

NSF Engineering Research Center
for Computer Integrated Surgical
Systems and Technology



LABORATORY FOR
**Computational
Sensing + Robotics**
THE JOHNS HOPKINS UNIVERSITY

MICRON RANGE-OF- MOTION VISUALIZATION

Team-14

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**WHITING
SCHOOL OF
ENGINEERING**
THE JOHNS HOPKINS UNIVERSITY



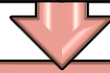
Goal



Vitreoretinal Microsurgery

Challenges

Solution - Micron

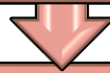


Deliverables



Block Diagram

Surgical Assistant Workstation



Dependencies

Software

Hardware



Timeline



Technical Approach

Work Flow

Phase-I

Phase-II

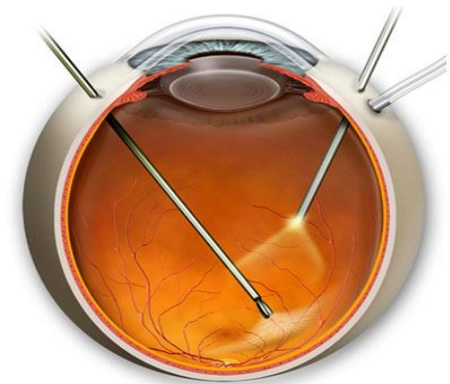
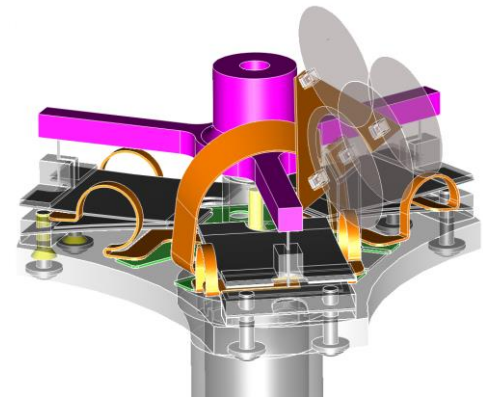


