Augmented Reality for Orthopedic and Trauma Surgery

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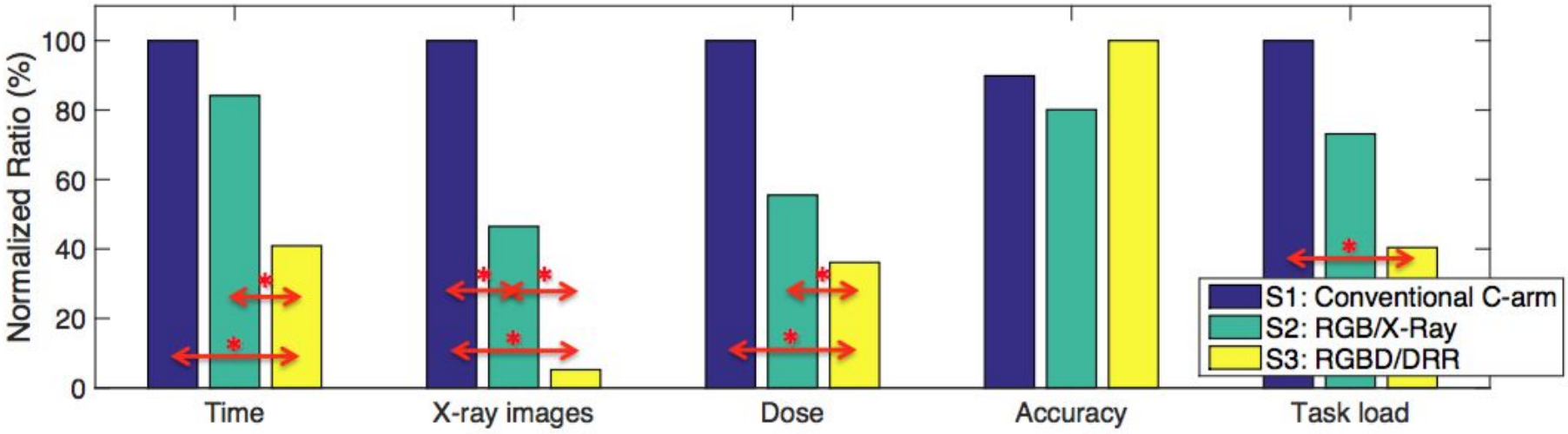
Project 6

Background

Orthopaedic surgeries are time intensive and require multiple images to ensure correct placement and direction of tools

Research has been done to create a manual calibration algorithm, that creates an intra-operative mixed-reality visualization

