JOHNS HOPKINS WHITING SCHOOL of ENGINEERING

LABORATORY FOR Computational Sensing + Robotics

Group 11: Augmented Reality Magnifying Loupe for Surgery

Checkpoint Presentation

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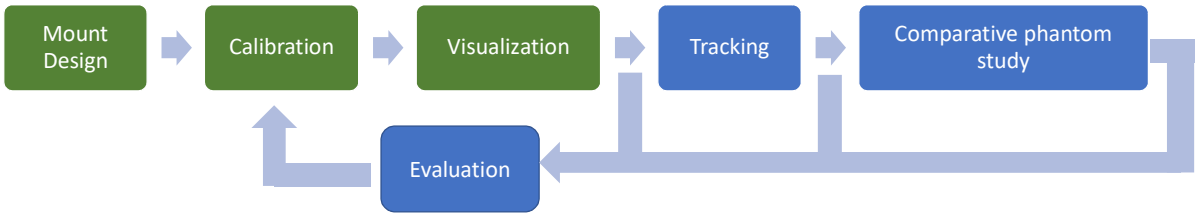
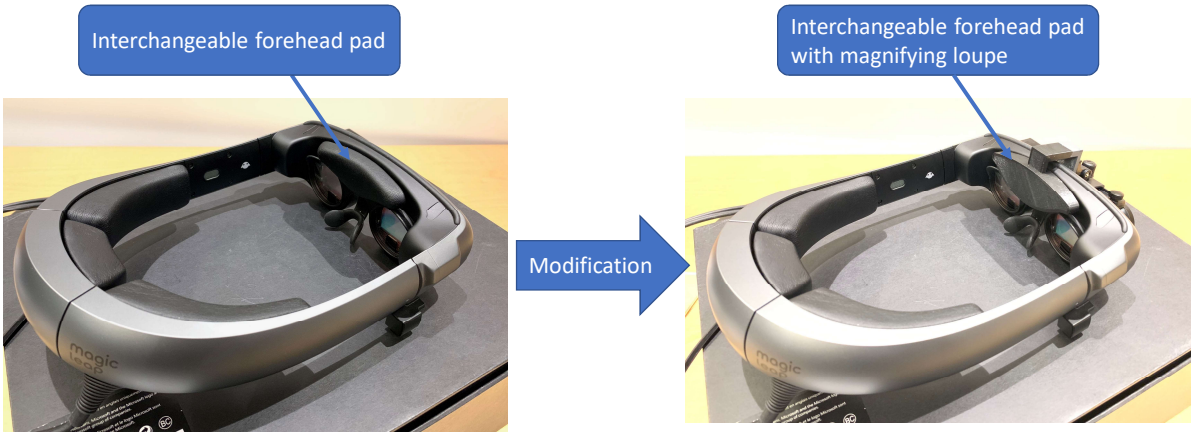
Project Summary

- Objectives:
  - Design a surgical loupe mount for optical see-through (OST) head-mounted display (HMD) and develop a calibration method to associate the field-of-magnified-vision, the HMD screen space and the task workspace.
- Current Status:

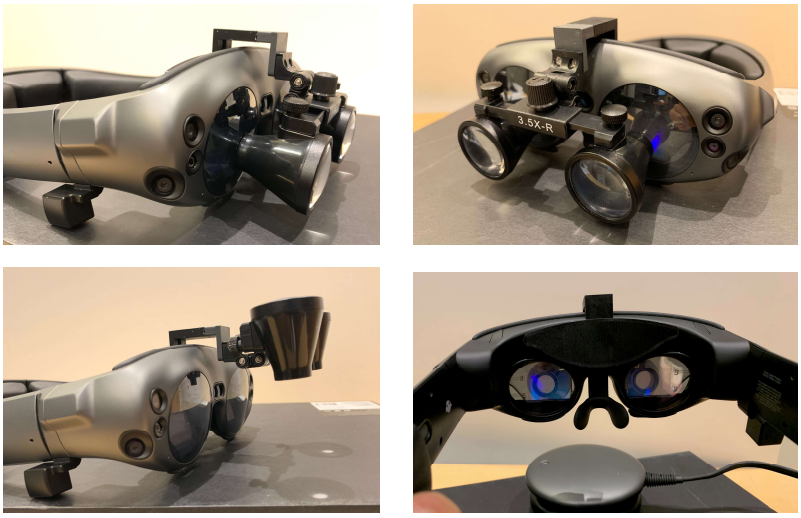


Mount Design



3

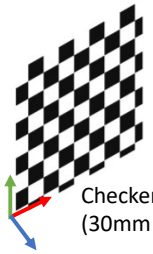
Mount Design



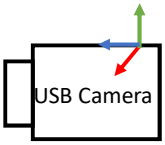
- ✓ Interchangeable lens for different magnification
- ✓ Able to flip
- ✓ Adjustable distance for different users