Reading Lists

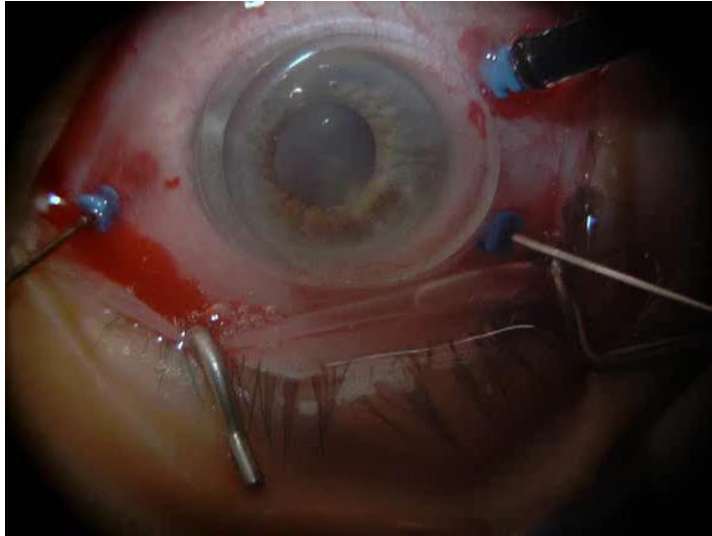
GOAL



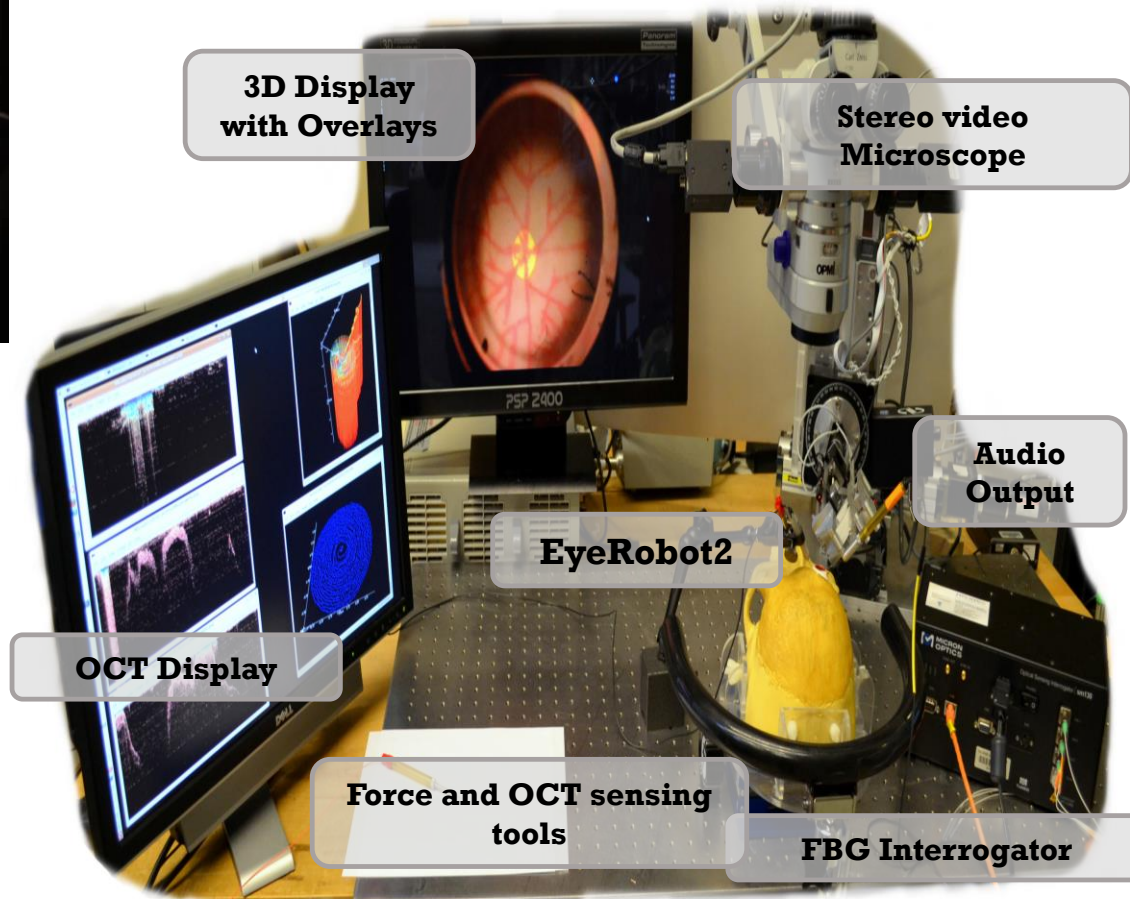
- Developing a visual alert assistance system for the surgeons dealing with very small anatomy.



VITREORETINAL MICROSURGERY



- Hand tremors
- Force Perception



3D Display
with Overlays

Stereo video
Microscope

Audio
Output

EyeRobot2

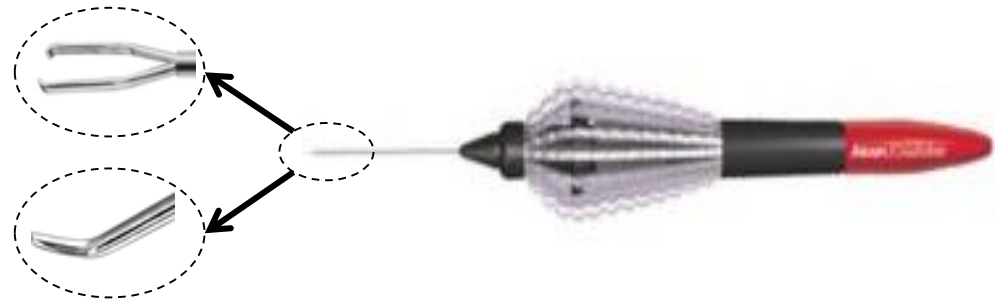
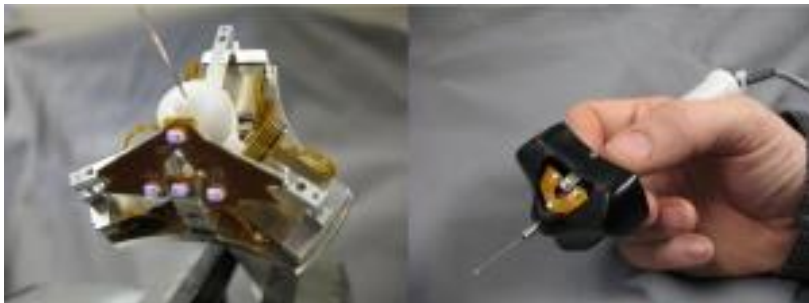
OCT Display