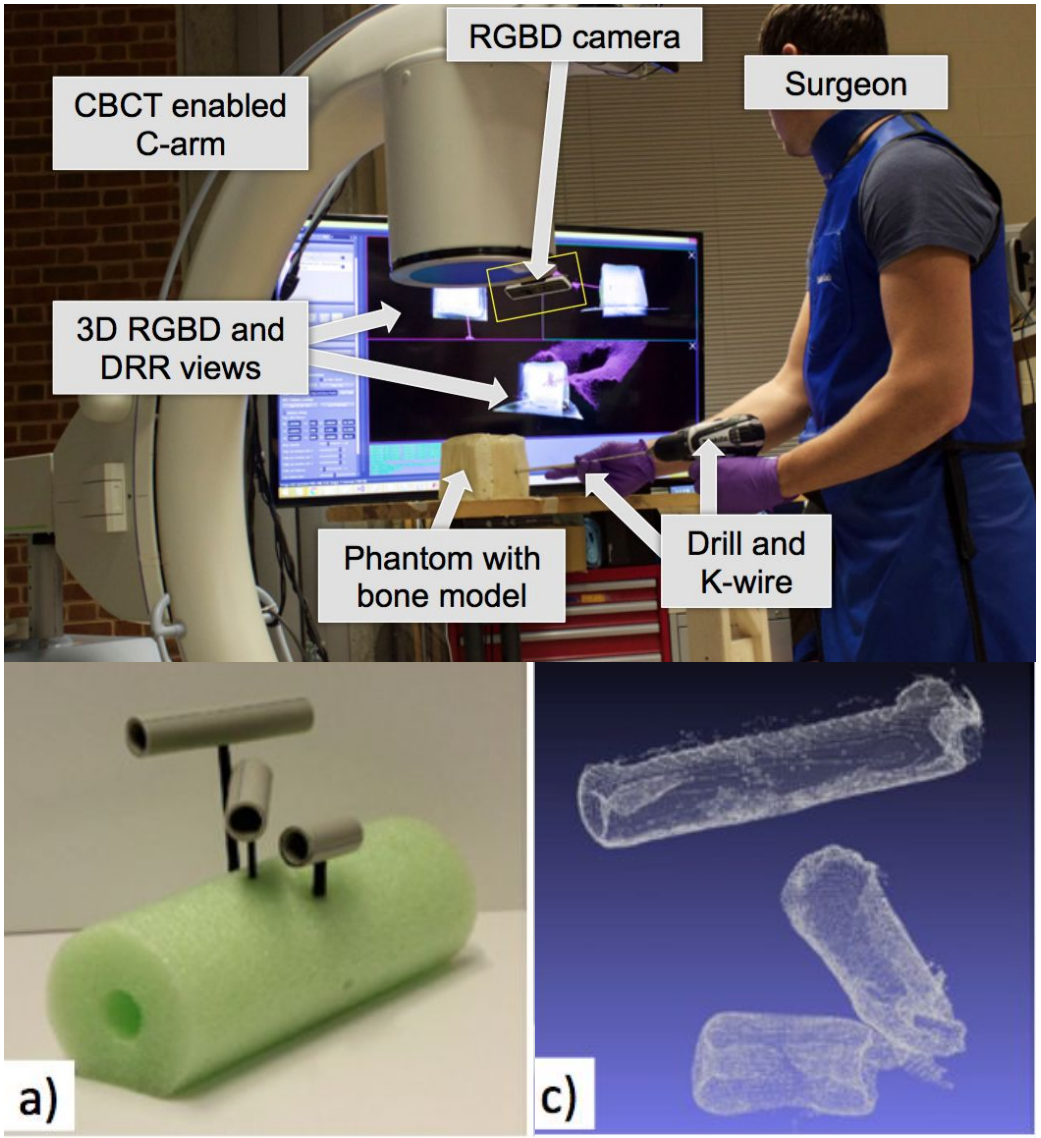
Minimizes: Time, X-ray images, Radiation Dosage, Task load



Dependencies

<u>Met</u>
Data: Created
Workspace: Mock OR
Technology: CBCT, RGBD
Software:MeshLab/PCL/ImFusion
Phantoms: Created and cheap
Code Backup: LCSR Gitlab

<u>Unmet</u>
Operating system
Clinician input
Data backup (working out)
Radiation Safety (potentially)



Technical Plan

Phase 1 - Done in ImFusion SDK

- KinFu generates the surface and export as point clouds
- Segmentation on CBCT and export the meshes

Phase 2 - Done in MeshLab

- Filter and extract the useful point clouds in KinFu
- Same for CBCT

Phase 3 - Done in PCL

- Transform the point clouds to PCL pcd format
- FPFH for initialization, currently hard-coded
- ICP for refining the results

ImFusion

Validation

Can test automated calibration vs. manual calibration results

Management Plan

Daniel Adler

- Mathematical modeling background, data analysis background, C++ experience, GUI design experience
- **PLAN:** Ensure algorithm is outlined to easily create the automation. Design experiments for RGBD/CBCT registration. Will make sure communication is constant and logbook is up to date.

Tiffany Chung

- Extensive C++ experience, computer vision and augmented reality work
- **PLAN:** Create design algorithm, and correctly setup component communication between SDKs. Perform data analysis for validation. Ensure deadlines are being reached, and code systems are backed up and documented.

