

Project proposal for CIS II —

# **Annotation Framework for Recurring Appointments in Medical Applications using Augmented Reality**

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# Background

- Inappropriate medical image display.
- Unintuitive presentation of ultrasound images
- Difficult to control the pose and position of the ultrasound probe



<https://www.cooleydickinson.org/programs-services/radiology-imaging/treatments-services/ultrasound/>

<https://www.radiology.ca/article/how-does-ultrasound-work>

# Goals:



Provided by mentor

To indicate the pose and position of the observation areas.

To display the ultrasound image saved on different time of a same patient whenever visits.

To design a human-AR device interaction system.

# Expected results

- **Minimum:** Design an augmented reality user-interface to:
  - Save the pose of the tool with respect to the patient's body.
  - Record images from the desired poses.
  - Show the recorded images during future patient visits.
- **Expected:** Make experiment on a human body phantom.
  - Use 3D scanner to create a virtual replica of the phantom.
  - Evaluate the performance of the user interface.
- **Maximum: Add body tracking function** to automatically identify the patient's body pose. Visualize the human body anatomy evolution with Hololens display.

# Technical Approach

## Tool Tracking:



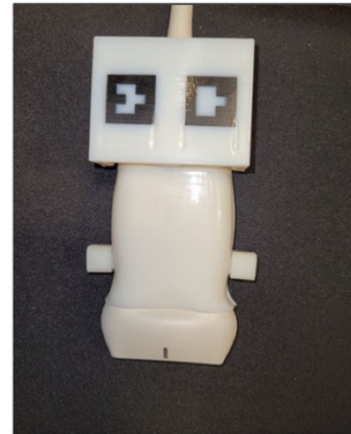
- Track the ultrasound probe
- Track the patient's body
- Identify the ultrasound probe's pose with respect to the human body

# Technical Approach: Ultrasound Probe Tracking

- Use optical markers attached on ultrasound probe to identify the orientation and location of it.



(a)