4

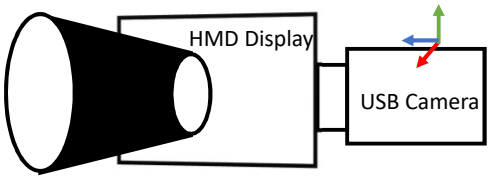
Calibration



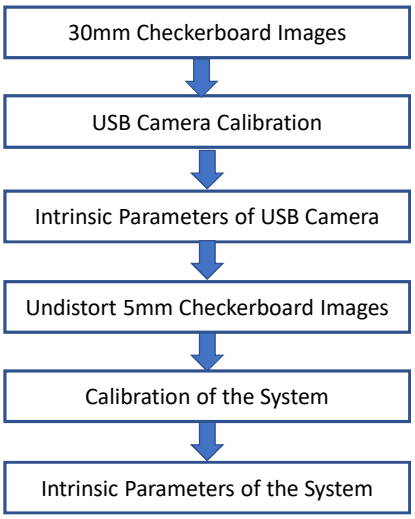
Checkerboard
(30mm grid)



Mini Checkerboard
(5mm grid)

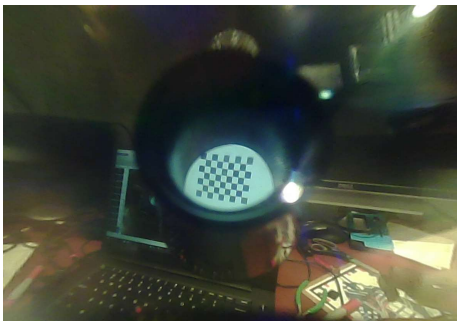


Magnifying
Loupe

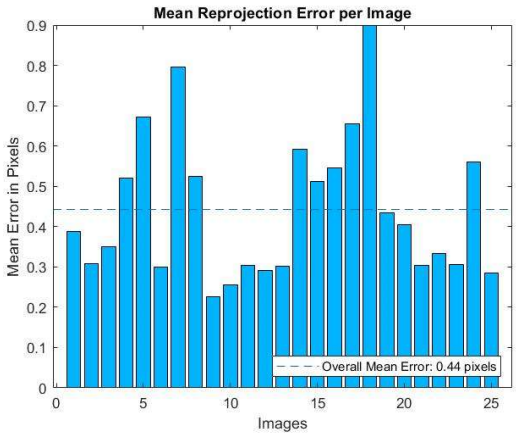


5

Calibration

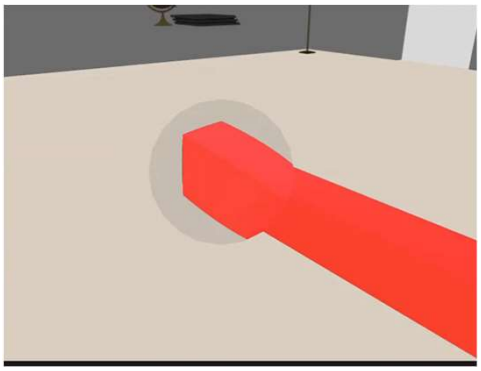


5mm checkerboard image captured by USB Camera

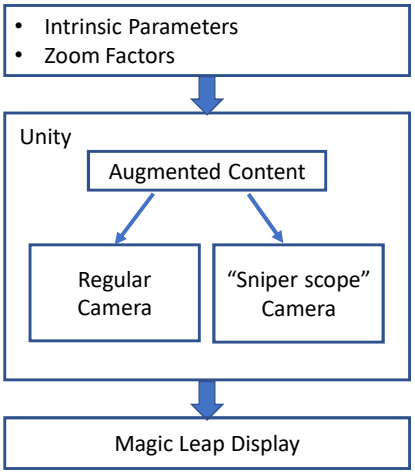


6

Visualization

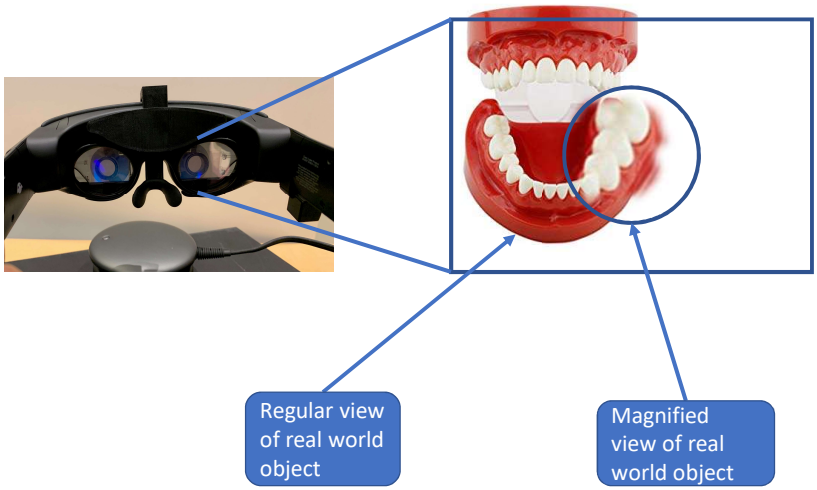


Magic Leap simulator display view



7

Visualization



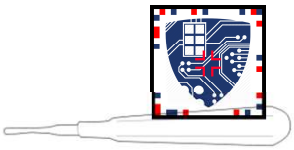
Problem: How to merge the magnified real and augmented content? Where is the 2D location of the circle on the display and what is the radius?

Solution: User dependent calibration to determine where to put my "sniper scope" camera view on display

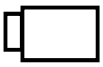
8

Tracking

RGB Marker tracking camera



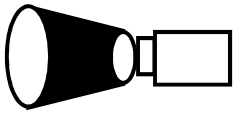
Dental tool + AR marker



RGB Camera on Magic Leap

Modification

Dental tool + mini AR marker



Magnifying Loupe

RGB Camera on Magic Leap

9

Updated Schedule

Activities	Feb 11	Feb 18	Feb 25	Mar 4	Mar 11	Mar 18	Mar 25	Apr 1	Apr 8	Apr 15	Apr 22	Apr 29	May 6	May 9
Literature review **(Complete)**														
Plan proposal and presentation **(Complete)**														
Design and manufacture HMD mount for loupes **(Complete)**														
Code Documentation **(Active)**														
Develop HMD calibration methods for single eye **(Complete)**														
Develop stereo HMD calibration methods **(Active)**														
Error Evaluation **(Active)**														
