EASYHEAL: AUGMENTED REALITY HOME TRAINING FOR MINOR INJURY

Qistina Aimi Binti Nazri
College of Computing, Informatics and Mathematics
UiTM Melaka, Campus Jasin
qistinaaimi01@gmail.com

Nurul Hidayah Binti Mat Zain*
College of Computing, Informatics and Mathematics
UiTM Melaka, Campus Jasin
nurul417@uitm.edu.my

Article Info	Abstract
	The need for accessible and engaging first-aid training is more pressing than ever, particularly among young adults who often lack preparedness for emergencies. Conventional training methods have limitations, making it difficult for most people to access and engage with first-aid education. To address this gap, EasyHeal was developed as an augmented reality-based interactive learning platform, providing widely accessible and pragmatic content. Through an agile development methodology, the application was designed to provide an improved user experience, which was evaluated using the User Experience Questionnaire (UEQ) among 25 respondents within the target age range of 18-26 years old. The results showed that users were highly pleased with the app's visual design and aesthetic appeal, with a mean score of 1.63 for Attractiveness. While the app is still in development to cover more injuries and address technical issues, its innovative approach has successfully improved the availability and interactivity of first-aid training for young adults.

INTRODUCTION

First aid treatment is a crucial initial response to help someone who is sick or injured. It can be required in various settings, including home, work, school, or public places, and can be necessary even in everyday situations. According to Eisenburger & Safar (1999), self-practice methods, such as audio-tape or video-tape-coached practice on mannequins, can be effective in certain contexts. However, first aid typically requires both theoretical knowledge and practical skills.

Research has shown that theoretical knowledge alone is not sufficient, and children who only acquire theoretical knowledge tend to perform poorly in practical assessments (Fariduddin et al., 2022). Therefore, expert guidance and training are essential to provide critical insights, correct techniques, and real-time feedback, especially in complex emergencies. However, traditional first aid courses often require in-person attendance, which can be a barrier for young people (aged 10-24 years) who may have limited accessibility due to busy schedules, limited mobility, or remote locations.

This project aims to address this issue by developing an app that provides in-home simulation training via Augmented Reality (AR). The app will offer virtual simulations of minor trauma scenarios, such as scratches, minor burns, and sprains, allowing users to gain knowledge and skills anywhere and anytime using their devices. By providing an accessible and interactive learning experience, the proposed application hopes to enhance young people's knowledge and skills in basic first aid treatment of minor injuries.

Problem Statement

Lack of experience using a first-aid kit properly

Lack of practical experience with first-aid kits can hinder one's ability to respond effectively in emergencies, leading to uncertainty and hesitation when the need arises to provide first aid (Nasser, 2018). Moreover, the inability to properly identify and utilize the tools in a first-aid kit can result in delayed reactions, as all the tools found in a first-aid kit may not be easy to identify and deploy (McCarthy & Uppot, 2019). This issue highlights the need for innovative training methods that can provide learners with hands-on experience and familiarization with first-aid equipment, enabling them to develop the necessary skills and confidence to respond effectively in emergencies. This underscores the significance of hands-on practice in developing the confidence and competence necessary to administer first aid correctly, as being certain that first-aid procedures are done in the correct manner and sequential order requires experience (Guerrero et al., 2020).

Inaccessibility of traditional first-aid training methods for many individuals

Geographical and accessibility barriers often render first-aid training inaccessible in remote or isolated areas, where courses or resources are hard to reach (Bakke et al., 2016). This limited availability is largely a result of geographical isolation and insufficient supporting infrastructure, making it difficult to accelerate access to life-saving knowledge. As a result, wide-area education of first aid in such areas is inhibited, leaving communities vulnerable to emergencies. Furthermore, financial constraints limit access to traditional first-aid training, as some resource-constrained organizations or communities cannot afford to provide relevant training due to financial, material, or instructor availability issues. This lack of access to training programs can have serious consequences, as it can lead to a lack of preparedness and response competency during emergencies.

Objective

Several objectives led to this project:

1. To design a 3D model of an augmented reality home training simulation for minor injuries.
2. To develop a markerless augmented reality home training simulation for minor injuries.
3. To evaluate user experience in augmented reality home training simulation for minor injuries.