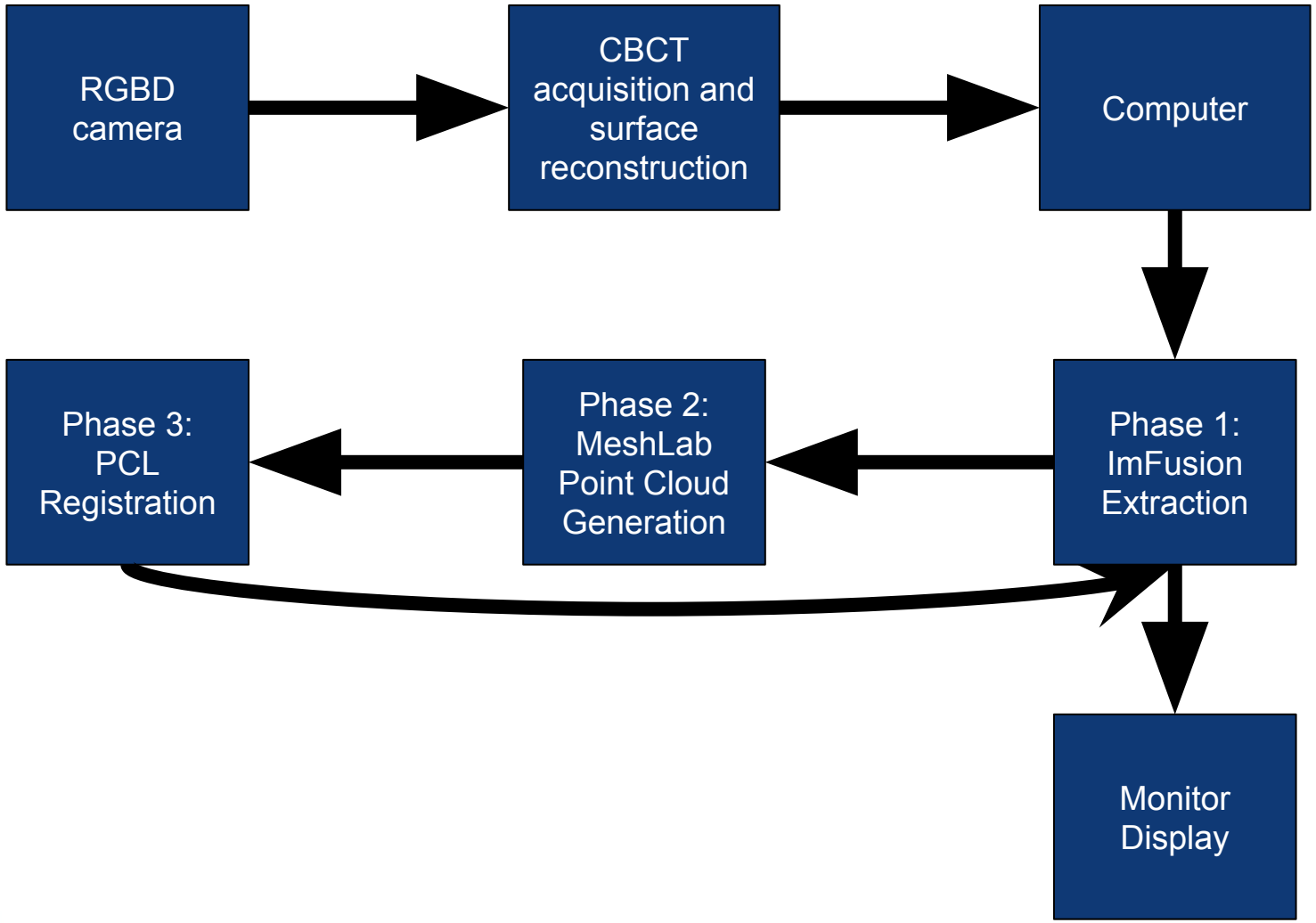
Deliverables

Minimum: Automate the calibration algorithm such that the program will take raw data and return the combined registration.