Force and OCT sensing
tools

FBG Interrogator

MICRON

- Tremor Cancellation
- Move actively to compensate



MICRON

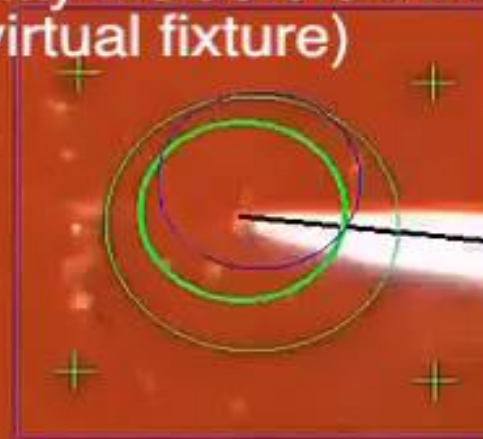
Trace 0.5 mm circle
Mircon Off

Trace 0.5 mm circle
Mircon Low Pass Filter

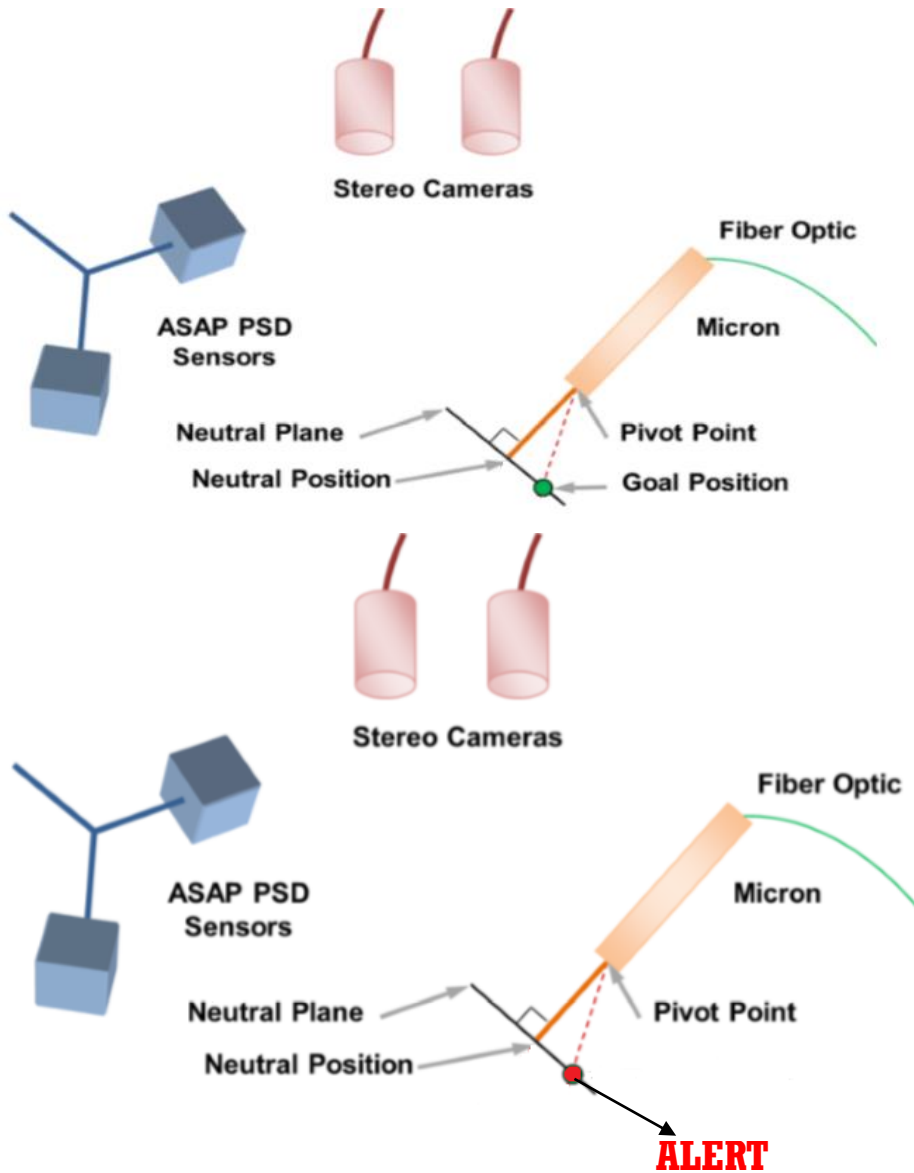
Trace 0.5 mm circle
Mircon Motion Scaling

Stay inside 0.5 mm circle
(virtual fixture)

PROBLEM



SOLUTION



DELIVERABLES

Maximum

Improve the robustness.