LITERATURE REVIEW

Current Approach of First-Aid Training

First-aid training is crucial for preparing individuals to respond effectively in emergencies, from minor injuries to life-threatening situations. The Malaysian Workplace First-Aid Guidelines, issued by the Ministry of Human Resources' Department of Occupational Safety and Health (DOSH) (2004), mandate that workplaces must have adequate first-aid facilities and trained personnel. Accredited training providers, such as CERT Academy and the Malaysian Red Crescent, offer comprehensive first-aid courses, including practical skills and teamwork.

However, despite the availability of training, accessibility remains a challenge, particularly in remote areas. Studies (Tse et al., 2023) suggest that first-aid training, especially among children, is crucial for reducing the impact of injuries. To increase awareness and accessibility, efforts must be made to promote greater awareness and reach a broader audience. By doing so, more individuals can acquire these life-saving skills and make a difference in handling emergencies.

Augmented Reality in First-Aid Training

Augmented Reality (AR) holds significant potential for enhancing first-aid training by providing realistic, interactive simulations within real environments, allowing trainees to practice emergency response procedures in a controlled, natural setting. This approach improves spatial awareness, and understanding of anatomy, and provides immediate feedback, while also supporting personalized learning and expanding access to training through remote or self-paced sessions (Bacca et al., 2014). However, challenges such as information overload, technical complexity, high costs, user adaptation issues, and resistance from instructors must be addressed to fully realize AR's potential in first-aid training (Barsom, Graafland, & Schijven, 2016).

The Benefit of Augmented Reality

Augmented Reality (AR) in-home training provides a risk-free environment for real-time practice, making it perfect for simulating high-risk tasks. By engaging users through interactive virtual elements, AR enhances learning retention and effectiveness, as noted by Bacca et al. (2014). Additionally, AR offers real-time guidance during emergencies, such as step-by-step first-aid instructions. While initial investment may be required, the long-term cost-effectiveness of AR is ensured by the reusability of tools and the widespread availability of AR-capable devices like smartphones. Furthermore, AR simplifies complex tasks by breaking them down into manageable steps, thereby accelerating the learning process, especially for practical skills.

Augmented Reality Markerless

This project utilizes markerless AR technology, which leverages the device's camera, GPS, accelerometer, and compass to interpret a three-dimensional environment and overlay

PCMJ

digital content. Unlike marker-based AR, markerless AR eliminates the need for specific markers, instead using sensors to determine the user's location and direction. This technology is particularly well-suited for this project as it allows users to freely move around and interact with training content, such as during first aid training, where users can observe the site of an injury from various angles and practice using equipment to conduct suitable interventions.

METHODOLOGY

This project employs the Agile methodology, a lightweight approach to software development that emphasizes flexibility and teamwork. Chosen for its ability to accommodate evolving requirements and frequent changes, Agile's iterative and incremental model allows for quick adaptation and reflection. The Agile methodology consists of 6 phases: *planning*, *design*, *development*, *testing*, *deployment*, and *review*.

Figure 1: Agile Methodology Phases
(*Source*: Laoyan, 2022)

Planning Phase

In the planning phase, proper data and information are rigorously searched and compiled from various reliable articles, journals, and websites. This would lead to the identification of overall goals associated with the objectives of the AR training system through such a search process. It contains, in particular, the project's objective, problem statement, and literature review.

Design Phase

During the design phase, a flowchart for EasyHeal was prepared to outline the application's structure, along with a storyboard to visually represent the user interface and interactions.

Development Phase

During the development phase within the Agile methodology adopted for this project, the focus lies in application scripting, mechanism development, modeling, and design. This includes selecting and installing essential software tools like Unity for project development, 3ds Max for creating 3D models, Canva for designing 2D assets, and AR Foundation for developing the AR application.

Testing Phase

The testing phase involved systematically evaluating the application's functionality, usability, and overall performance to ensure it met the project's objectives. This phase included both internal testing by the app's development and external testing with real users. The primary focus was on identifying and resolving any bugs, ensuring that the AR features worked seamlessly, and confirming that the user experience was intuitive and engaging.

