BME 402

iPhone VR Training Model for Microsurgical Practice

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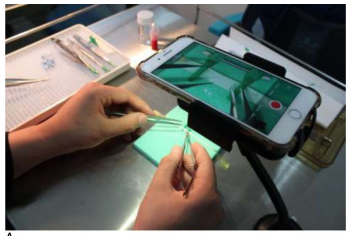
Problem Statement

Challenge

Lack of microsurgical practice due to limited resources

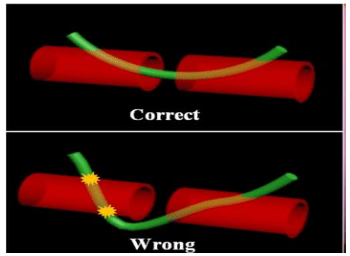
Solution

iPhone camera provides comparable magnification to microscopes



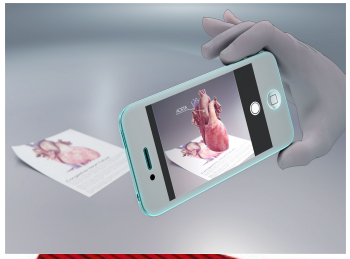
Problem

1. Inadequate depth perception by iPhone alone
2. Too much delay



Proposal

Streamlined real-time iPhone VR training model with little time delay



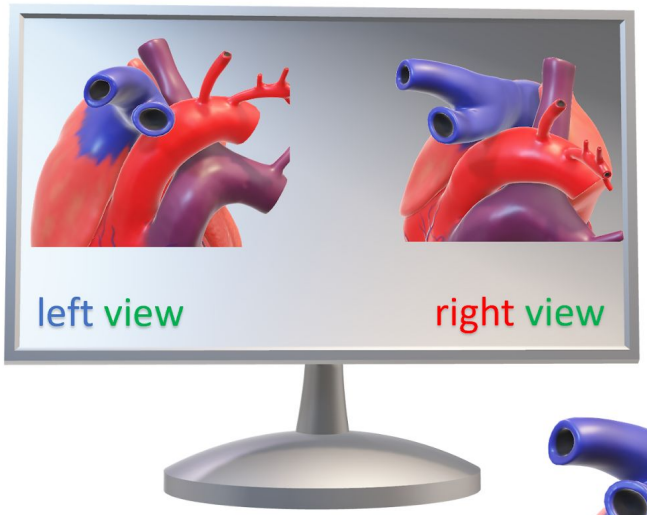
Product Design Specifications (PDS)

- Client Prototypes:
- iPhone on stand connected to Macbook
- VR App on iPhone creating two images
- iPhone on stand connected to Macbook with Google VR cardboard glasses

- Improve the VR viewing experience
  - Minimize display lag between devices

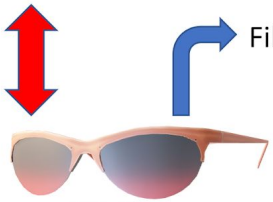
- Minimize unnecessary visuals to the user's eyes
  - Not overly bright, no sudden flashes, reduce motion blur
- Minimize the number of devices used