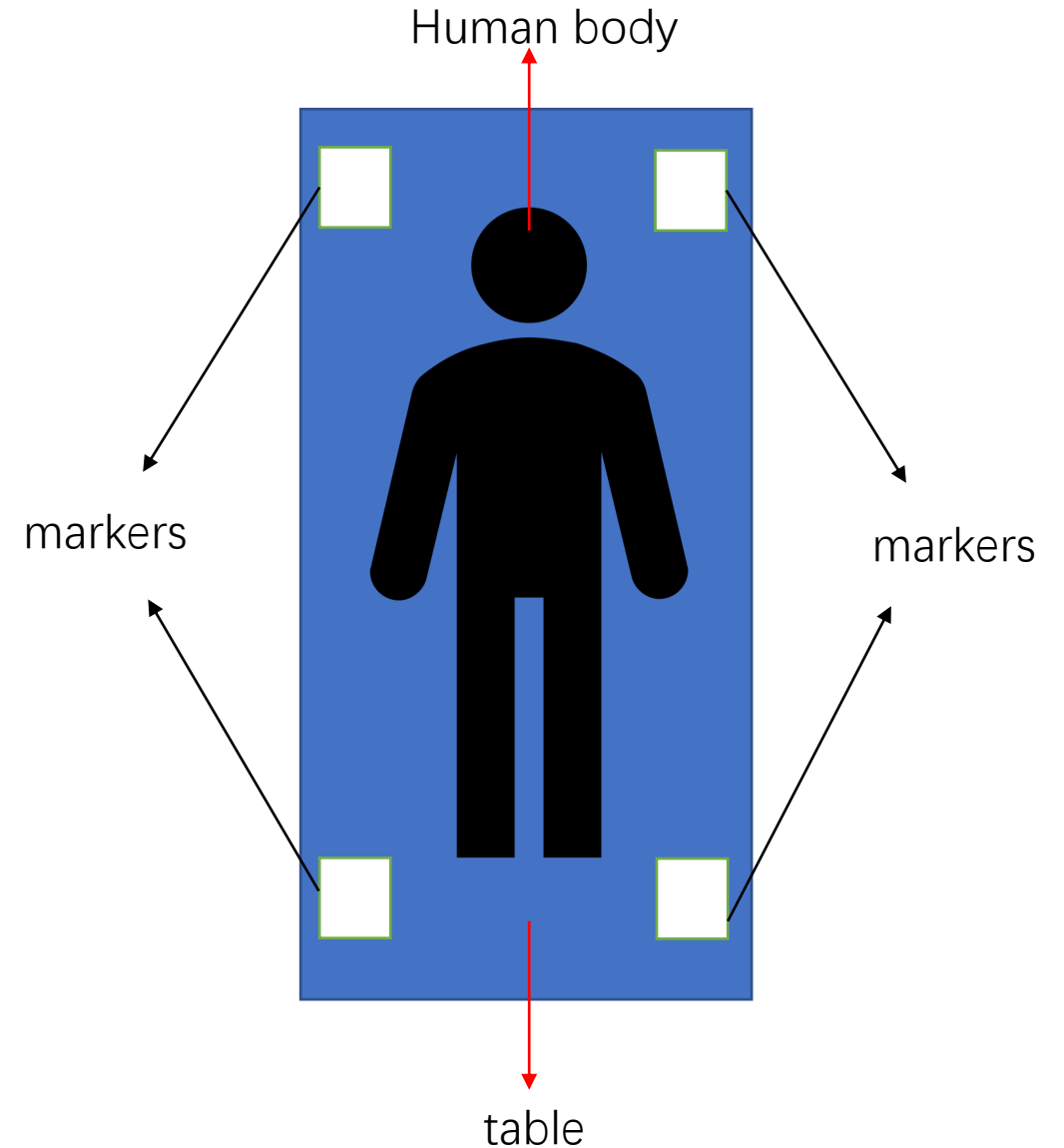


(b)

Nguyen, T., Plishker, W., Matisoff, A. *et al.* HoloUS: Augmented reality visualization of live ultrasound images using HoloLens for ultrasound-guided procedures. *Int J CARS* **17**, 385–391 (2022).  
<https://doi.org/10.1007/s11548-021-02526-7>

# Technical Approach: Estimation of Body Pose

- First we attach markers on the table to identify the relative position of the patient.



# Technical Approach: Estimation of Body Pose



- Fix the position of the patient

<https://smithersmedicalproducts.com/video/>

# Technical Approach: Imaging Saving and Display

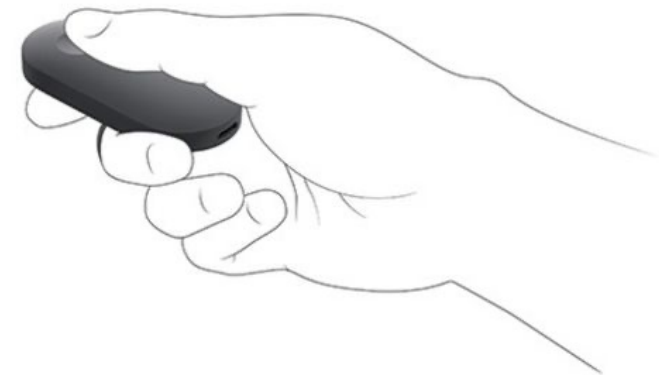
- Display: Hololens
- Image-Saving: Hololens Clicker