Participants

To assess the user experience of the EasyHeal application, 25 students from Universiti Teknologi Mara Cawangan Melaka Kampus Jasin, aged 18 to 26, will be recruited as users. This sample size is considered reliable for assessing item quality and provides access to a large group of potential users within the targeted demographic. Feedback from these respondents will be crucial in determining the project's success in meeting its objectives. Choosing students from this university ensures easy access to a relevant group and allows for accurate feedback from the application's intended audience, specifically youth who require active first-aid training.

Instrument

Participants are required to evaluate all questions in the User Experience Questionnaire (UEQ) questionnaire. The UEQ provides a convenient and effective means to swiftly assess the user experience of a product (Schrepp et al., 2014). The questionnaire aims to assess various aspects of the user experience, including attractiveness, perspicuity, efficiency, dependability, stimulation, and novelty. The responses to this questionnaire will play a crucial role in refining and enhancing the AR First Aid Training App to better meet user needs and expectations. Figure 2 displays the set of 26 questions utilized for evaluating the user's experience.

	1	2	3	4	5	6	7		
annoying	O	O	O	O	O	O	O	enjoyable	1
not understandable	O	O	O	O	O	O	O	understandable	2
creative	O	O	O	O	O	O	O	dull	3
easy to learn	O	O	O	O	O	O	O	difficult to learn	4
valuable	O	O	O	O	O	O	O	inferior	5
boring	O	O	O	O	O	O	O	exciting	6
not interesting	O	O	O	O	O	O	O	interesting	7
unpredictable	O	O	O	O	O	O	O	predictable	8
fast	O	O	O	O	O	O	O	slow	9
inventive	O	O	O	O	O	O	O	conventional	10
obstructive	O	O	O	O	O	O	O	supportive	11
good	O	O	O	O	O	O	O	bad	12
complicated	O	O	O	O	O	O	O	easy	13
unlikable	O	O	O	O	O	O	O	pleasing	14
usual	O	O	O	O	O	O	O	leading edge	15
unpleasant	O	O	O	O	O	O	O	pleasant	16
secure	O	O	O	O	O	O	O	not secure	17
motivating	O	O	O	O	O	O	O	demotivating	18
meets expectations	O	O	O	O	O	O	O	does not meet expectations	19
inefficient	O	O	O	O	O	O	O	efficient	20
clear	O	O	O	O	O	O	O	confusing	21
impractical	O	O	O	O	O	O	O	practical	22
organized	O	O	O	O	O	O	O	cluttered	23
attractive	O	O	O	O	O	O	O	unattractive	24
friendly	O	O	O	O	O	O	O	unfriendly	25
conservative	O	O	O	O	O	O	O	innovative	26

Figure 2: UEQ Questionnaire
(*Source:* https://www.ueq-online.org/?lang=en)

Calculation

The user experience of the EasyHeal application was evaluated using the User Experience Questionnaire (UEQ), a tool designed to measure seven specific aspects of user experience. The analysis utilized the UEQ tool along with benchmark data from the UEQ- Online website, allowing for a comparison of EasyHeal's performance with other applications.

The mean results from EasyHeal were compared against this benchmark data, providing insights into where the app stands relative to industry standards. This approach offered a clear perspective on EasyHeal's relative quality. The benchmark data, interpreted through a dedicated Excel tool, highlighted the app's strengths and weaknesses, guiding informed decisions to enhance its overall usability and user satisfaction. Table 1 indicates how the categories map to the observed mean scale values.

Table 1: How the categories correspond to the observed mean scale values.
(Source: Schrepp et al., 2017)

Scale	Excellent	Good	Above Average	Below Average	Bad
Attractiveness	≥ 1.75	$\geq 1.52 < 1.75$	$\geq 1.17 < 1.52$	$\geq 0.7 < 1.17$	< 0.7
Efficiency	≥ 1.78	$\geq 1.47 < 1.78$	$\geq 0.98 < 1.47$	$\geq 0.54 < 0.98$	< 0.54
Perspicuity	≥ 1.9	$\geq 1.56 < 1.9$	$\geq 1.08 < 1.56$	$\geq 0.64 < 1.08$	< 0.64
Dependability	≥ 1.65	$\geq 1.48 < 1.65$	$\geq 1.14 < 1.48$	$\geq 0.78 < 1.14$	< 0.78
Stimulation	≥ 1.55	$\geq 1.31 < 1.55$	$\geq 0.99 < 1.31$	$\geq 0.5 < 0.99$	< 0.5
Novelty	≥ 1.4	$\geq 1.08 < 1.4$	$\geq 0.71 < 1.05$	$\geq 0.3 < 0.71$	< 0.3

