



Mixed Reality for Biopsy Site Localization - Checkpoint

Students:

Ruby Liu

Liam Wang (external to CIS II)

Mentors:

Dr. Peter Kazanzides

Dr. Ashley Antony

Dr. Jeffrey Scott

Dr. Kristin Bibee

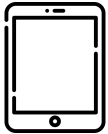
Dr. Elise Ng

Project Summary



Problem

Skin biopsies are used by dermatologists to diagnose cutaneous ailments, but site identification can be difficult – leading to site misidentification



Goal

We aim to create a mobile augmented reality application that can provide dermatologists with additional guidance to locate the biopsy site



Progress: On track

All milestones and deliverables so far have been completed on schedule

UI Outline

At Biopsy

Take two 2D color photos of biopsy site + surrounding anatomical landmarks
(No change to current procedure)

Pre-Surgery

Import biopsy image from photo library

Place CV tracking marker(s) on patient skin near biopsy site

Use biopsy photo as reference (edge detection overlay) to align mobile camera and take picture

User manually labels biopsy site and anatomical features

Software overlays biopsy site on live camera feed



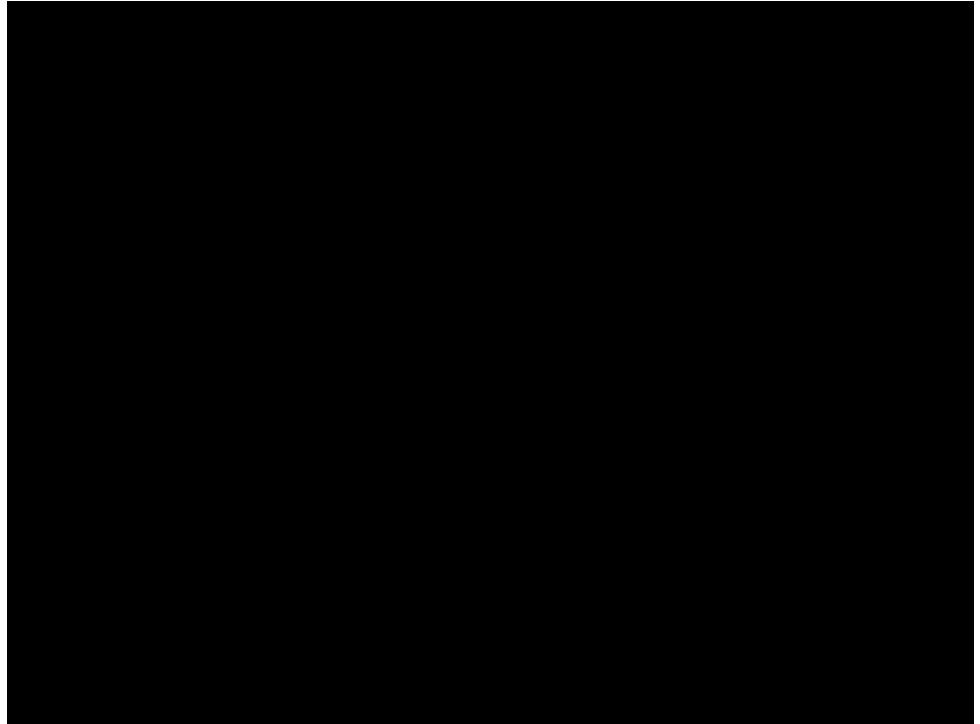
Current Progress: Registration

Algorithm to register site is complete -
no accuracy metrics yet.

Uses the openCV function
getPerspectiveTransform to get the
projective transformation between the
two sets of points.

User-selected points have no
automatic correcting/feature
detection: will assess necessity after
error metrics.

Code is on a Gitlabs repository.





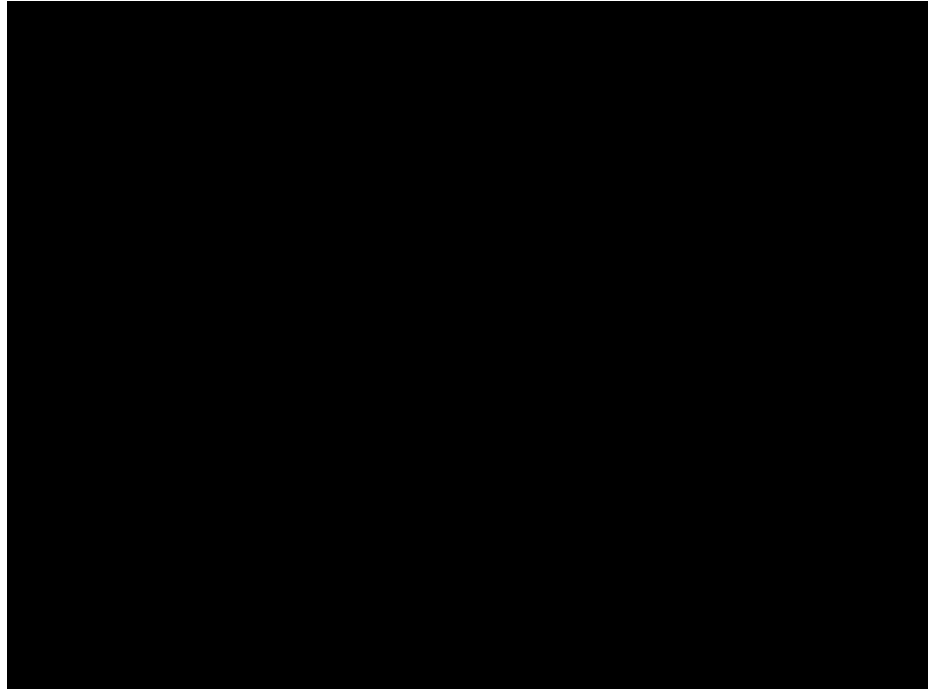
Current Progress: Marker Tracking

Marker tracking in a live video is functional.