<https://www.ithome.com.tw/news/104200>



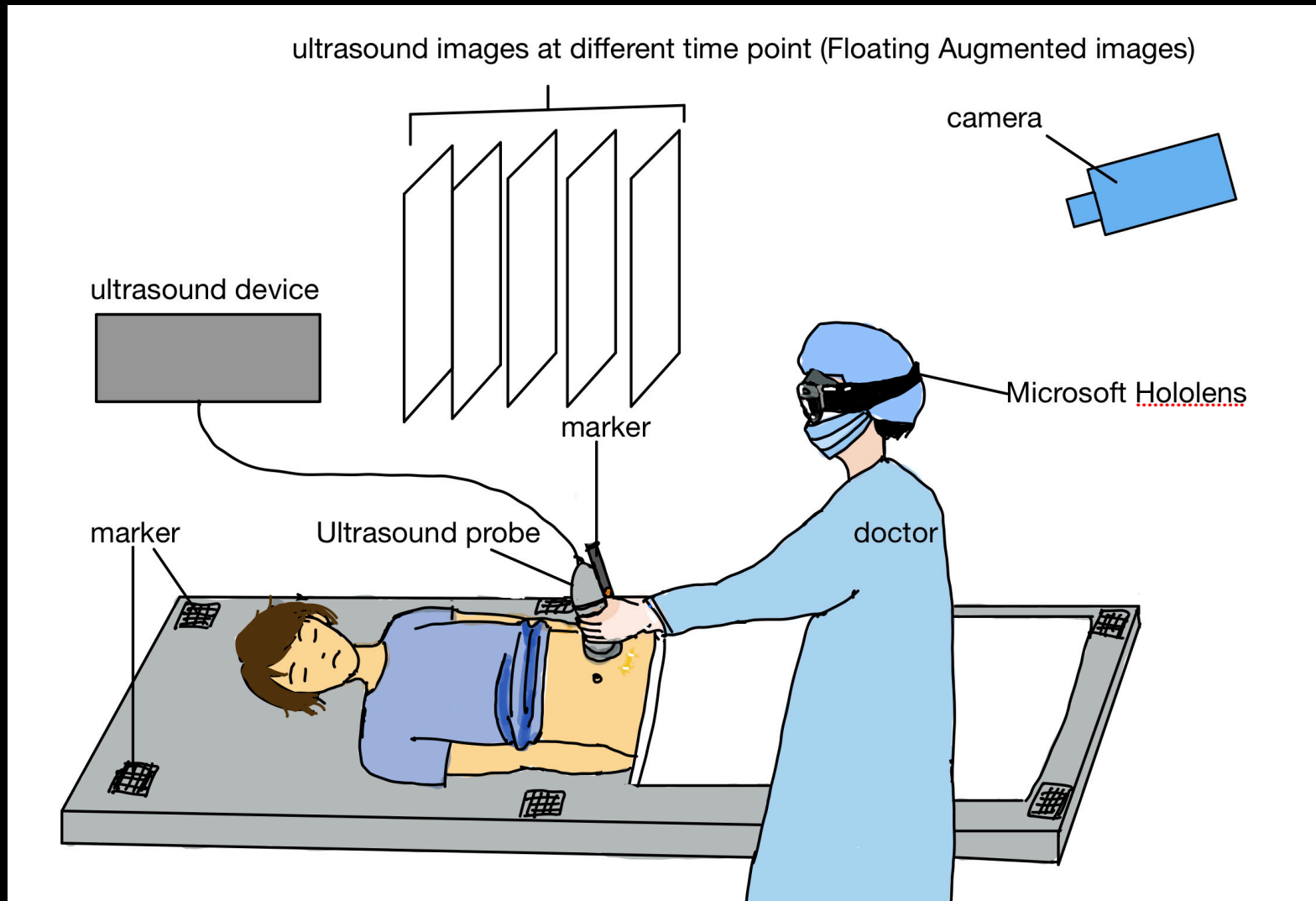
<https://www.geekwire.com/2016/hololens-interface-leaked-in-app-walkthrough-video/>



<https://www.ithome.com.tw/news/104200>

# Technical Approach: User-interaction

- An extension of augmented reality and computer vision.