Deployment Phase

This stage prioritizes the release of increments of the AR training system that have undergone rigorous testing and validation. This project offers undergraduate students the opportunity to engage in academic research. Thus, this is not slated for public release as it requires the university's authorization for market deployment. The resulting applications will remain the intellectual property of UiTM and will be retained within the university's collection. Consequently, the likelihood of any changes or regressions during the deployment phase is minimal. However, should the need for adjustments arise, the developer will promptly address them to ensure the integrity and functionality of the project are upheld.

Review Phase

Concluding the Agile methodology phases, the review phase involves users receiving a Google Forms questionnaire to evaluate the application following its use. By addressing the

problem statement and achieving the project's overall goals, the aim is to guarantee the application's user experience.

RESULT AND DISCUSSION

Demography Participants

The survey demographics reveal that the majority of respondents were female (84%) and aged between 21-23 years (84%). While 28% had participated in first-aid training, 72% had not. Familiarity with first-aid kits was high, with 84% reporting at least some experience, though only 4% had used one frequently. In terms of knowledge about treating minor injuries, 80% had basic knowledge, 8% had moderate or advanced knowledge, and none were experts. Regarding technology use, 36% rated their experience as intermediate, with 32% as beginners and 32% as advanced. For AR technology, 40% were somewhat familiar, 40% had used it a few times, and 20% had never used it, with no respondents identifying as experts. Table 2 presents a comprehensive overview of the demographic data from the evaluation summary.

Table 2: Participant's Demography

Question	Range	Frequency	Percentage (%)
Gender	Male	4	16
	Female	21	84
Age	18 - 20	3	12
	21 - 23	21	84
	24 - 26	1	4
Have participated in first-aid training	Yes	7	28
	No	18	72
Usually use a first aid kit	Never used it	3	12
	Somewhat familiar	21	84
	Used it a few times	1	4
	Frequently use it	0	0
	Expert in using it	0	0
Knowledge of treating minor injuries	No knowledge	1	12
	Basic knowledge	20	80
	Moderate knowledge	2	8
	Advanced knowledge	2	8
	Expert knowledge	0	0
Experience using technology	Beginner	8	32
	Intermediate	9	36
	Advanced	8	32
	Expert	0	0
Experience using Augmented Reality (AR) technology	Never used it	5	20
	Somewhat familiar	10	40
	Used it a few times	10	40
	Frequently use it	0	0
	Expert in using it	0	0

User Experience Questionnaire Findings

The evaluation results reveal varying perceptions across different user experience dimensions of the EasyHeal application. The mean scores for each element in the UEQ were calculated and then compared with the benchmark table in Table 1 to assess the app's performance. The UEQ consists of six elements: *Attractiveness*, *Perspicuity*, *Efficiency*, *Dependability*, *Stimulation*, and *Novelty*.

Attractiveness

The highest mean score for the attractiveness element was 1.760 for "Annoying/Enjoyable," indicating that users generally found the application enjoyable. The lowest in this category was "Good/Bad" with a mean score of 1.4, suggesting a more neutral response. Table 3 provides a detailed mean score of Attractiveness.

Table 3: Mean Score for Attractiveness

Code	Item	1	2	3	4	5	6	7	Std. Dev.	Mean
UEQ1	Annoying / Enjoyable	0	0	0	1	7	14	3	0.7	1.760
UEQ12	Good / Bad	2	0	2	2	3	8	8	1.8	1.400
UEQ14	Unlikeable / Pleasing	0	1	1	2	2	15	4	1.2	1.640
UEQ16	Unpleasant / Pleasant	0	0	1	3	4	12	5	1.1	1.680
UEQ24	Attractive / Unattractive	0	1	1	3	3	11	6	1.3	1.600
UEQ25	Friendly / Unfriendly	0	1	0	3	5	8	8	1.3	1.720
	Total Mean									1.633

Perspicuity

Table 4 shows the result of the perspicuity element. "Complicated/Easy" received the highest mean score of 1.680, reflecting that users found the application relatively easy to use, while "Not understandable/Understandable" scored the lowest at 1.360.

