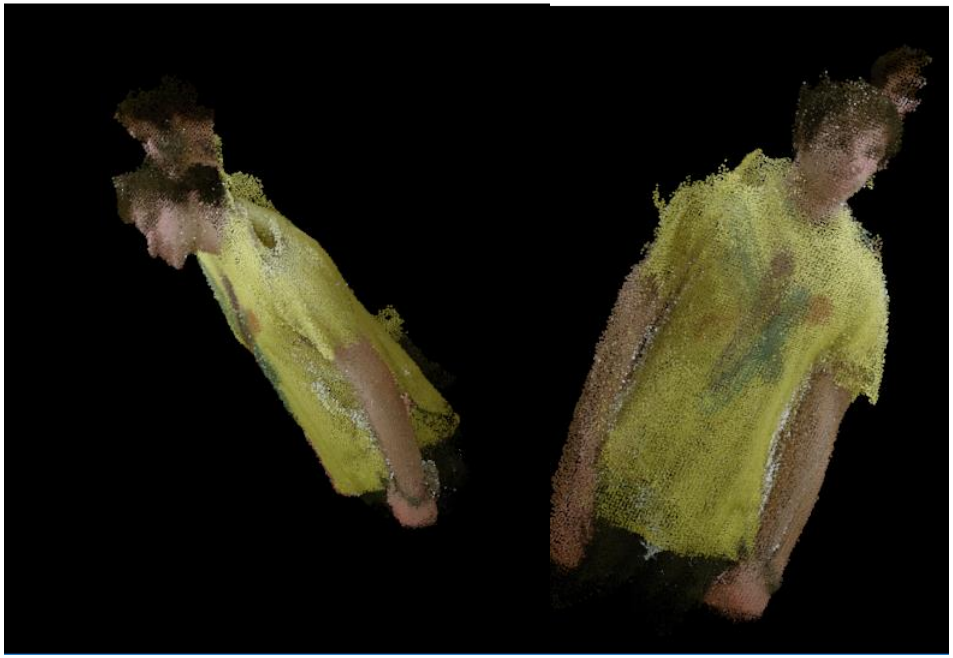
Results (as seen in demonstration)



SVD approach



SVD+ICP approach

Conclusions

- We tried our best to develop, a low cost Kinect based scanning system with the objective to generate 3D model of human body.
- We initiated from the previous projects and started from the scratch to bring some improvements in the project and learned variety of new skills such as image filtration in 3D, feature matching, 3D transformation and new tools such OpenCV, PCL and Kinect.
- However, due to time constraint, we were not able to achieve the results much similar as expected.