Surgical Skill Analysis with Virtual Reality: Project Plan

TEAM: ADITYA KHANDESHI, LIZA NAYDANOVA, ALEXANDRA SZEWC

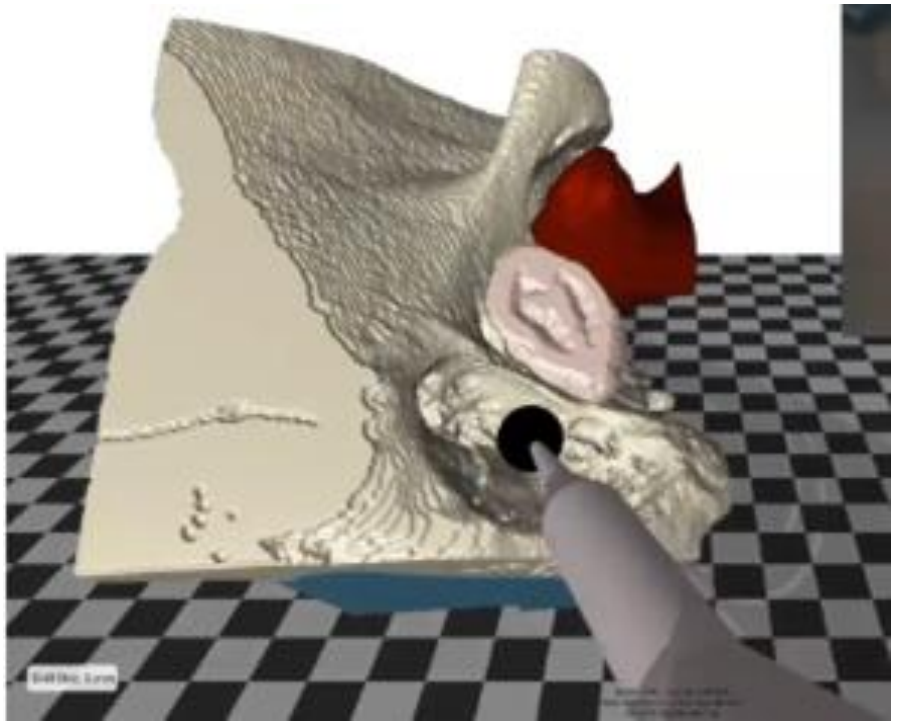
MENTORS: MAX LI, ADNAN MUNAWAR, DR. FRANCIS CREIGHTON, PROF. MATHIAS UNBERATH, PROF. RUSS TAYLOR

Background

- Current evidence has shown that higher-volume surgeons with superior technical skill yield better patient outcomes
- Current evaluation of surgical skill
  - Objective Structured Assessments of Technical Skills (OSATS)
  - Society for Improving Medical Professional Learning platform
- Issues with Current Evaluation Methods
  - Bias from evaluator
  - Poor intra-evaluator reliability
- Technical skill in Otolaryngology-Head and Neck Surgery (OHNS)

Background

- Mastoidectomy Procedures
  - Highly precise surgery
  - Requires drilling of temporal bone
- Temporal Bone Simulators
  - Stereoscopic vision and haptic feedback
  - Automated metrics have limited results
- Objective technical assessment needed for OHNS



