Sculptura

Software Engineering project

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Introduction

Main goal

The goal of our project was to create a 3D scanning system of human body

Objectives

- Data acquisition with Kinect
- Alignment methods using OpenCV
- Point Cloud registration improvement
- Color meshing
- GUI implementation

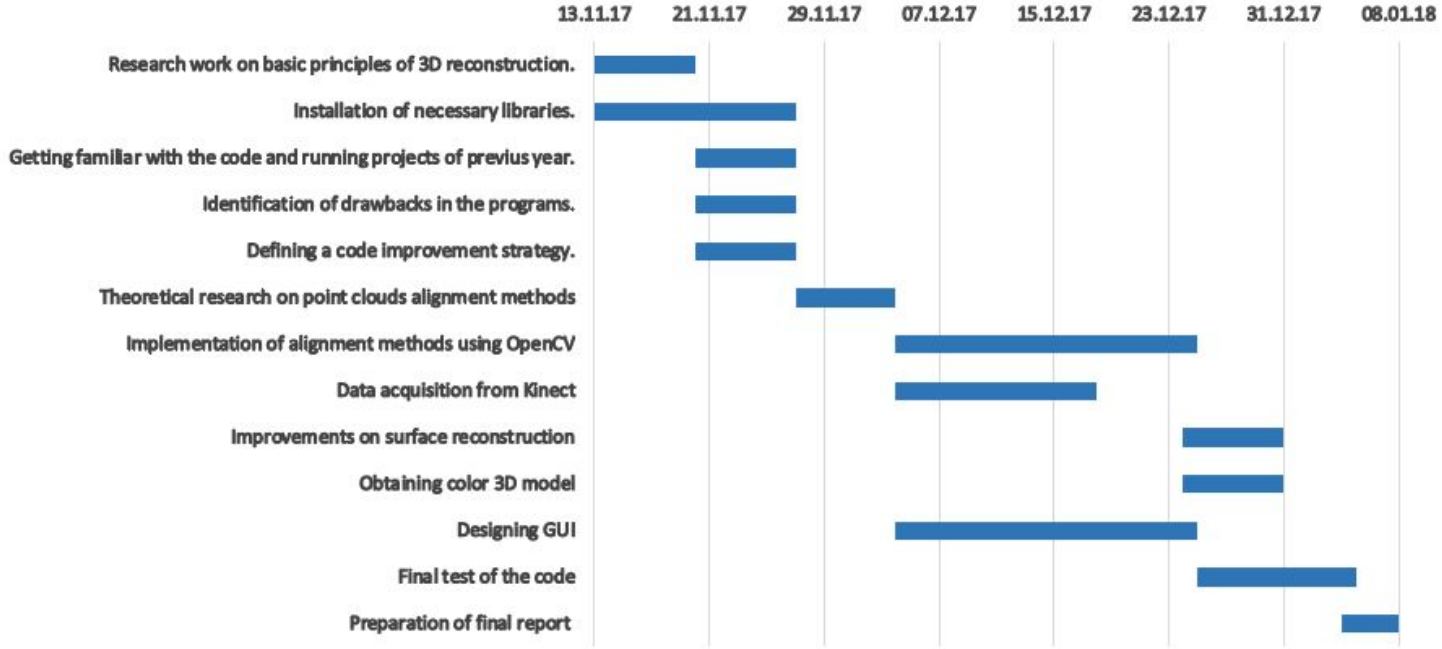
Project management

Roles in a team

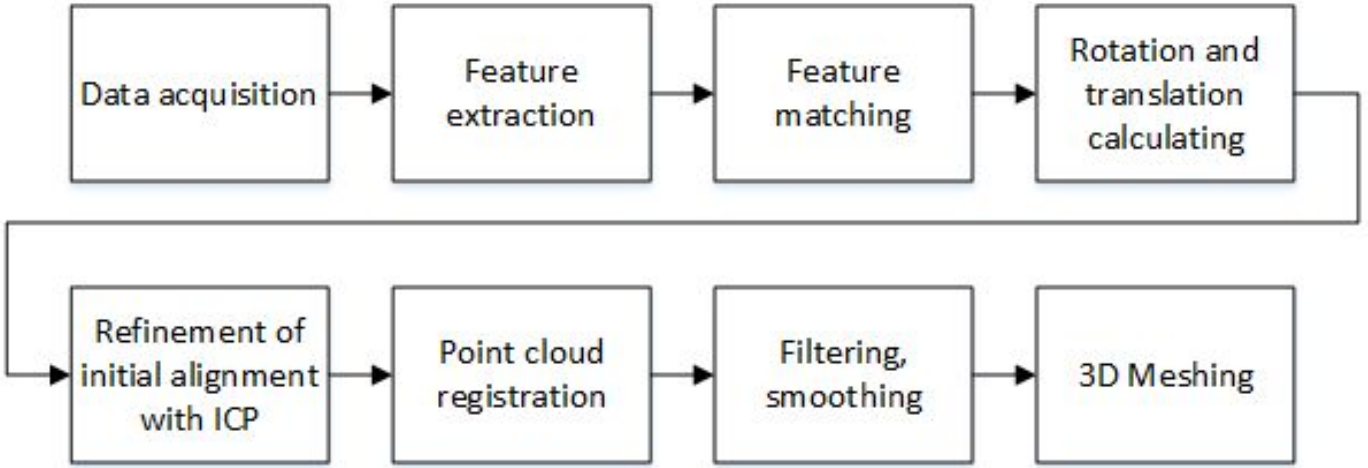
Karim Botros	Kinect data acquisition
Mohamed Ali	Feature operations and point cloud alignment
Elizaveta Genke	3D meshing
Daria Zotova	GUI implementation