Design - 3D Glasses Model

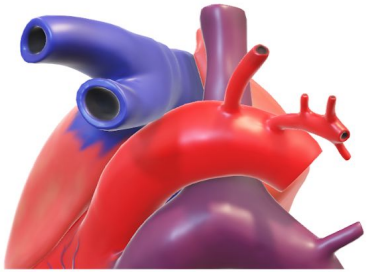


Filter that only passes light from right image

Filter that only passes light from left image

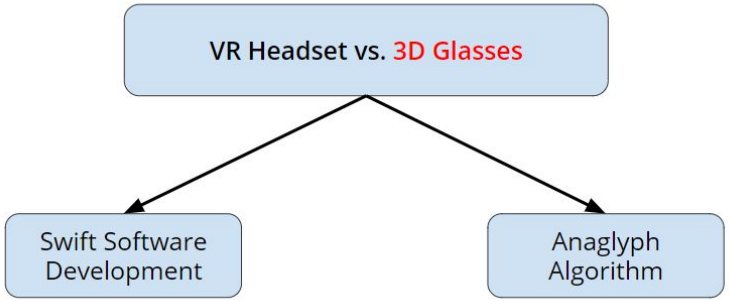


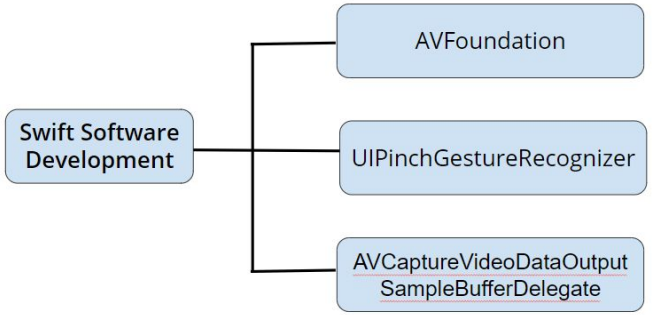
3D Glass

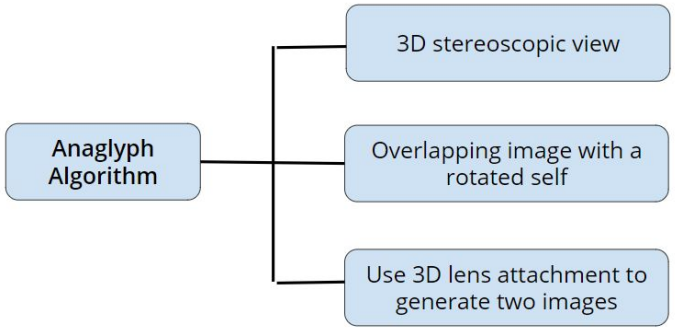


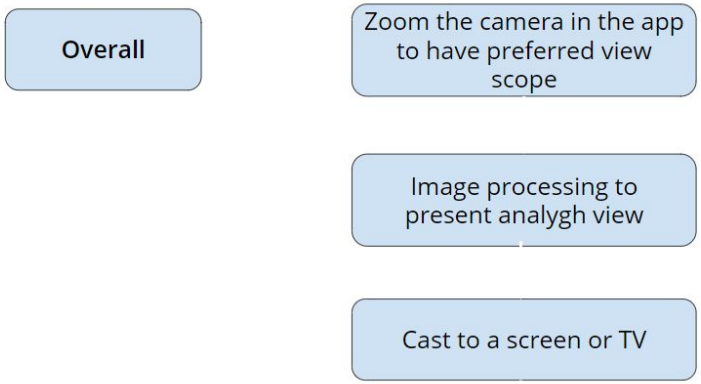
combined view

Methodology









Code Development Evaluation

```
General Properties:
         Name: 'Jiong.avi'
         Path: 'C:\Users\User1\Documents\MATLAB'
     Duration: 2.1595
  CurrentTime: 0
    NumFrames: 63

Video Properties:
        Width: 1080
       Height: 1920
    FrameRate: 29.9700
 BitsPerPixel: 24
  VideoFormat: 'RGB24'
```

```
General Properties:
         Name: 'Rabbit.avi'
         Path: 'C:\Users\User1\Documents\MATLAB'
     Duration: 125.9607
  CurrentTime: 0
    NumFrames: <Calculating...> learn more
```

Expected: 1890 frames

```
Video Properties:
        Width: 320
       Height: 240
    FrameRate: 15.0000
 BitsPerPixel: 24
  VideoFormat: 'RGB24'
```

The performance of the code while processing different video is significantly dependent on the power of the hardware.

The performance of the code is based on how long it takes to process the modified video relative to the length of the original video.

Testing Results

The code in this current iteration as well as its present hardware (64-bit Windows 7 computer with an Intel(R) Core(™) i7-4770 CPU @ 3.40 GHz with 16.0 GB of ram) is incapable of processing video that we expect to be used in the proper environment.

There are two aspects that we can focus on: refining the code as we convert it to be used in the Swift language so that it can run more efficiently, and increase the minimum requirements of the smartphone to be used so that more powerful hardware is required in practical use.

	Rabbit.avi	star_trails.avi	Jiong.avi
Original Video Frame Rate	15	25	29.97
Program Processing Speed in Frames per Second	46.58	10.964	5.14
Video Quality in Pixel Resolution	320x240	1280x720	1080x1920

Discussion

- Software Development
  - Basic functions achieved
  - Two white edges near top and bottom can potentially be removed, but does not affect usage
- Anaglyph Conversion
  - Functional Software in MATLAB
  - Requires Swift adaptation
  - Requires further modification to perform optimally in a scenario similar to one requested by the client

Timeline - Goals

- Fabrication
  - App Software
    - Camera Function - Completed
    - Data Stream Collection - In Progress
  - Image Conversion Software
    - MATLAB image Conversion - Completed
    - Swift Image Conversion - In Progress

- Testing/Evaluation
  - Software Bug Removal
  - Long Exposure Evaluation
  - Effective Latency
  - Depth Perception Effectiveness
  - Resolution Comparison

Budget

- The design team was not informed of a formal budget for the project
  - Materials that may be required to purchase must be run through Dr. Poore and his lab group.

Future Work

- Near Future
  - Software production

- Far Future - Testing
  - Software Bug Removal
  - Long Exposure Evaluation
  - Resolution Comparison
  - Effective Latency
  - Depth Perception Effectiveness

Acknowledgements

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  - Dr. Ellen Shaffrey
  - Dr. Poore’s Lab Group
  - Dr. Suarez-Gonzalez

References

[1] “Microsurgery Essentials: Intra-Operative Technique,” *Plastic & Reconstructive Surgery*. https://plasticsurgery.stanford.edu/education/microsurgery/intraoperative.html (accessed Oct. 01, 2020).

[2] “Highest Resolution Microsurgery Microscope | MM51,” *Mitaka USA*. https://mitakausa.com/mm51/ (accessed Sep. 18, 2020).