

Senior Project, 2014, Spring

Human Hand Movement Visualization

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Problem

BACKGROUND: Data is collected from the movement of a human hand using MEMS inertial sensors. This data is then processed by MATLAB into rotational data.

PROBLEM: The collected data needs to be visualized. The solution must read the data obtained by MATLAB and render a visualization of the movement of the hand.

Current System

Currently a visual representation has been created with the Processing programming language and IDE.

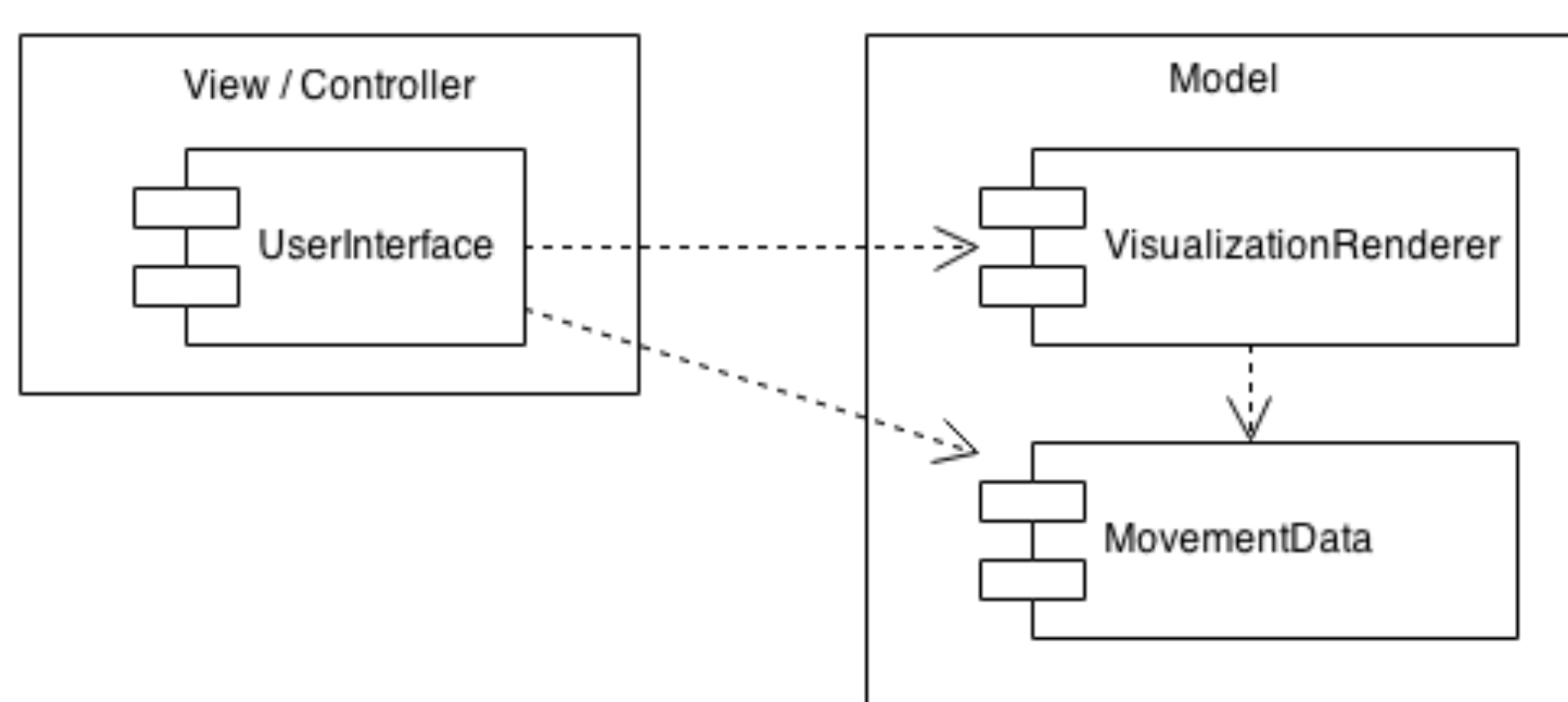
Limitations of the current system include the inability to load data directly from MATLAB and limited extensibility.