Project management

Time management



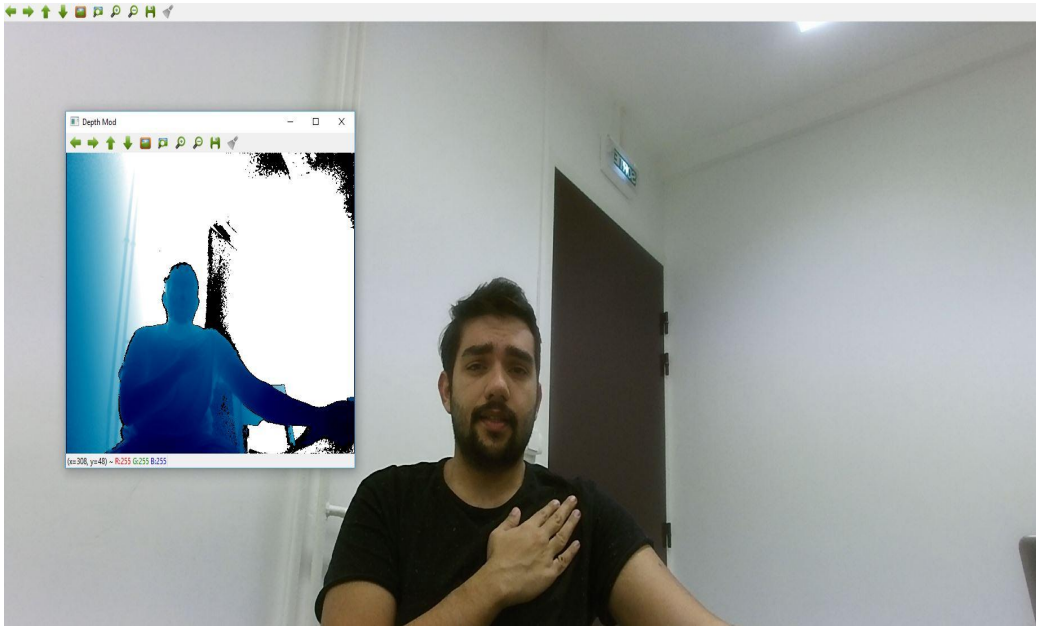
Software design

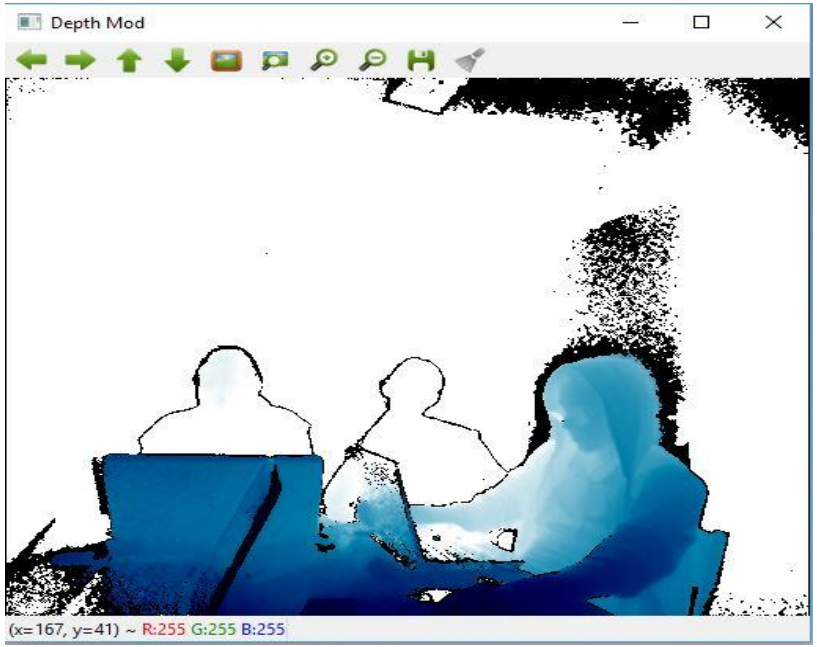


Data acquisition

- Principles of work
- Different kinds of data
- No null frame “Safe-Release”

Data acquisition





Point Cloud Registration

Iterative Closest Point (ICP)

- **Given:** Two corresponding point sets (clouds)

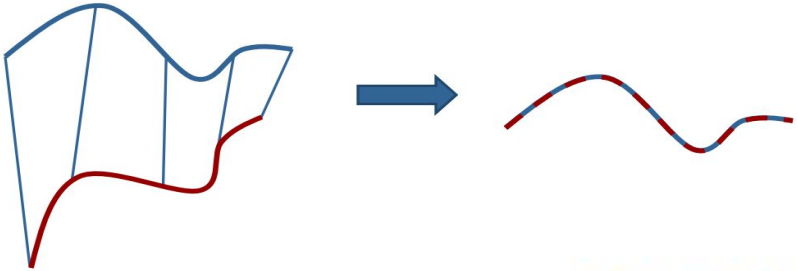
$$P = \{\mathbf{p}_1, \ldots, \mathbf{p}_n\}$$
$$Q = \{\mathbf{q}_1, \ldots, \mathbf{q}_n\}$$