Expected

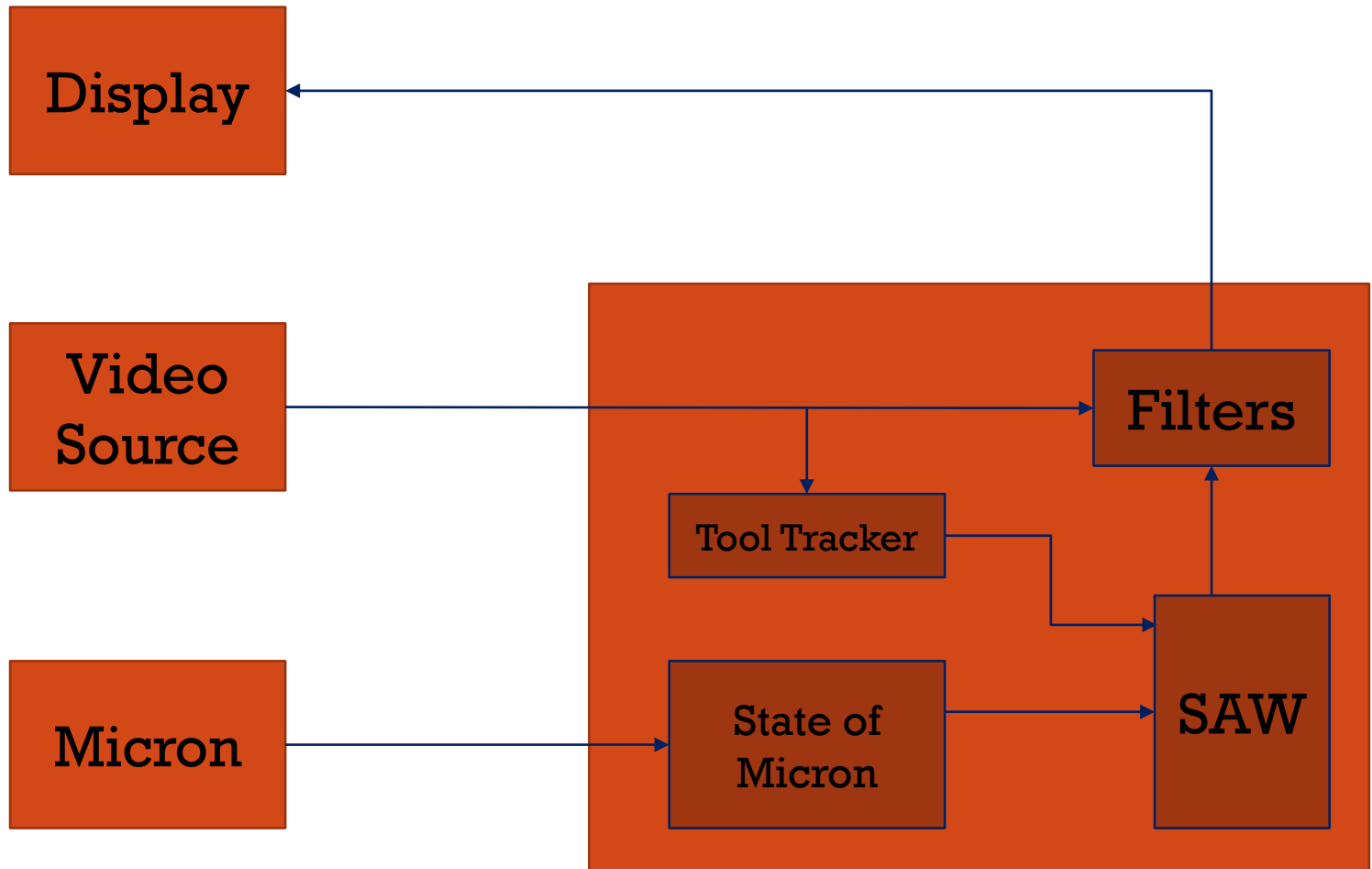
Visual alert assistance system

Get feedback from the surgeons.

Minimum

Test application running and have some overlays displayed .