Track minimized AR marker **(Upcoming)**														
Conduct a comparative phantom study **(Upcoming)**														
Prepare for final report and poster **(Upcoming)**														

10

Updated Deliverables

- Minimum: A hardware prototype to integrate Magic Leap One with magnifying loupe, a calibration process for single eye
- Expected: A user-friendly stereo calibration process to associate the field-of-magnified-vision, the HMD screen space and the task workspace
- Maximum: Minimized AR marker tracking ability, evaluation results of proposed system with a comparative phantom study

Updated Dependencies

Dependencies	Solution	Alternative	Estimated Date
Access to Magic Leap One	Ask Dr. Navab for access	Ask Ehsan for Epson BT-300	Resolved
Access to surgical loupe	Ask Long for access		Resolved
Access to CAD Software (SolidWorks or PTC Creo)	Download from JHU software catalog		Resolved
Access to 3D printer	Access to LCSR 3D printer	Use DMC 3D printer	Resolved
USB Camera with wide FOV	Ask Long for access	Buy one from Amazon	April 11

Updated Key dates and milestones

- Mar 4th: Finish Hardware prototype, begin calibration
- Mar 25th: Finish calibration for single eye
- Apr ~~8th~~ 15th: Finish stereo calibration, begin ~~evaluation~~ implementing minimized AR marker tracking
- May 6th: Finish evaluation and minimized AR marker tracking
- May 9th: Finish project report

References

- M. Figl *et al.*, "A fully automated calibration method for an optical see-through head-mounted operating microscope with variable zoom and focus," in *IEEE Transactions on Medical Imaging*, vol. 24, no. 11, pp. 1492-1499, Nov. 2005.