- **Wanted:** Translation $\mathbf{t}$ and rotation R that minimize the sum of the squared error

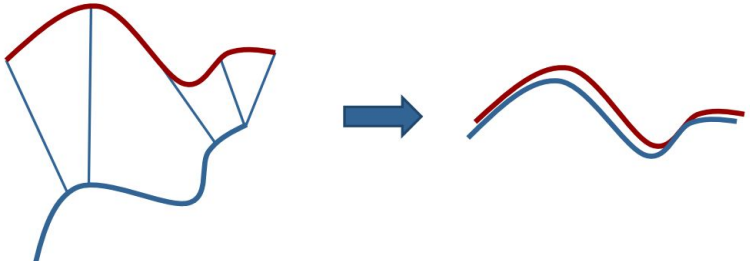
$$E(R, \mathbf{t}) = \frac{1}{n} \sum_{i=1}^{n} ||\mathbf{p}_i - R\mathbf{q}_i - \mathbf{t}||^2$$

where $\mathbf{p}_i$ and $\mathbf{q}_i$ are corresponding points

Known Correspondences



Unknown Correspondences



ICP Algorithm

[Besl & McKay, 92]

Selecting Source Points

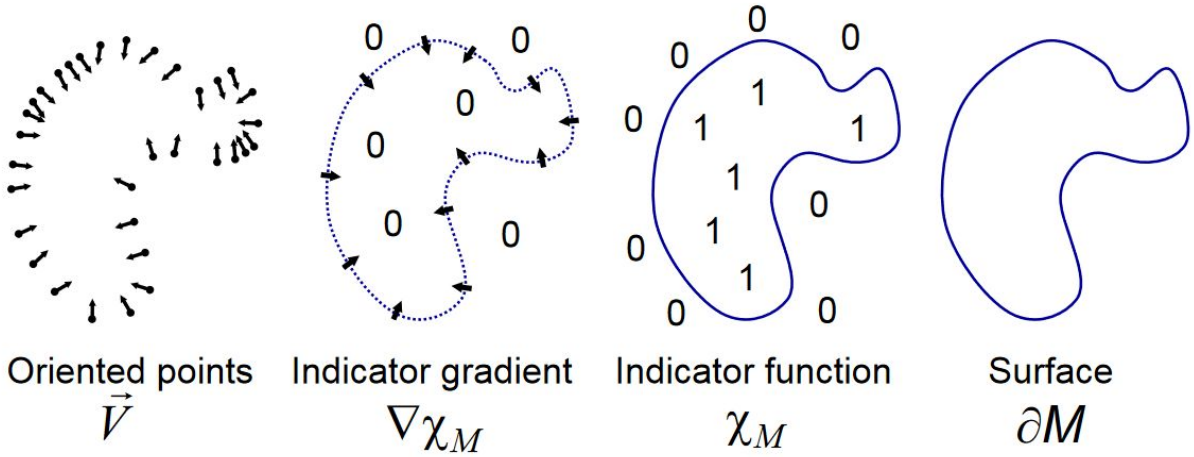
- Use all points
- Random sampling
- Spatially uniform sub-sampling
- Feature-based sampling