BLOCK DIAGRAM

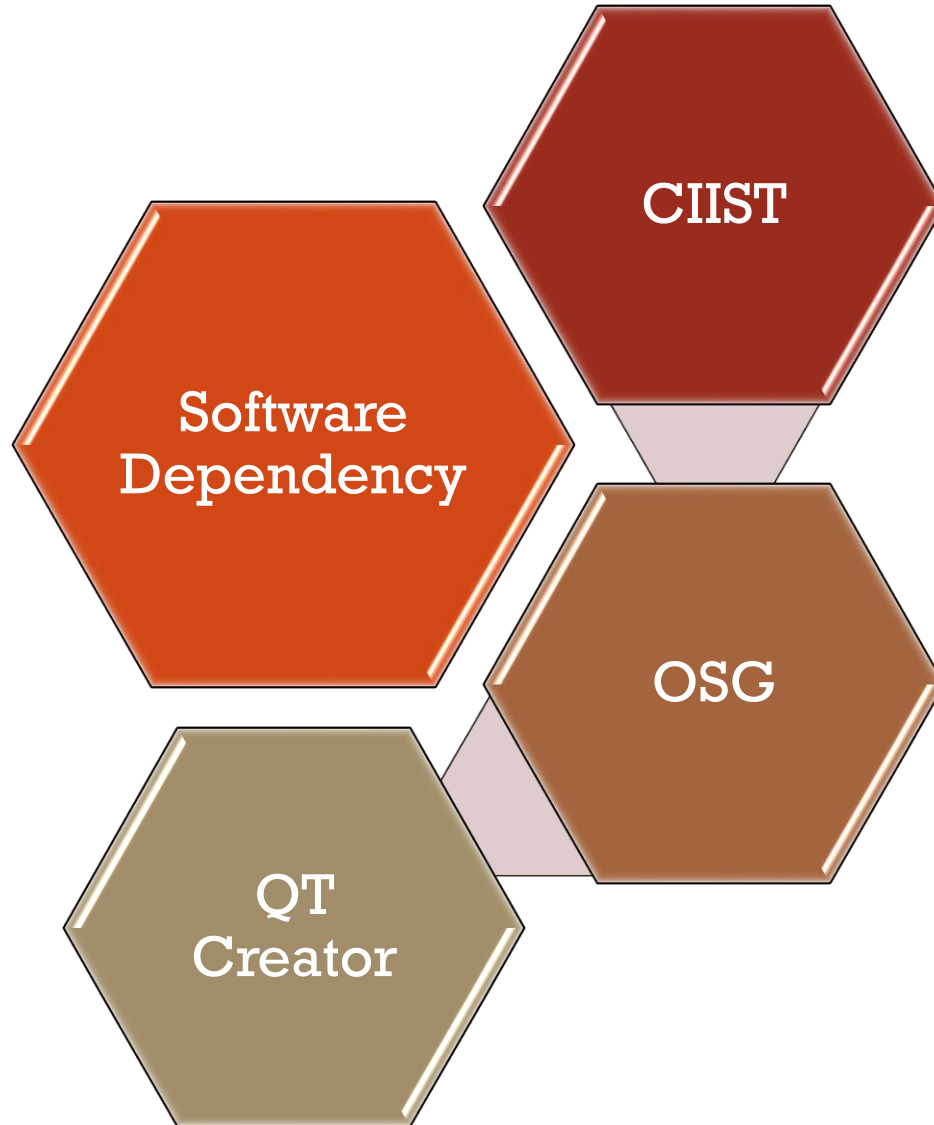


SURGICAL ASSISTANCE WORKSTATION

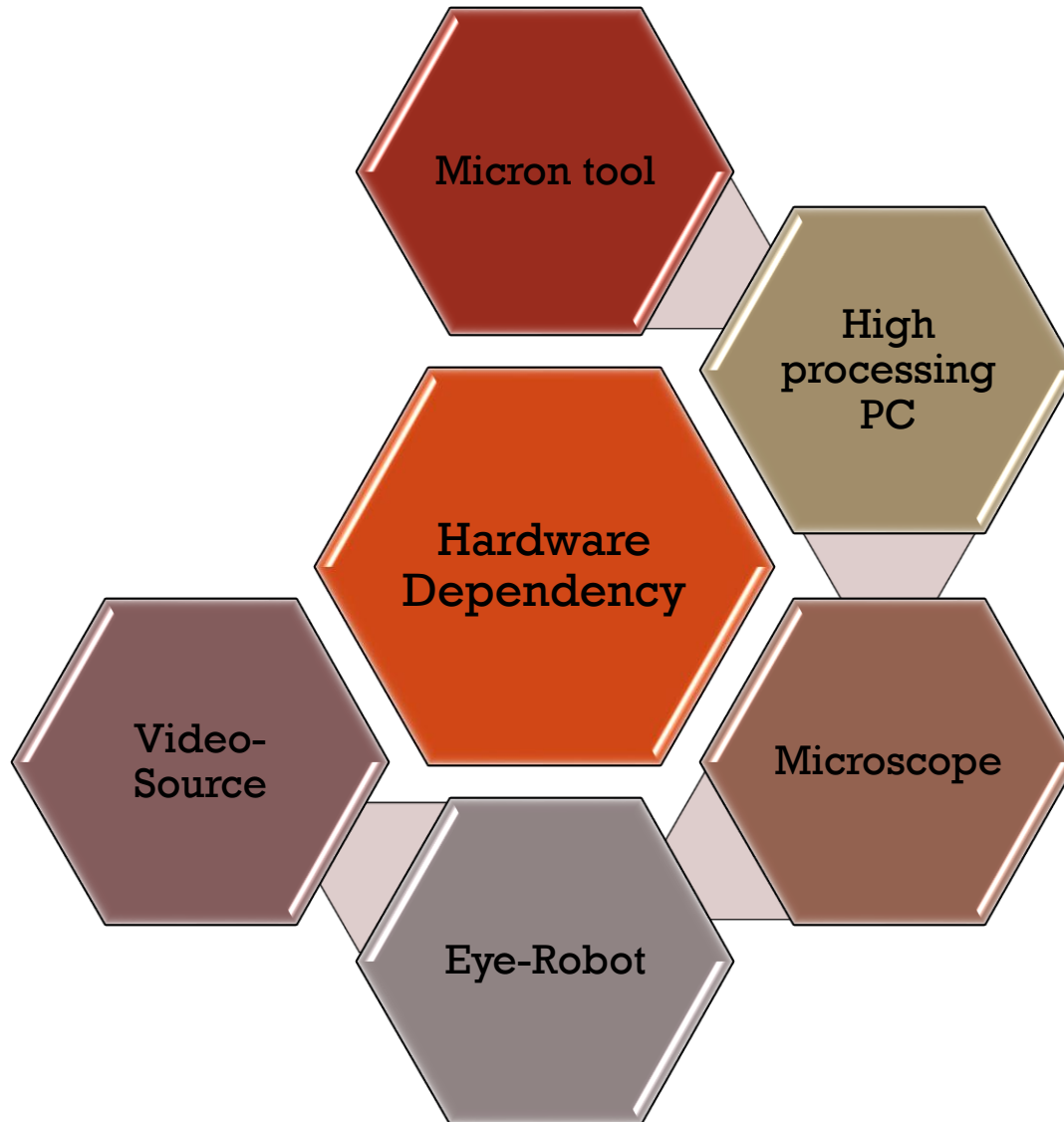


- Visualization & display
- Real time image and sensor processing
- 3D modeling and information fusion
- Task representation
- Safety monitoring
- Manipulation assistance and “virtual fixtures”

SOFTWARE DEPENDENCIES



HARDWARE DEPENDENCIES



TIMELINE

Week Starting with	Feb. 4	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	
Understanding CISST and SteroVision libraries	█	█	█				Spring Break								
Setting up development Environment	█	█	█												
Understanding the Existing Framework				█											
Create a test Application				█	█										
Include some overlays				█	█										
Communicate with the micron and get the information				█	█										
Work on the simulator						█			█	█	█				
Feedback											█				
Alert system											█	█			
Feedback													█		
Debugging													█	█	█
Improve the tracker													█	█	█

PHASE-I

Dependency	Source	Status/Comments	What If ??	Due
PC or Laptop	Self	Acquired	Project Delayed	
Cisst and Stereo Vision Libraries	Open Source-Online	Installed	Custom Libraries	
OpenSceneGraph	Open Source-Online	Installed	Can use OpenGL	
Qt Creator - IDE	Open Source	Installed	Use other free IDEs available	
Material to understand Micron better	Dr.Russel Taylor	Acquired	Learn Myself	
Documentation of previous work	Marcin Balicki	Acquired	Learn myself	

