Mobile Telesurgery Platform in Mixed Reality - Final Checkpoint

Student: Guanhao(Dean) Fu
Mentor: Peter Kazanzides, Ehsan Azimi

Grand Goal

- Lower cost
- Sterile bedside operation(solo)
- Mobile

Novel Surgeon Console!

Non-sterile, stationary

Sterile, mobile

https://ciis.lcsr.jhu.edu/lib/exe/fetch.php?media=courses:456:2020:cis_ii_mobile_telesurgery.pptx

Project Goal

- Design a wearable system that
  - Captures surgeon's arm motion in 3/4DOF at tool (palm)
  - Can control state-of-the-art robot in virtual context (Unity, Rviz, etc.)
  - Has high precision in position control of the slave robot
  - Has a similar workspace as the Da Vinci's MTM
  - Rules of engagement

Deliverables – revised

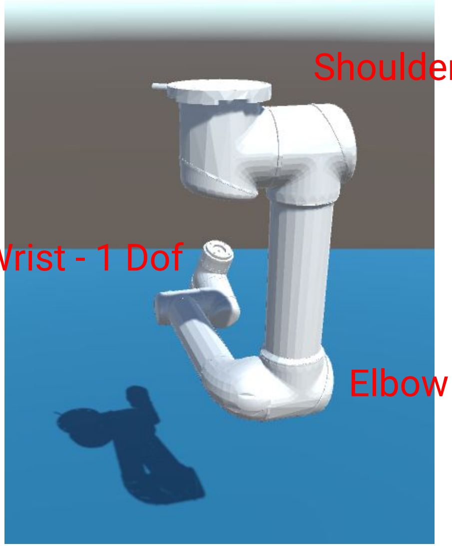
- Minimum Deliverable:
  - Joint measuring system that captures full motion of single human arm (3/4 DOF at tool), virtual demo in Unity
- Expected Deliverable:
  - Virtual demo of pos/orientation of the tool in virtual workspace, w/ rules of engagement working
- Maximum Deliverable:
  - Achieve wrist 3DOF using 2 IMUs from wrist to dorsal side of hand.

Milestones Progress

Milestones	Complete Date	Overall Status
Design Solution Decision Made	3/15/2020	Completed
Algorithm Implemented	4/5/2020	Completed
Calibration protocols validated	4/10/2020	Completed
Kinematic Measurement Validated	4/16/2020	Minimum Deliverable
Successful Virtual Demo	4/26/2020	Expected Deliverable
6 DOF w/ extra IMU Implemented	4/28/2020	Maximum Deliverable
Complete Documentation	5/4/2020	

Project Progress

- Minimum Deliverable met
- Calibration protocol: orientation protocol completed, link length waiting for debug
- Rules of engagement: work in progress
- Still possible of reaching maximum deliverable if above is resolved soon



Expected Result

- 2~3 Demonstration Videos
    - 1 for minimum deliverable - UR5 demonstration of joint angle tracking in real time
    - 1 for expected deliverable - end effector demonstration in a virtual workspace
    - 1 for maximum deliverable of wrist 2DOF motion

Major difficulties

- IMU was delivered 1 week later than expected - company messed up the address
- IMU was having connection issue in Unity, just resolved on 4/29/20
- IMU library support in Unity
  - No clear documentation of Unity library from LP-RESEARCH
  - Rely on Customer support from LP-RESEARCH to assist

Updated Timeline

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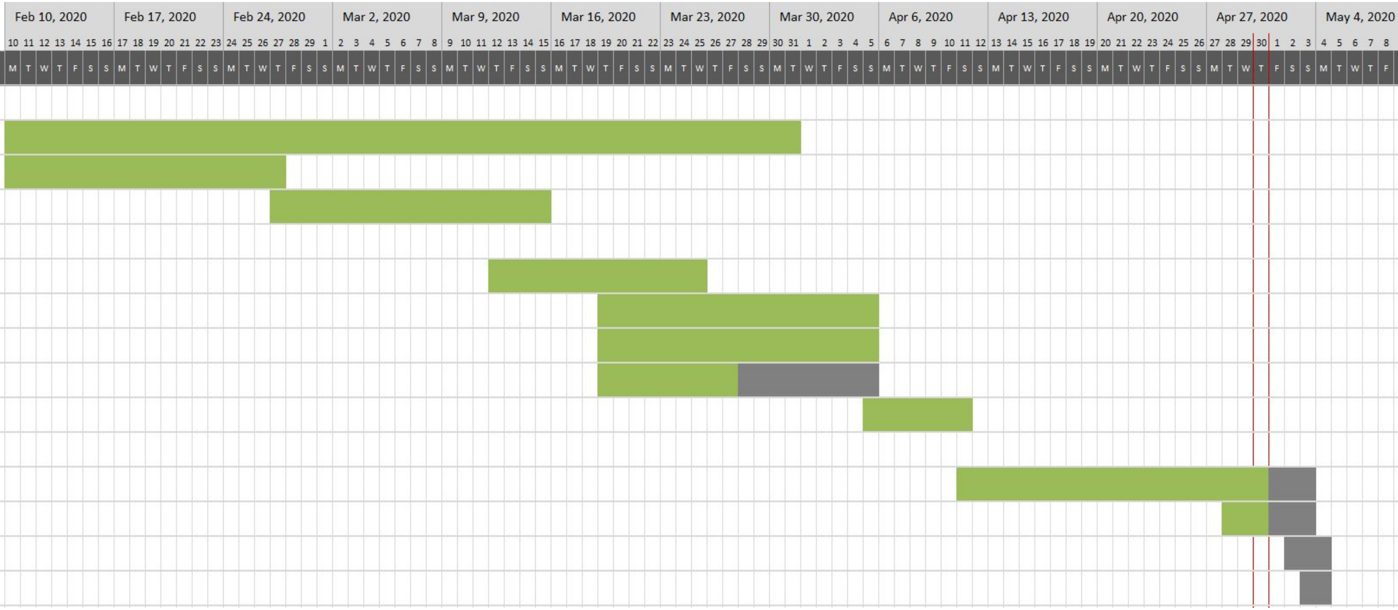
TASK	PROGRESS	START	END
Dependencies and design solution			
Resolve Dependencies	100%	2/10/20	3/31/20
Brainstorm and Discuss Technical Solutic	100%	2/10/20	2/27/20
Decide on which approach to proceed	100%	2/27/20	3/15/20
Algorithm implementation			
Decide and order IMU	100%	3/12/20	3/25/20
Kinematic algorithm implementation	100%	3/19/20	4/5/20
Sensor fusion algorithm implementation	100%	3/19/20	4/5/20
Rules of engagement defined	50%	3/19/20	4/5/20
Calibration protocol defined	100%	4/5/20	4/11/20
Testing and Validation			
Test end effector position in Unity	90%	4/11/20	5/3/20
Debug and physical demo of system	50%	4/28/20	5/3/20
Document all codes	0%	5/2/20	5/4/20
Report and poster writing	0%	5/3/20	5/4/20



Reading List

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Updated Dependencies

Dependency	Solutions	Deadline	Backup Plan	Affect what	Status
IMU connection	Contact LP-RESEARCH	4/30	None	System validation and testing	Completed
IMU Unity support	Contact LP-RESEARCH	4/30	None	System validation and testing	Completed
Algorithm Implementation	Unity on personal PC	3/25	Contact mentors to use lab machines	System realization	Completed
Parts Delivered	Contact Dr. Kazanzides	3/31	None	System realization	Completed