Feature-based Sampling

Detect interest points (same as with images)

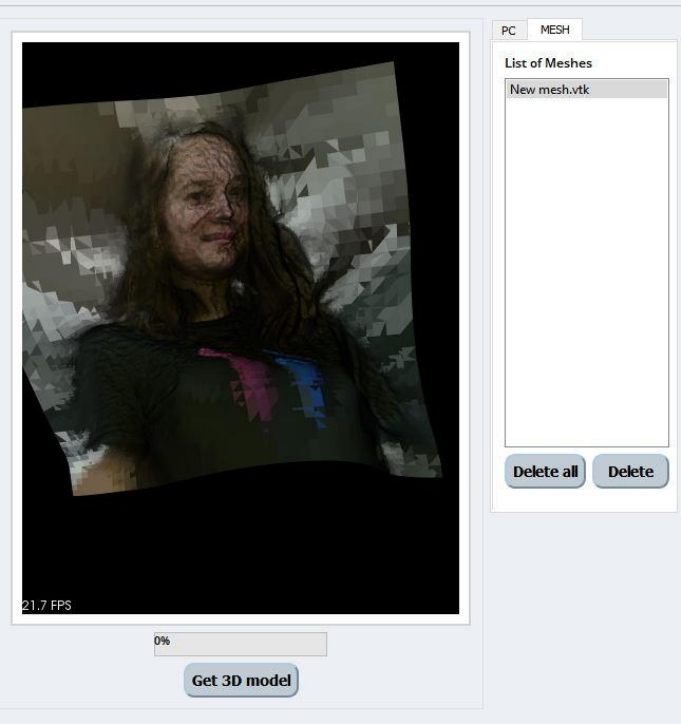
- Decrease the number of correspondences
- Increase efficiency and accuracy
- Requires pre-processing