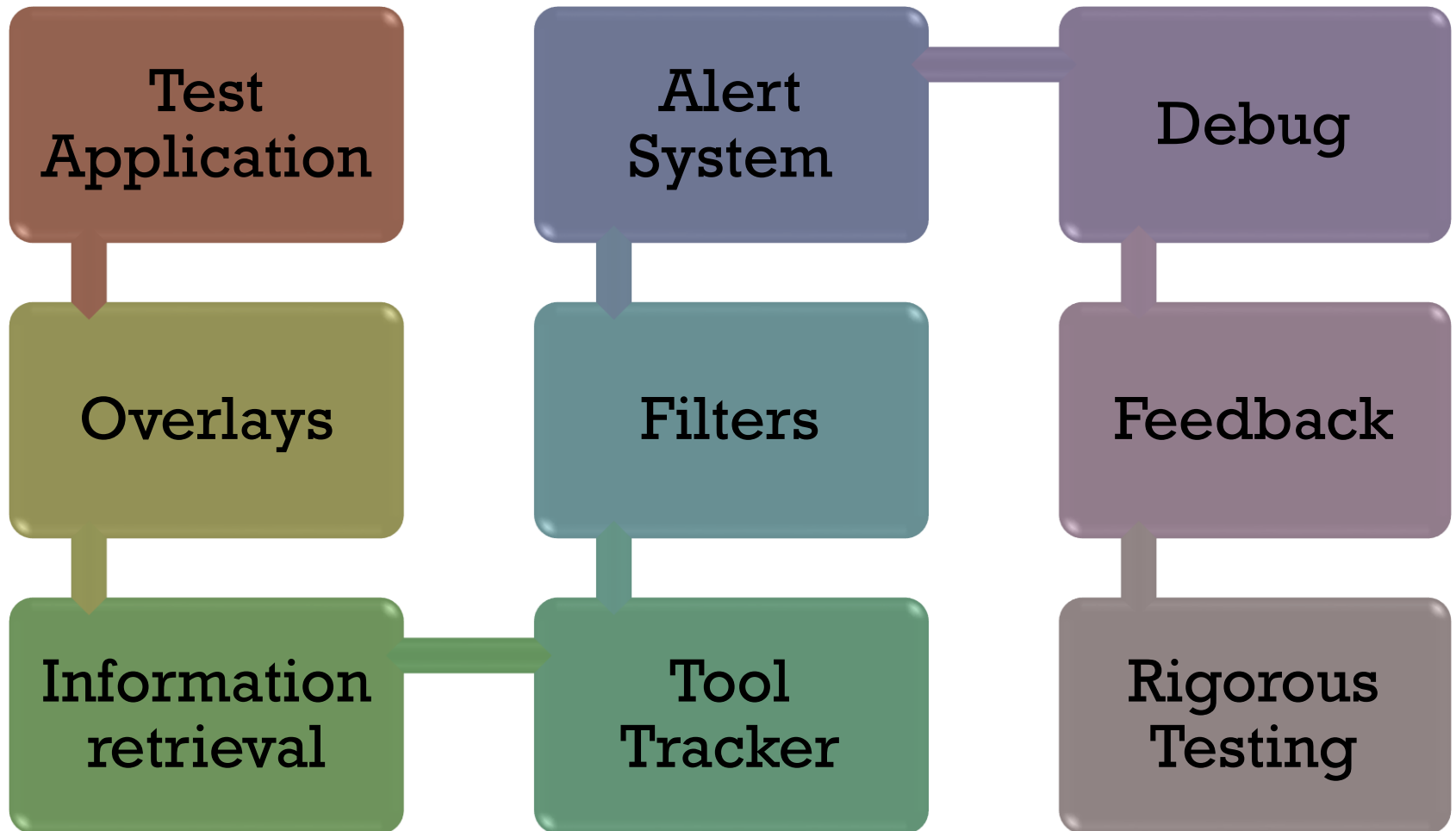
PHASE-II

Dependency	Plan/Source	Status/Comments	What If ??	Due
Access to Micron	Dr.Taylor	In Process/Wont need till the completion of PhaseI	Simulate	
Access to Microscope	Dr.Taylor	In Process/Wont need till the completion of PhaseI	Simulate	
Access to EyeRobot	Dr.Taylor	In Process/Wont need till the completion of PhaseI	Simulate	