# Summary of Technical Approach

- Platform:
  - Unity&Vuforia Engine, C#, Microsoft Hololens
- Functions:
  - Tool Tracking
    - Track the ultrasound probe
    - Estimate the body pose
    - Identify the ultrasound probe's pose with respect to the human body
  - Image Saving and Display
    - Display: Microsoft Hololens
    - Image-saving: Hololens clicker
  - User-interaction
    - Hololens

# Timeline

2.28: Plan and prepare for the project.

3.7: Use unity vuforia engine to track the pose and position of an ultrasound probe model.

3.14: Track the pose and position of the ultrasound probe model with respect to a box. Save the poses and positions.

3.21: Use 3D scanner to make 3D anatomy samples on a human body phantom.

3.28: Make experiment on human body phantom for recurring anatomy tracking

4.15: Add interaction function for history images saving. Integrate time-sequence images with tool position.

4.30: Integrate previous work. Add body tracking function.

start

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2022/2/12

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2022/4/23

2022/4/30

2022/5/7

# List of dependencies & plan for resolving

Items	Date	Status
Computer with Unity Vuforia Engine and C#	2 /28	Available
Human body phantom	2 /28	Available
Optical Markers	3/1	Downloaded online.
Cameras for tracking	3/1	Available.
Ultrasound probe model	3/14	Will be printed using lab's 3D printer.
Microsoft Hololens and Hololens Clicker	3/14	Lab purchased. Wait for mentor assignment
3D Scanner	3/21	Available

# Milestones

Date	Object	Status
2/28	Learn Unity Essentials and Vuforia. Plan for the project.	Finished
3/21	Finish pose tracking. Use a box to simulate the human body. Use different markers to recognize the ultrasound probe model and the box. Use Unity and Vuforia for relative pose tracking and saving.	On progress
4/15	Use 3D scanner to create virtual replica of human body phantom for recurring anatomy tracking. Use the phantom to test previous work: save the position and pose of images with respect to ultrasound probe at different time point.	Pending
5/1	Integrate prior work. Add human body tracking function. Design better interaction experience.	Pending

# Management Plan

- Meet with project mentor Alejandro every Thursday at 11:30 a.m.
- Daily communication with mentor through skype and email
- Code: Upload on Github
- Documentation: Google drive, CIS II Wiki and Github

# Reference and Reading list

- Nguyen, T., Plishker, W., Matisoff, A. *et al.* HoloUS: Augmented reality visualization of live ultrasound images using HoloLens for ultrasound-guided procedures. *Int J CARS* 17, 385–391 (2022). <https://doi.org/10.1007/s11548-021-02526-7>
- Magic pillow: <https://smithersmedicalproducts.com/video/>
- Matthew G. Hanna, Ishtiaque Ahmed, Jeffrey Nine, Shyam Prajapati, Liron Pantanowitz; Augmented Reality Technology Using Microsoft HoloLens in Anatomic Pathology. *Arch Pathol Lab Med* 1 May 2018; 142 (5): 638–644. doi: <https://doi.org/10.5858/arpa.2017-0189-OA>
- Farahani, N., Post, R., Duboy, J., Ahmed, I., Kolowitz, B. J., Krinchai, T., Monaco, S. E., Fine, J. L., Hartman, D. J., & Pantanowitz, L. (2016). Exploring virtual reality technology and the Oculus Rift for the examination of digital pathology slides. *Journal of pathology informatics*, 7, 22. <https://doi.org/10.4103/2153-3539.181766>
- M. Krichenbauer, G. Yamamoto, T. Taketom, C. Sandor and H. Kato, "Augmented Reality versus Virtual Reality for 3D Object Manipulation," in *IEEE Transactions on Visualization and Computer Graphics*, vol. 24, no. 2, pp. 1038-1048, 1 Feb. 2018, doi: 10.1109/TVCG.2017.2658570.
- Zhu E, Hadadgar A, Masiello I, Zary N. 2014. Augmented reality in healthcare education: an integrative review. *PeerJ* 2:e469 <https://doi.org/10.7717/peerj.469>

Thank you

*Any Questions?*