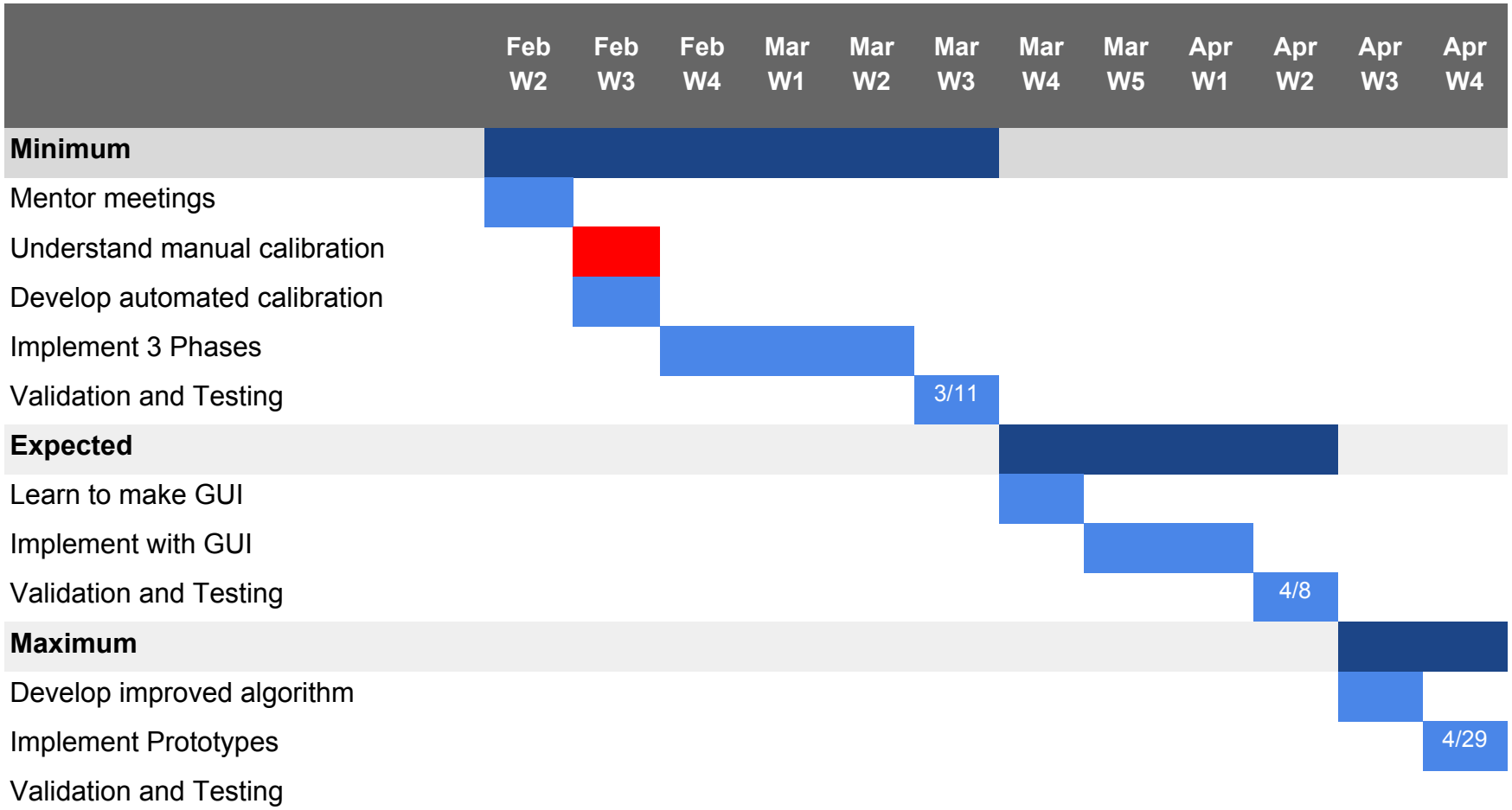
Expected: Create a simple user interface with ImFusion so that 3D visualization appears with minimal instruction, a “one-click” solution.

Maximum: Propose and implement prototypes for alternative method from literature research.

Information Flow



Timeline


Feb W2
Feb W3
Feb W4
Mar W1
Mar W2
Mar W3
Mar W4
Mar W5
Apr W1
Apr W2
Apr W3
Apr W4
Minimum
Mentor meetings
Understand manual calibration
Develop automated calibration
Implement 3 Phases
Validation and Testing
3/11
Expected
Learn to make GUI
Implement with GUI
Validation and Testing
4/8
Maximum
Develop improved algorithm
Implement Prototypes
4/29
Validation and Testing

References

Fischer M, Fuerst B, Lee SC, Fotouhi J, Habert S, Weidert S, Euler E, Osgood G, Navab N. Pre-Clinical Usability Study of Multiple Augmented Reality Concepts for K-Wire Placement. *International Journal of Computer Assisted Radiology and Surgery / International Conference on Information Processing in Computer-Assisted Interventions (IPCAI)*, Heidelberg, June 2016.

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Rusu RB, Blodow N, Beetz M. 2009. Fast point feature histograms (FPFH) for 3D registration. In *Proceedings of the 2009 IEEE international conference on Robotics and Automation* (ICRA'09). IEEE Press, Piscataway, NJ, USA, 1848-1853.

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