PHASE III – NO DEPENDENCIES

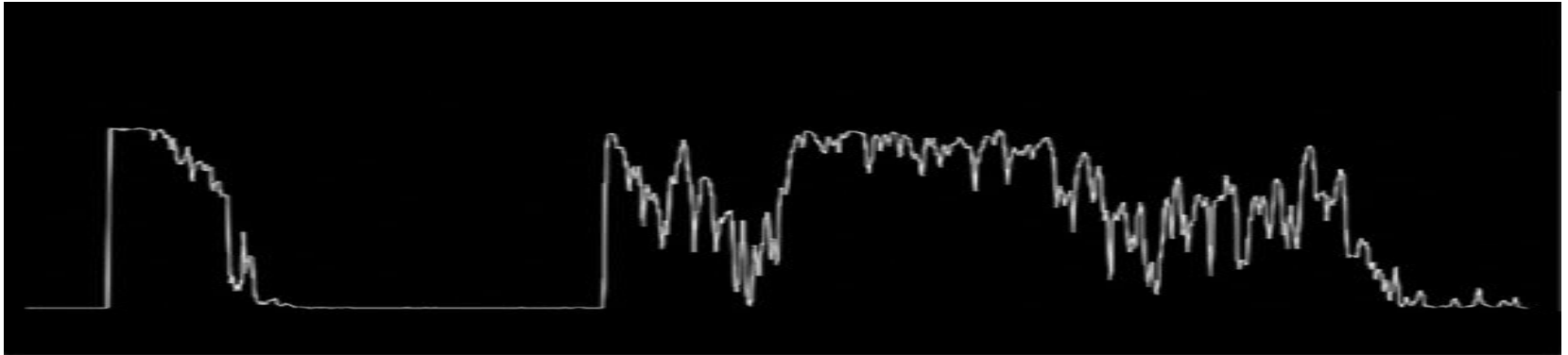
PHASE IV – NO DEPENDENCIES

WORK FLOW



TECHNICAL APPROACH

- Create a simple test application which will have some overlays like Ascan, Hscan, fps rate etc ..



Sample Ascan

TECHNICAL APPROACH

- Develop an alert system which will graphically warn the surgeon, if the micron is going out the range-of-motion
- Keep on testing the alert system physically, making the micron go out of the range of motion and check the efficiency.

Procedure – Yet to Decide

READING LISTS

[1] B. C. Becker, S. Voros, R. A. MacLachlan, G. D. Hager, and C. N. Riviere, "Active Guidance of a Handheld Micromanipulator using Visual Servoing", in IEEE International Conference on Robotics and Automation, Kobe, Japan, May 12-17, 2009. pp. 339-344.

[2] B. Becker, R. MacLachlan, and C. Riviere, "State estimation and feedforward tremor suppression for a handheld micromanipulator with a Kalman filter", in IEEE RSJ Int Conf Intell Robot Syst, 2011. pp. 5160-5165. NIHMSID: 345014.

[3] B. Becker, R. MacLachlan, L. Lobes, and C. Riviere, "Vision-Based Retinal Membrane Peeling with a Handheld Robot", in IEEE Int Conf Robot Autom, 2012. pp. 1075-1080. NIHMSID: 368417.

[4] B. Becker, S. Yang, R. MacLachlan, and C. Riviere, "Towards vision-based control of a handheld micromanipulator for retinal cannulation in an eyeball phantom", in Proc IEEE RAS EMBS Int Conf Biomed Robot Biomechatron, 2012. p. accepted for publication. NIHMSID: 368431.

READING LISTS

[5] B. Gonenc, M. A. Balicki, J. Handa, P. Gehlbach, C. N. Riviere, R. H. Taylor, and I. Iordachita, "Preliminary Evaluation of a Micro-Force Sensing Handheld Robot for Vitreoretinal Surgery", in IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Vilamoura, Algarve, Portugal, 7-12 October, 2012. pp. 4125-4130.

[6] R. MacLachlan, B. Becker, J. Cuevas-Tabarés, G. Podnar, L. Lobes, and C. Riviere, "Micron: an actively stabilized handheld tool for microsurgery", IEEE Trans Robot., vol. 28- 1, pp. 195-212, 2012. NIHMSID:345015.

[7] S. Yang, M. Balicki, R. A. MacLachlan, X. Liu, J. U. Kang, R. H. Taylor, and C. N. Riviere, "Optical Coherence Tomography Scanning with a Handheld Vitreoretinal Micromanipulator ", in IEEE Engineering in Medicine and Biology Conf, San Diego, Aug 28-Sep 1, 2012. pp. 948-951. NIHMSID: 383510.

[8] S. Yang, R. MacLachlan, and C. Riviere, "Design and analysis of 6 DOF handheld micromanipulator", in Proc IEEE Int Conf Robot Autom., St. Paul, MN, May 14-18, 2012. pp. 1946-51. NIHMSID: 368427.

READING LISTS

[9] B. Becker, R. MacLachlan, L. Lobes, G. Hager, and C. Riviere, “Vision-Based Control of a Handheld Surgical Micromanipulator with Virtual Fixtures”, IEEE Transactions on Robotics, pp. Accepted Nov 27, 2012, 2013. NIHMSID: 429749.

[10] M. Balicki, J.-H. Han, I. Iordachita, P. Gehlbach, J. Handa, R. H. Taylor, and J. Kang, “Single Fiber Optical Coherence Tomography Microsurgical Instruments for Computer and Robot-Assisted Retinal Surgery”, in Medical Image Computing and Computer Assisted Surgery (MICCAI 2009), London, September 20-24, 2009. pp. 108-115. PMID: 20425977

QUESTIONS?