Requirements

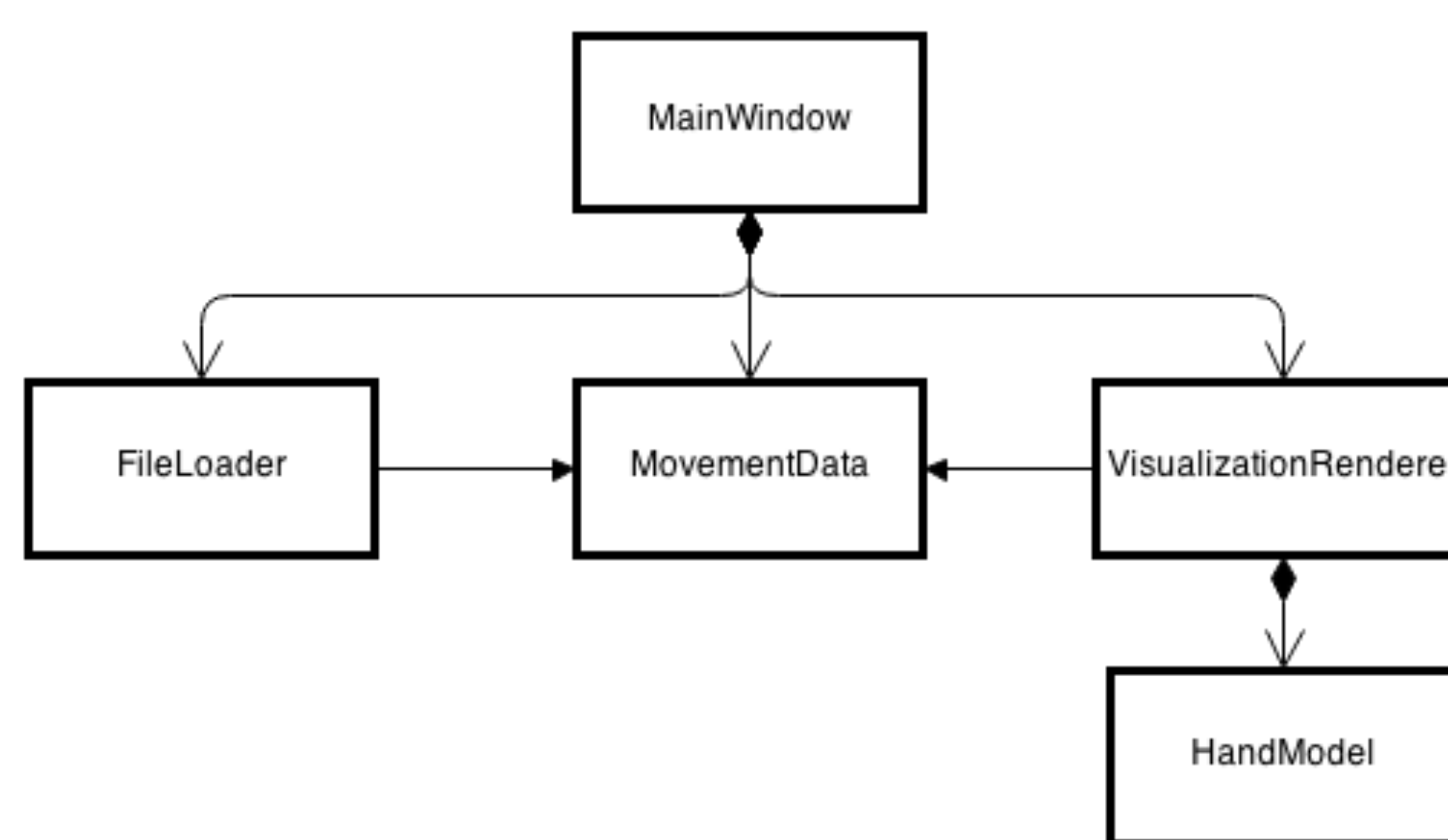
The solution must correctly display the movement data consisting of the following motions:

- Rotation of the hand around the X, Y, and Z axes
- Rotation of the thumb around the X, Y, and Z axes from a given position θ
- Rotation of the thumb on a given plane