Table 4: Mean Score for Perspicuity

Code	Item	1	2	3	4	5	6	7	Std. Dev.	Mean
UEQ2	Not understandable / Understandable	0	0	0	1	7	14	3	1.0	1.360
UEQ4	Easy to learn / Difficult to learn	2	0	2	2	3	8	8	1.9	0.560
UEQ13	Complicated / Easy	0	1	1	2	2	15	4	1.1	1.680
UEQ21	Clear / Confusing	0	0	1	3	4	12	5	1.5	1.440
	Total Mean									1.260

Efficiency

The mean result of the efficiency element in Table 5 was rated highly for "Inefficient/Efficient" with a mean score of 1.720, indicating effectiveness, although "Fast/Slow" scored only 0.880, pointing to concerns about speed.

Table 5: Mean Score for Efficiency

Code	Item	1	2	3	4	5	6	7	Std. Dev.	Mean
UEQ9	Fast/Slow	1	2	1	2	8	11	0	1.5	0.880
UEQ20	Inefficient/Efficient	0	0	2	0	6	12	5	1.1	1.720
UEQ22	Impractical/Practical	0	1	0	3	5	11	5	1.2	1.600
UEQ23	Organized/Cluttered	1	2	2	1	1	12	6	1.8	1.360
	Total Mean									1.390

Dependability

For dependability, "Obstructive/Supportive" had the highest mean score at 1.720, showing that users found the application supportive, while "Unpredictable/Predictable" was rated the lowest at 1.000, indicating some unpredictability issues. Table 6 provides a detailed mean score of dependability.

Table 6: Mean Score for Dependability

Code	Item	1	2	3	4	5	6	7	Std. Dev.	Mean
UEQ8	Unpredictable/Predictable	0	0	1	7	9	7	1	1.0	1.000
UEQ11	Obstructive/Supportive	0	0	1	2	5	12	5	1.0	1.720
UEQ17	Secure/Not Secure	0	0	1	4	5	12	3	1.0	1.480
UEQ19	Meets expectations/Does not meet expectations	0	3	2	2	1	12	5	1.7	1.280
	Total Mean									1.370

Stimulation

According to Table 7, stimulation saw the highest mean score of 1.880 for "Not interesting/Interesting," suggesting that users found the application engaging, while the lowest score of 1.040 was for "Valuable/Inferior," indicating a more mixed perception of value.

Table 7: Mean Score for Stimulation

Code	Item	1	2	3	4	5	6	7	Std. Dev.	Mean
UEQ5	Valuable/Inferior	1	2	3	2	3	9	5	1.8	1.040
UEQ6	Boring/Exciting	0	2	0	0	6	12	5	1.3	1.640
UEQ7	Not interesting/Interesting	0	1	0	1	2	16	5	1.1	1.880
UEQ18	Motivating/Demotivating	0	1	2	2	3	12	5	1.4	1.520
	Total Mean									1.520

Novelty

In Table 8, novelty, "Usual/Leading edge" scored the highest at 1.600, reflecting a sense of innovation, while "Creative/Dull" received the lowest score of 0.760, suggesting room for improvement in creativity.

Table 8: Mean Score for Novelty

Code	Item	1	2	3	4	5	6	7	Std. Dev.	Mean
UEQ3	Creative/Dull	1	3	5	2	1	7	6	2.0	0.760
UEQ10	Inventive/Conventional	1	0	2	3	9	7	3	1.4	1.080
UEQ15	Usual/Leading edge	0	0	1	2	6	13	3	1.0	1.600
UEQ26	Conservative/Innovative	2	0	1	2	4	13	3	1.6	1.280
	Total Mean									1.180

Based on Table 9, the experience findings show that EasyHeal's Attractiveness is rated as Good with a score of 1.633, indicating general user appeal, though 75% of results fall below the benchmark. Perspicuity is Above Average at 1.260, meaning the app is generally easy to understand, though some users face challenges with clarity. Efficiency is also Above Average at 1.390, showing that users can complete tasks easily, but may encounter issues with speed. Dependability scores are 1.370, reflecting reliability, though some concerns exist regarding error frequency and data security. Stimulation is Good at 1.520, suggesting the app is engaging, though it may lack uniqueness. Finally, Novelty is rated Good at 1.180, indicating some original features, but not entirely fresh or surprising.