Operation: Requires user input to select the points on a freeze frame for calibrating an HSV threshold. Uses the threshold to find the centroids of markers for each frame.

Concerns: sensitive to lighting changes and somewhat jittery – may look into options for improvement.

Code is on a Gitlabs repository.



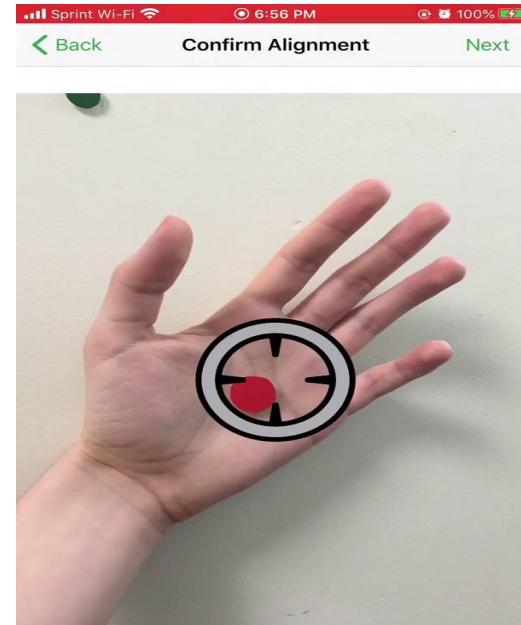
Current Progress: Application

iOS app mock-up of registration setup workflow is complete.

Point pair selection interface allows user to see both images while selecting a corresponding location.

OpenCV canny edge detection overlay of biopsy photo is displayed while user is taking surgery photo for approximate perspective alignment.

Registration algorithm has not been added to iOS app yet.



Update: Deliverables

	Deliverable	Expected Completion
Min	Basic placeholder application	2/26
	Algorithm to register biopsy site photos to another photo / marked photos	3/5
Expected	Algorithm to track markers and overlay biopsy site to live video / video with tracking and code documentation	4/2
	Error metrics to quantify accuracy of the live overlay	4/9
	Basic working interface with calibration overlay guidance with application documentation	4/2
Max	Completely functional mobile application with documentation	5/1
	Experimental data to quantify the geometric accuracy of our application	5/1



Timeline/Milestones

Registration and Tracking (Ruby)

Milestone	Expected Completion
Create basic I/O application to record user clicks on biopsy images	2/26 ✓
Finish algorithm to register biopsy site photos to another photo	3/5 ✓
Finish algorithm to track markers	3/15 ✓
Finish algorithm to overlay biopsy site to live video with marker and code documentation	4/2
Quantify accuracy of the live overlay with pixel error metrics	4/9
Acquire experimental data and quantify errors in real units	5/1

Mobile Application Development (Liam)

Milestone	Expected Completion
Create basic placeholder mobile application and determine how programs will interface	2/26 ✓
Create edge detection overlay for photography guidance and document code	3/5 ✓
Have a working UI to select points on images	3/15 ✓
Integrate photo registration and marker tracking into the mobile application	4/2
Complete and deploy final application with documentation	5/1



Update: Dependencies — All Met

Dependency	Need	Contingency	Status	Planned Deadline	Hard Deadline
Biopsy photos from Dr. Antony	For testing the registration algorithm	Photos of ourselves	Met	2/19	2/26
Computer/internet access	For software development and communication	If technical difficulties — repair or use alternate device. Internet — mobile data.	Currently met	Continuous	Continuous
Mobile device	For testing mobile application	Use mobile device software simulators	Currently met	Continuous	Continuous
Platform to develop application	Platform that isn't specific to iOS or Android and able to develop on Windows and MacOS	If not possible for technical reasons, use XCode (MacOS dev only)	Met — Using XCode on Liam's Mac	2/26	3/5
Stickers	Markers for computer vision tracking	Print colored dots and tape them on	Met — Ruby has	3/1	3/15
Being able to load our application to an independent device	Independence would be useful for user testing, but iOS development restrictions may prevent easy deployment (may need a license or to stay plugged in to a computer)	Keep device plugged in, look for other methods of deployment, or buy license	Met — can use while unplugged	4/1	4/15



Team Management

- Weekly/biweekly meetings with Dr. Kazanzides and Dr. Antony have been helpful for discussing current and future progress, though many have been cancelled for lack of necessity or availability. Dr. Antony may be less available in the near future due to her other duties.
- Ruby and Liam keep in contact over Slack and work together during Zoom meetings on a mostly weekly basis.
- Code is documented and uploaded to a Gitlab repository that Ruby, Liam, Dr. Kazanzides, and Dr. Antony have access to.



References

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