System Design



Object Design



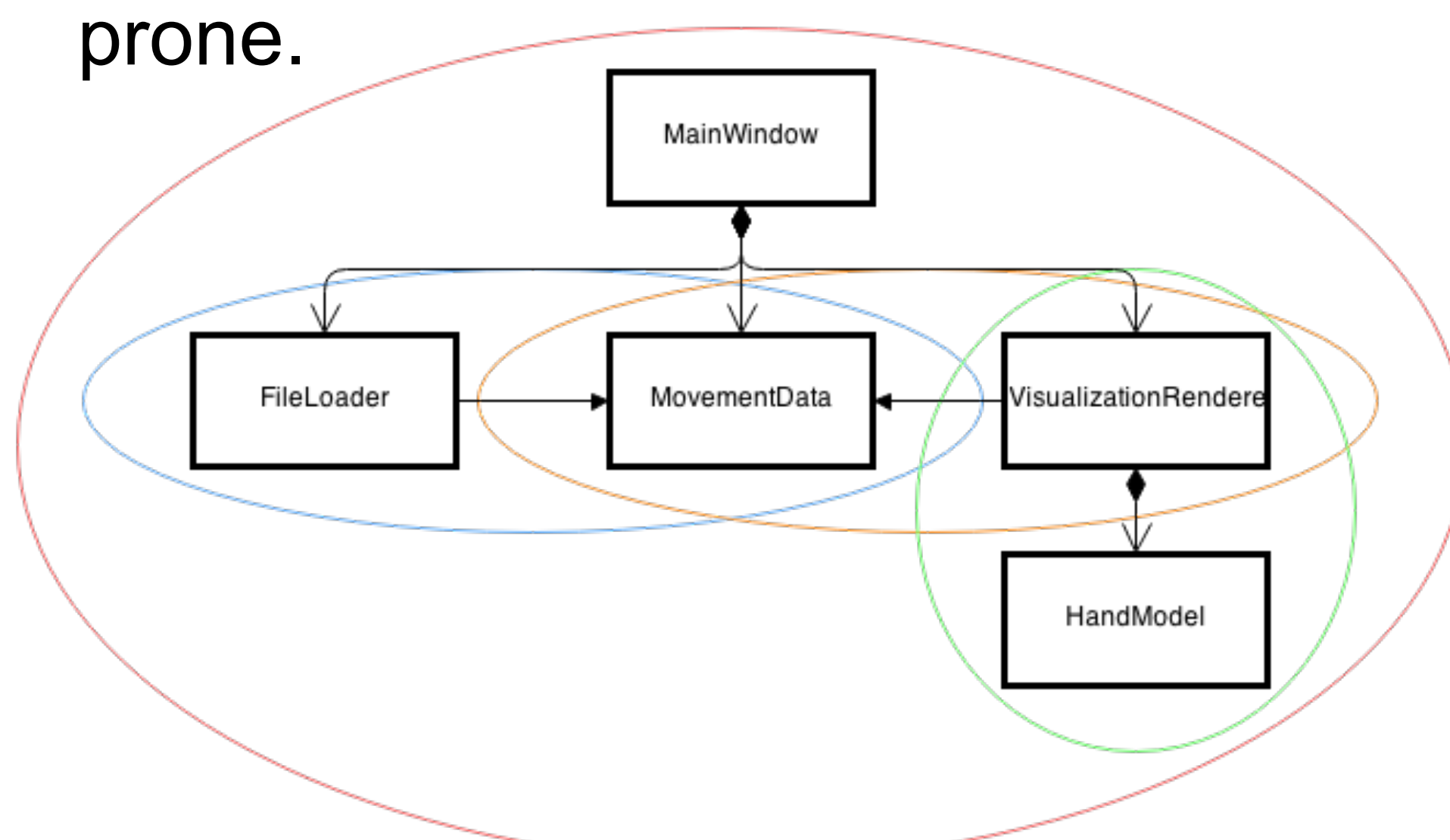
Implementation

The core of the solution lies in the VisualizationRenderer class:

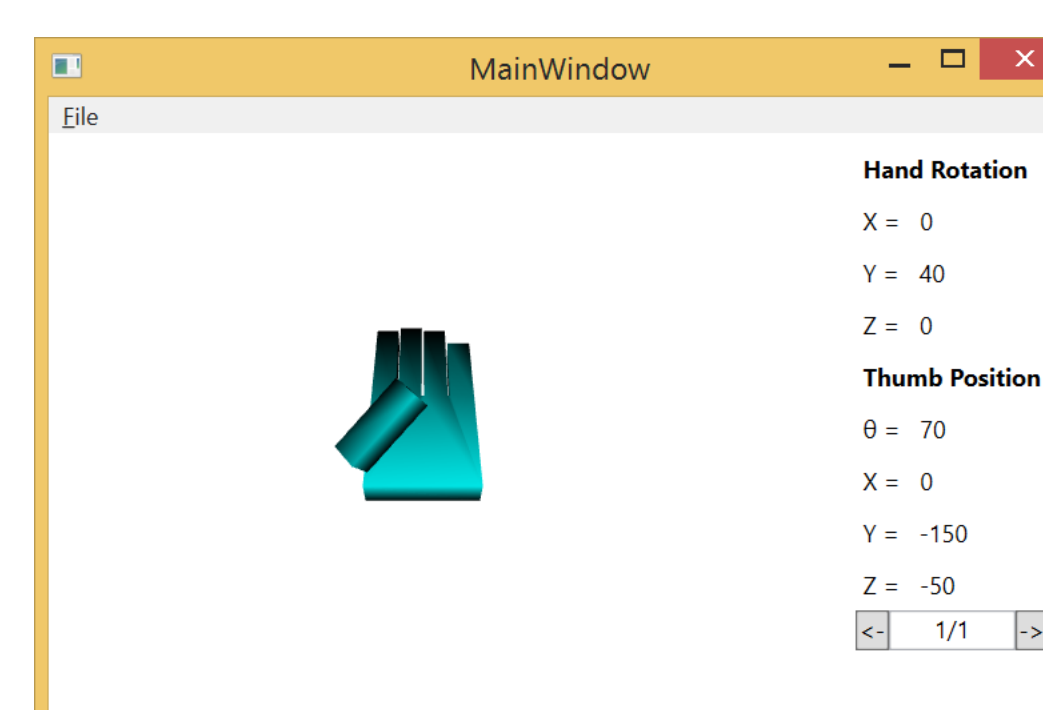
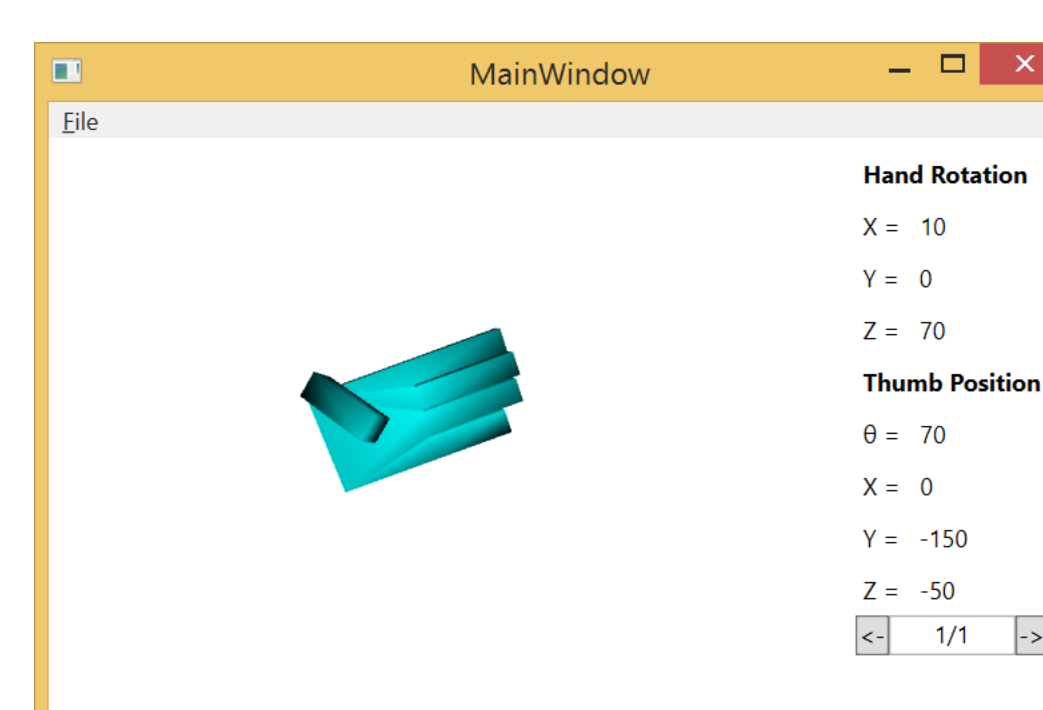
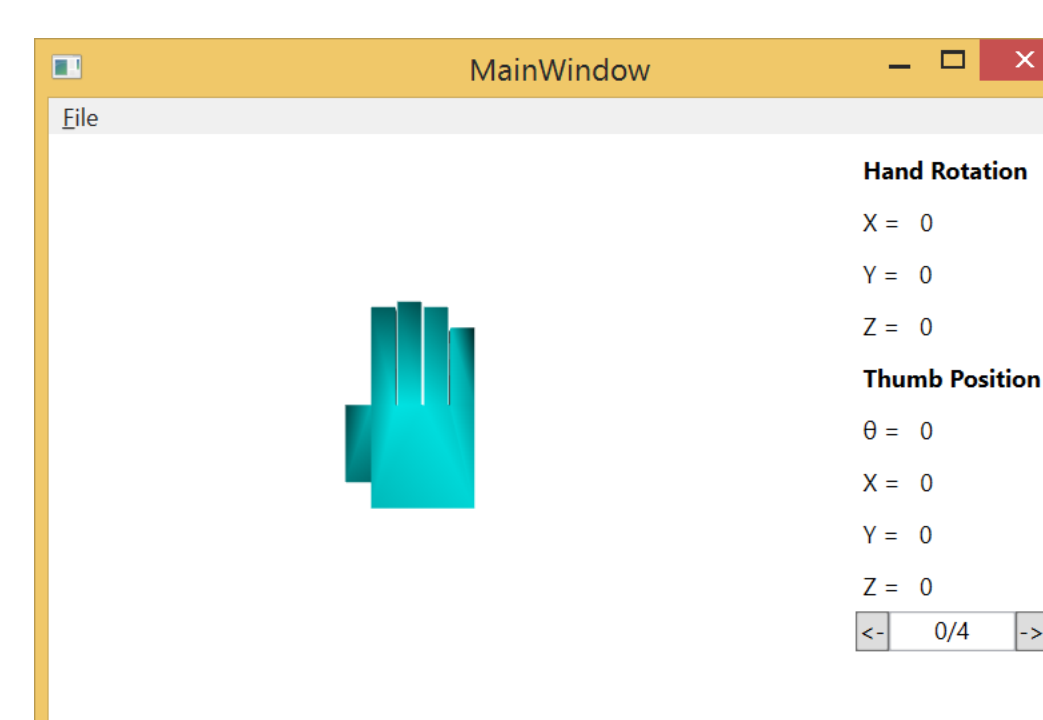
- The hand is rotated according to the loaded data
- The thumb's initial position is calculated from a value θ
- The thumb is rotated around its base
- The thumb is transformed onto a given plane
- Rotations use WPF animations to transition smoothly between positions

Verification

The functionality of each class was tested in isolation first. Following this, each class was tested while paired with any associated class as shown in the image below. This bottom up approach ensures that the solution is thoroughly tested with a high degree of confidence that the system is stable and not error-prone.



Screenshots



Summary

Data obtained from the movement of a human hand needed to be visualized. Visualization software was created to accomplish this.

The solution renders a 3D model of a hand and thumb and transforms the model according to the data. The hand rotates around its X, Y, and Z axes. The thumb is transformed by an angle θ representing the initial position of the thumb in relation to the hand. Then, the thumb is transformed around its X, Y, and Z axes. Additionally, the thumb can be transformed onto a given plane and rotated on that plane.

Acknowledgement

The material presented in this poster is based upon the work supported by my mentor, Fatemeh Abyarjoo.