



Integrated Eye-Tracking on Magic Leap One during Augmented Reality Medical Simulation for Pediatric Anesthesia and Critical Care

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Background

- Augmented reality (AR) has been studied as a clinical teaching tool, however eye tracking capabilities integrated within AR have not yet been explored.
- The recently developed Chariot Augmented Reality Medical (CHARM) Simulator integrates real-time communication into a portable medical simulator.
- The purpose of this project was to test and refine the gaze tracking capabilities of the CHARM simulator on the Magic Leap One (ML1) AR platform to enable the use of fixation data as a teaching tool for anesthesia residents learning resuscitation skills.

Methods: Study Procedures

- Adults aged 18 and older were recruited using convenience sampling.
- Participants were provided with a ML1 headset that projected a hologram of a hospital bed with a pediatric patient and a monitor (**Figure 1**).
- They were instructed via audio recording to gaze at variables in this scenario. The participant gaze targets from the ML1 output were compared to the specified gaze points from the audio recording (defined as the *capture rate*).
- A priori, investigators planned to conduct iterative modifications of the eye tracking software until a capture rate of 80% was achieved.¹
- Two consecutive participants with gaze concordance less than 80% triggered software modifications and the project concluded after three consecutive participants' fidelity was greater than 80%.

Methods: Software Optimization

- Software developers collaborated with physicians and education specialists to modify and refine the eye tracking during the application.
- In order to translate the raw eye direction data into meaningful, intentional gazes, a preliminary algorithm was written that measured if the raw eye direction from ML1 aligned directly with the object in AR space.
- Initially, the instant the eye direction was found to intersect the intended AR object, a 'match' was logged. This had the side effect of creating many false positives due to the direction of the gaze crossing over other important objects.

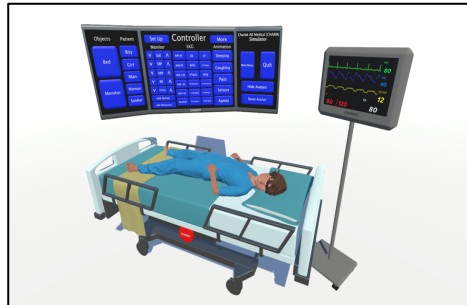


Figure 1 (above): CHARM Simulator Holographic Set-up with View of Instructor Controller. Gaze targets included each of the vital signs on the monitor
Table 1 (right): Capture rate was determined by dividing the total number of identically matching reported gazes to specified gazes by the 95 total gaze seconds.

Results

- Thirteen participants were included in the study. Eye tracking concordance was less than 80% reliable in the first ten participants (**Table 1**).
- The investigators hypothesized that the eye movement detection threshold was too sensitive for registering a match, thus the algorithm was adjusted to reduce noise.
- The project was concluded after the final three participants' gaze capture rate was 80%, 80%, and 80.1%, respectively.

Discussion

- This report suggests that eye tracking technology can be reliably used with the ML1 enabled with CHARM simulator software.
- The AR medical simulation software investigated in this project provides the foundation for integrated, real-time learning opportunities. The AR simulation can provide real-time, programmed prompts during the simulation that can redirect attention to important elements based on gaze.
- For example, a student may be prompted with a hologram to gaze at a shockable electrocardiogram after a pre-determined allowable amount of time has passed since the initiation of the unnoticed rhythm.

References

- 1 Orquin L, Holmqvist K. A Primer on Eye Tracking Methodology for Behavioral Sciences. In: A Handbook of Process Tracing Methods: 2nd Edition. Routledge, 2019, pp 53–64.

Participant	Concordance
1	0.46
2	0.14
3	0.21
4	0.15
5	0.17
6	0.29
7	0.37
8	0.56
9	0.62
10	0.64
11	0.80
12	0.80
13	0.81