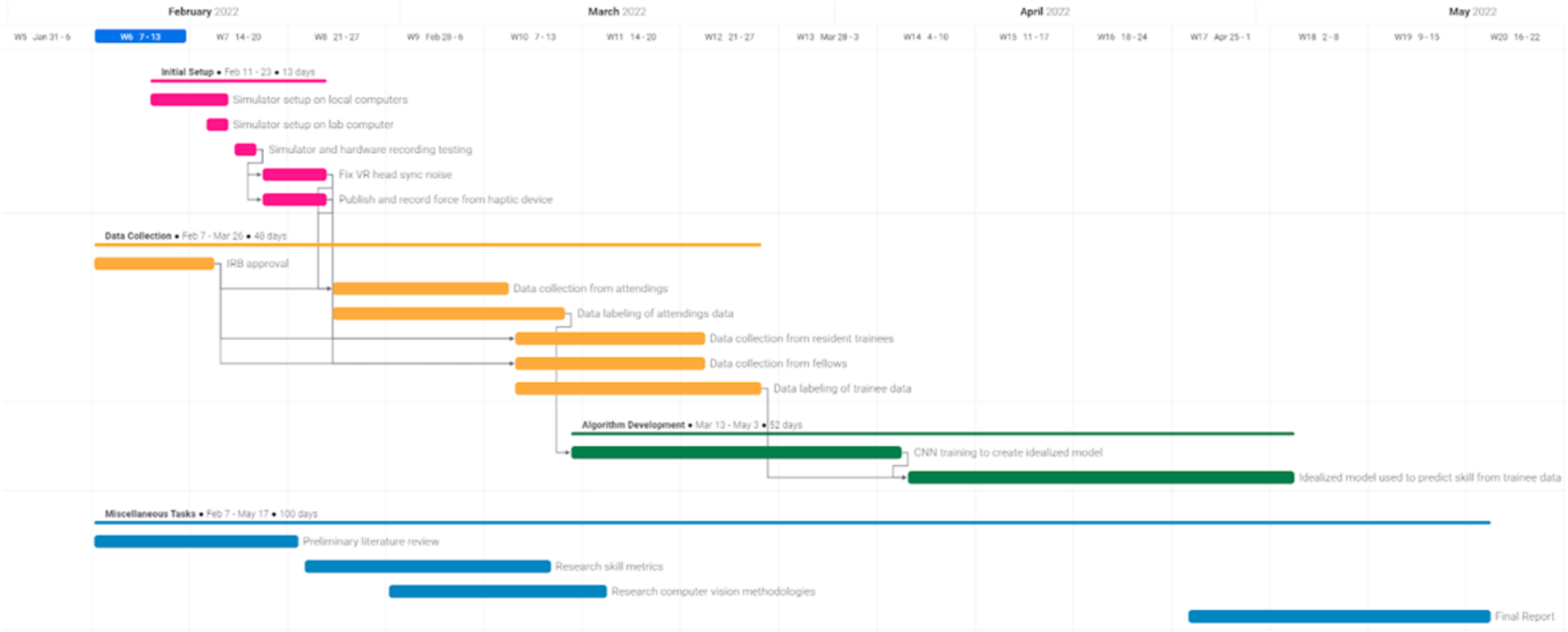
Methods/Aims

- Asynchronous Multibody Framework (AMBF)
  - Generates stereoscopic RGB data for training of computer vision algorithms
- Data collection from practicing surgeons/residents
  - Define/measure metrics relevant to surgical skill
- Generate/validate algorithm to evaluate and predict surgical skill
  - Use data collected from AMBF simulator
  - Use extracted metrics to correlate with skill

Deliverables

Minimum	Perform data collection from surgeon and resident users at JHMI
	Document collection practices
Expected	Develop algorithm for surgical skill analysis
	Evaluate existing algorithms for this purpose
	Documentation
Maximum	Conference Paper

Milestones and Schedule



Dependencies

Main Dependencies	Sub Dependencies	Contact	Expected Date	Status	Alternate Plan
Dataset	IRB Training	Dr. Danielle Trakimas	02/15	Ongoing	N/A
	Data collection (attendings, N=6)	Dr. Danielle Trakimas	03/10	Not started	Will use data already collected by one attending
	Data collection (resident trainees, N=8)	Dr Danielle Trakimas	03/22	Not started	Will use prior methods to develop regression models to see which metrics correlate with scores
	Data collection (fellows, N=8)	Dr. Danielle Trakimas	03/22	Not started	
	Data labeling (2 attendings will score)	Dr. Danielle Trakimas	03/27	Not started	N/A
Hardware	HTC Vive Pro VR Headset	Max Li	02/15	Completed	N/A
	OMNI phantom haptic device	Max Li	03/02	Ongoing	Use Da Vinci controls to simulate behavior of haptic device
	Computer capable of running simulator	Adnan Munawar	02/16	Completed	N/A
Computational Resources	GPU (depends on the algorithm for surgical skills analysis, may not be needed)	Professor Unberath Max Li	03/22	Not started	Will use Google Colab credits

Management Plan

- Weekly meeting with mentors:
  - Max Li
  - Adnan Munawar
- Weekly lab meetings
- Communication through Slack
- Code management via git
- Additional files shared in Microsoft Teams

Reading List

- Ding AS, Lu A, Li Zet al. Automated Registration-Based Temporal Bone Computed Tomography Segmentation for Applications in Neurotologic Surgery. Otolaryngol Head Neck Surg 2021:1945998211044982.
- Azari DP, Frasier LL, Quamme SRP, et al. Modeling surgical technical skill using expert assessment for automated computer rating. Ann Surg. 2019;269(3):574-581. doi:10.1097/SLA.0000000000002478
- Munawar A, Li Z, Kunjam Pet al. Virtual Reality for Synergistic Surgical Training and Data Generation. Computer Methods in Biomechanics and Biomedical Engineering: Imaging & Visualization 2021.
- Birkmeyer JD, Finks JF, O'Reilly Aet al. Surgical skill and complication rates after bariatric surgery. N Engl J Med 2013; 369:1434-1442.
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- Sethia R, Kerwin TF, Wiet GJ. Performance Assessment for Mastoidectomy. Otolaryngol Head Neck Surg 2017; 156:61-69.