Prehospital Provider Training with Augmented Reality Simulation: A Prospective, Mixed Methods Study

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Background

Pediatric emergency calls are often high-stakes clinical encounters yet represent less than ten percent of EMS responses. EMS clinicians responding to pediatric cases must be familiar with pediatric-specific protocols and maintain a ready knowledge of pediatric medication dosing. However, municipal fire services and other EMS organizations often have limited funding, time, and other resources to devote to training.

Community Partner

The Mountain View Fire Department exists to save lives and property, protect the environment and minimize the risk of fire and natural disaster by investing in education, training and prevention.

Methods and Approach

- We developed an AR pediatric seizure response simulation where participants wore Magic Leap (ML) headsets and responded to the scenario using both physical and holographic assets.
- We anticipated that AR simulation may have the potential to be used as an education tool for prehospital providers and other first responders. Thus, we aimed to determine the acceptance of AR simulation amongst prehospital providers. We also aimed to evaluate the usability and ergonomics of the technology.

This was a prospective, mixed methods study. We conducted focus group interviews after the EMS providers completed the AR simulation. Secondary outcomes explored the usability of the system with the System Usability Scale and ergonomics with the ISO 9241-400 six-item scale. Thematic analyses were performed on transcriptions of the interviews. Descriptive statistics were used to report the secondary outcomes.

Figure 1. EMS providers wear ML1 headsets while completing the AR simulation

Results

The usability of the simulation system (Table 1) was assessed with the System Usability Scale. Most participants agreed or strongly agreed that the simulation system was easy to use (86.3%) and that they would like to use the simulation system frequently (81.8%). Almost half of the participants (45.5%) agreed or strongly agreed that they would need the support of a technical person to be able to use the simulation system.

The ergonomic aspects of the simulation system (Table 2) and ML1 headset were assessed with a six-item scale. The majority (63.6%) of participants agreed or strongly agreed that they would be comfortable using the device for a long time. Less than ten percent of participants agreed or strongly agreed that the headset is too bulky or too heavy (4.5%) or that the mental effort required to operate the device was very high (4.5%).

Finally, a thematic analysis of focus group interview revealed seven domains (n=number of participant statements identified within each domain): general appraisal (n=20), realism (n=23), learning efficacy (n=27), mixed-reality feasibility (n=25), technology acceptance (n=24), software optimization (n=20), and alternate use cases (n=3).

Item	Mean	SD	%Strongly Agree/Agree
I think that I would like to use this system frequently	4.2	0.96	81%
I found this system unnecessarily complex	2.3	1.29	9%
I thought the system was easy to use	4.1	0.89	86%
I think that I would need the support of a technical person to be able to use this system	3.2	0.91	45%
I found the various functions in this system were well integrated	4.0	0.79	86%
I thought there was too much inconsistency in this system	2.6	1.05	18%
I would imagine that most people would learn to use this system very quickly	4.0	0.95	86%
I found the system very cumbersome to use	2.3	0.88	9%
I felt very confident using the system	3.5	0.96	64%
I needed to learn a lot of things before I could get going with this system	2.7	0.95	23%

Table 1. System Usability Scale

Item	Mean	SD	%Strongly Agree/Agree
The headset is too bulky or too heavy	2.0	0.95	5%
The mental effort (concentration) required to operate the device was very high	2.1	0.56	5%
Arm and hands/fingers fatigue were very high	1.8	0.75	5%
Eye fatigue was very high	2.0	0.84	9%
Head fatigue was very high	1.8	0.59	0%
I would be comfortable using the device for a long time	3.5	1.19	64%

Table 2. Ergonomics (ISO 9241-400)

Conclusions

The use of Augmented Reality in first responder training has an overall favorable assessment for learning and practicing for critical care and communication. By improving training of local EMS agencies with this type of simulation, we can improve our local communities' effectiveness when responding to pediatric emergencies.

AR software is not a replacement for traditional training but can be used to supplement training and allow EMS providers to practice emergency protocols at any time.

In order to make this type of educational tool an efficacious and enduring form of training, simulation developers must work closely with EMS providers to continually test and improve these AR training scenarios.

Recommendations

- The participants in the Mountain View Fire Department brought up that it in order to make augmented reality training more realistic and practical, it would be best to include locations where real emergencies happen such as city streets, dark apartments, and along highways. By doing so, this eliminates the need to take crews away from their stations or posts to achieve this goal.
- The CHARM software is currently being expanded to incorporate these additional environments where EMS providers normally practice medicine.

Acknowledgements

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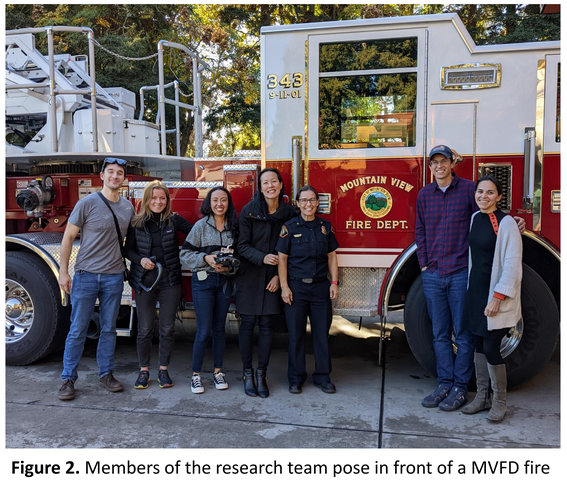

Figure 2. Members of the research team pose in front of a MVFD fire engine with Battalion Chief Jenna Graham