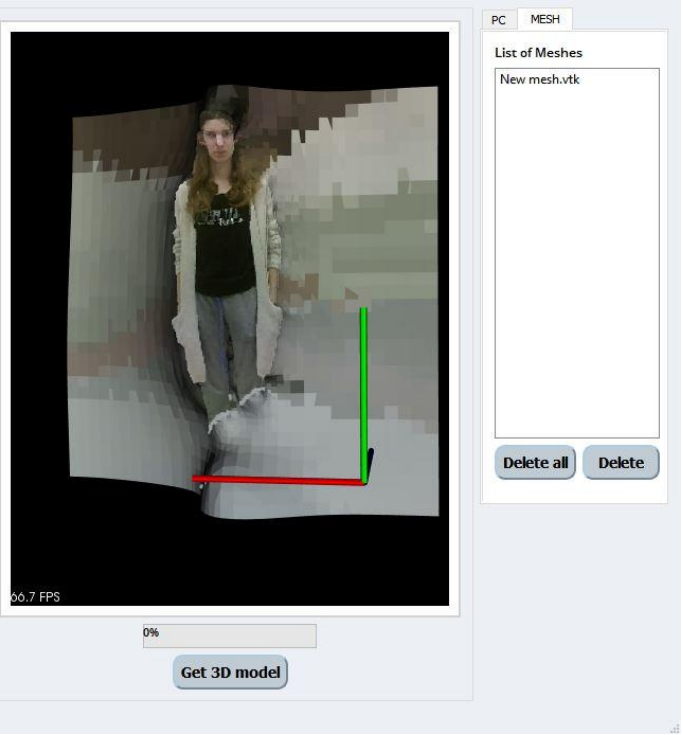
3D meshing



M.Kazhdan et al. / *Poisson Surface Reconstruction (2006)*

3D meshing


PC
MESH
List of Meshes
New mesh.vtk
Delete all
Delete
21.7 FPS
0%
Get 3D model

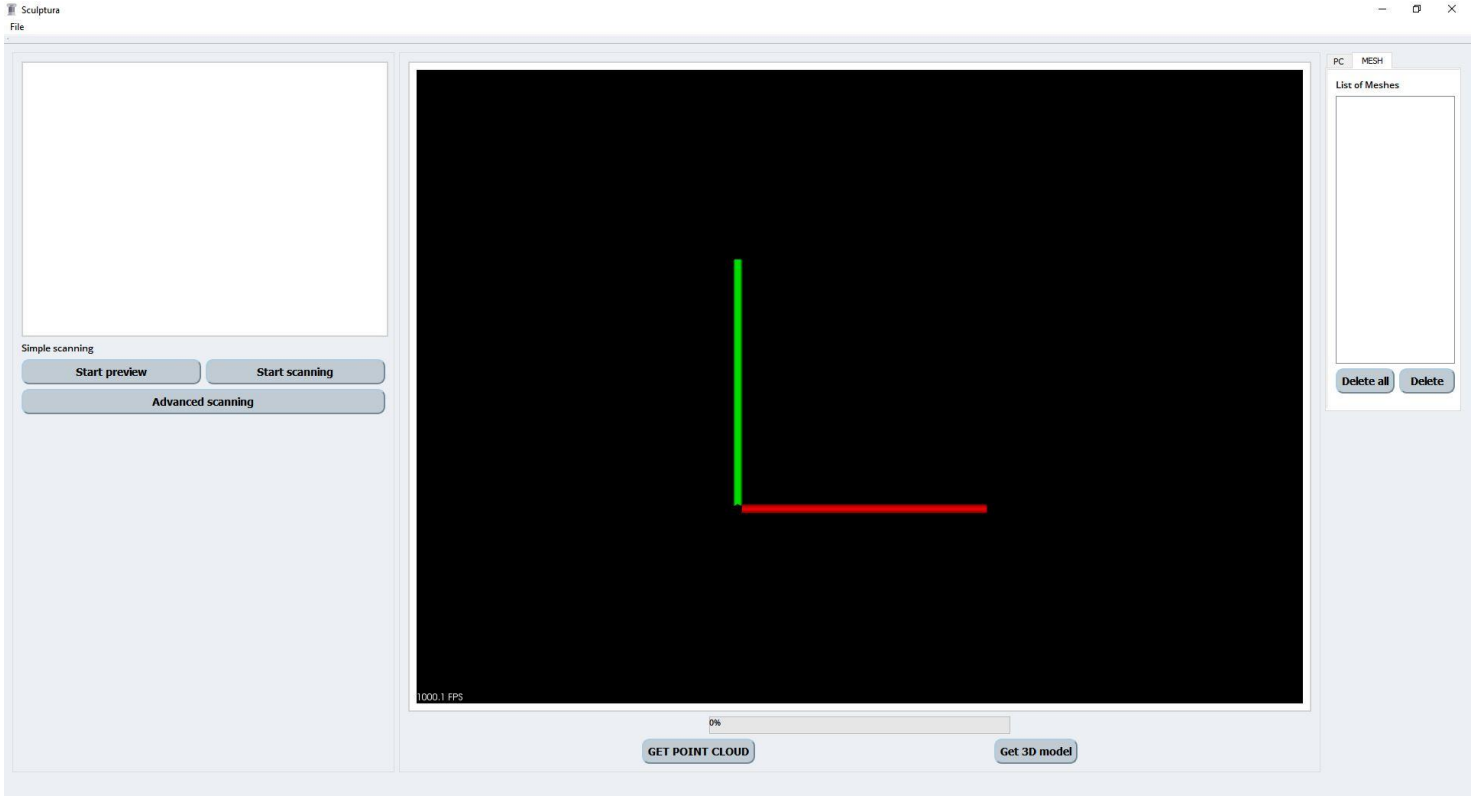

PC
MESH
List of Meshes
New mesh.vtk
Delete all
Delete
66.7 FPS
0%
Get 3D model

GUI implementation

Requirements

- Implementation in Qt Designer
- Simplicity of usage
- Usability in Software Design
- Minimum interactions to get final result

GUI implementation



Thank you for your attention.