Table 9: EasyHeal Scale Mean Comparison to Benchmark

Scale	Mean	Comparisson to benchmark	Interpretation
Attractiveness	1.633	Good	10% of results better, 75% of results worse
Perspicuity	1.260	Above Average	25% of results better, 50% of results worse
Efficiency	1.390	Above Average	25% of results better, 50% of results worse
Dependability	1.370	Above Average	25% of results better, 50% of results worse
Stimulation	1.520	Good	10% of results better, 75% of results worse
Novelty	1.180	Good	10% of results better, 75% of results worse

CONCLUSION

Overall, EasyHeal is an augmented reality application for home training on minor injuries that is near completion and has successfully met its primary objectives, offering engaging and interactive training. Users have responded positively to its aesthetics, interactivity, and reliability, with above-average ratings on efficiency and perspicuity. However, the project still faces some limitations, including a limited scope of injury scenarios, technical complexity in 3D modeling, and Android-only compatibility. Addressing these challenges and implementing future improvements such as expanding injury scenarios, enhancing 3D modeling and animation, enabling cross-platform compatibility, introducing gamification features, and incorporating a comprehensive first-aid knowledge base will significantly enhance the overall effectiveness, usability, and accessibility of EasyHeal, making it an even more valuable resource for users.

REFERENCES

Bacca, J., Baldiris, S., Fabregat, R., Graf, S., & Kinshuk. (2014). Augmented Reality Trends in Education: A Systematic Review of Research and Applications. Educational Technology & Society/Journal of Educational Technology & Society, 17(4), 133–149. http://www.ifets.info/journals/17_4/9.pdf

Bakke, H. K., Steinvik, T., Angell, J., & Wisborg, T. (2016, December 1). A nationwide survey of first aid training and encounters in Norway. BMC Emergency Medicine. https://doi.org/10.1186/s12873-017-0116-7

Barsom, E. Z., Graafland, M., & Schijven, M. P. (2016). Systematic Review on the Effectiveness of Augmented Reality Applications in Medical Training. Surgical Endoscopy. https://doi.org/10.1007/s00464-016-4800-6

Eisenburger, P., & Safar, P. (1999). Life supporting first aid training of the public—review and recommendations. Resuscitation, 41(1), 3-18.

Fariduddin, M. N., Mohamed, M., & Jaafar, M. (2022). Kids save lives Malaysia handbook for primary school children: development and usability study. ASM Sci. J, 17, 2022.

Laoyan, S. (2022, October 15). What Is Agile Methodology? (A Beginner's Guide) [2023] • Asana. Asana. https://asana.com/resources/agile-methodology

McCarthy, C. J., & Uppot, R. N. (2019b). Advances in Virtual and Augmented Reality—Exploring the Role in Health-care Education. Journal of Radiology Nursing, 38(2), 104–105. https://doi.org/10.1016/j.jradnu.2019.01.008

Moreno-Guerrero, A. J., García, S. A., Navas-Parejo, M. R., Campos-Soto, M. N., & García, G. G. (2020). Augmented Reality as a Resource for Improving Learning in the Physical Education Classroom. International Journal of Environmental Research and Public Health, 17(10), 3637. https://doi.org/10.3390/ijerph17103637

Nasser, D. N. (2018). Augmented Reality in Education Learning and Training. https://doi.org/10.1109/icca-ticet.2018.8726192

Schrepp, M., Hinderks, A., & Thomaschewski, J. (2014). Applying the User Experience Questionnaire (UEQ) in Different Evaluation Scenarios. Lecture Notes in Computer Science, 383–392. doi:10.1007/978-3-319-07668-3_37

Schrepp, M., Hinderks, A., & Thomaschewski, J. (2017). Construction of a Benchmark for the User Experience Questionnaire (UEQ). International Journal of Interactive Multimedia and Artificial Intelligence, 4(4), 40. https://doi.org/10.9781/ijimai.2017.445

Tse, E., Plakitsi, K., Voulgaris, S., & Alexiou, G. A. (2023). The role of a first aid training program for young children: A systematic review. Children, 10(3), 431.

User Experience Questionnaire (UEQ). (n.d.). https://www.ueq-online.org/?lang=en