Android-based First Aid Simulation System

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Abstract— This research aimed to design and develop an Android-based mobile application focused on teaching first aid for various injuries and illnesses. The app integrates multimedia elements such as video demonstrations, animations, and interactive decision-making scenarios, providing users with an immersive environment to practice first aid skills. The development utilized C# for programming, Unity Engine for mobile application development, and various multimedia tools such as Adobe Photoshop, Freepik, and ElevenLabs for enhanced user engagement. The study followed the Agile methodology to ensure iterative feedback and continuous improvement during development. The quality of the application was assessed using the ISO 25010 software quality characteristics model, and evaluations by 10 IT experts and 70 end-users resulted in excellent ratings, with scores of 4.56 and 4.64, respectively. The app is now available for download through a QR code, providing a valuable educational tool for promoting first aid awareness and preparedness.

Index Terms— **Android-based application, first aid simulation, mobile learning, multimedia, ISO 25010, usability testing, emergency preparedness, simulation, mobile health education, Agile development.**

1. Introduction

In the digital era, mobile technology has transformed how education is delivered, offering new opportunities for accessible, engaging, and interactive learning. One critical area where this transformation is needed is in first aid training. Despite its importance in saving lives during emergencies, a significant portion of the population remains untrained or unprepared to respond effectively in critical situations. Traditional first aid courses, while valuable, often face limitations in terms of accessibility, engagement, and the ability to provide hands-on experience. Many individuals, particularly those in rural or underserved areas, lack the resources or opportunities to attend in-person first aid classes, leaving them vulnerable in emergencies. To address this gap, this study developed an Android-based mobile application designed to teach first aid through a combination of multimedia elements, including video demonstrations, animations, and interactive decision-making scenarios. The application provides users with the opportunity to engage in virtual emergencies, allowing them to practice first aid skills in a safe, controlled, and immersive environment.

This mobile application aligns with several United Nations Sustainable Development Goals (SDGs), reflecting its broader social impact. SDG 3: Good Health and Well-being is directly addressed through the app's goal of improving first aid knowledge and empowering individuals to take immediate

action in emergencies, potentially saving lives and reducing the severity of injuries. By increasing the general population's ability to administer first aid, the app contributes to healthier and safer communities. Furthermore, the app promotes SDG 4: Quality Education by offering a modern, engaging platform for learning that is both accessible and effective. Mobile technology allows the app to reach a broad audience, particularly those who may not have access to traditional educational resources, thereby fostering a more inclusive approach to health education. The app also embodies SDG 9: Industry, Innovation, and Infrastructure, showcasing how technological innovation can solve real-world problems, particularly by integrating advanced features like multimedia simulations and interactive learning into first aid training. Finally, by enhancing individual preparedness for medical emergencies, the app contributes to SDG 11: Sustainable Cities and Communities, supporting community resilience and disaster preparedness. In disaster-prone areas, where timely medical intervention is critical, the ability to act swiftly with basic first aid can significantly mitigate the impact of emergencies, thereby building more resilient and sustainable communities.

Overall, this study not only provides a novel solution to the challenges of traditional first-aid training but also contributes to achieving key SDGs. By leveraging mobile technology to make first aid education accessible, engaging, and practical, this application has the potential to empower individuals, strengthen communities, and improve health outcomes on a broader scale.

2. Objectives

Generally, the study aimed to design and develop a first-aid simulation mobile application.

Specifically, it aimed to:
1. design a mobile application that:
   a. provides information on first aid for various injuries and illnesses.
   b. Incorporates multimedia elements such as video demonstrations and animations.
   c. Includes engaging decision-making scenarios and simulations for users to practice first aid skills in virtual emergencies.
2. develop the application using C# for programming, Unity Engine for mobile application development, and other multimedia tools such as Adobe Photoshop, ElevenLabs, Freepik, and Figma.
3. assess the quality characteristics of the application using the ISO 25010 model, focusing on:

    a. functional suitability,
    b. performance efficiency,
    c. compatibility, usability,
    d. reliability,
    e. maintainability, and
    f. portability;
4. evaluate the usability of the application in terms of:
    a. appropriateness, recognizability,
    b. learnability,
    c. operability,
    d. user error protection,
    e. user interface aesthetics, and
    f. accessibility; and
5. prepare an implementation plan for deploying the application.

3. Review of Related Literature

First aid training is an essential aspect of ensuring public health and safety. The knowledge of how to administer basic first aid can significantly impact the outcomes of medical emergencies. According to Vital First Aid Training Services (2019), basic first aid skills allow individuals to manage emergencies effectively until medical professionals arrive. Without such knowledge, even seemingly minor injuries can escalate, leading to more severe outcomes. For example, improper treatment of burns, fractures, or choking incidents may lead to complications or even death, demonstrating the critical importance of early intervention.

The importance of first aid knowledge is underscored by statistics that show how timely intervention can prevent fatalities. Life First (2019) reported that 59% of deaths caused by injuries could have been avoided if first aid had been administered before emergency responders arrived. This statistic highlights the significance of first aid education and the role it plays in saving lives during critical moments. However, despite its importance, research shows that a majority of people feel unprepared to respond effectively in emergencies. According to the British Red Cross (2018), a large proportion of the population lacks the confidence or knowledge to administer first aid, with 71% of adults unable to act if someone collapses and is unresponsive but still breathing. This gap in first aid knowledge and preparedness is a serious concern, as it results in missed opportunities to save lives.

The use of simulation-based learning has gained significant traction in various fields, including healthcare and emergency management. Simulation allows learners to experience real-life scenarios in a controlled, risk-free environment, enhancing their ability to apply learned skills in actual situations (Lohman, 2021). In the context of first aid, simulations provide a valuable tool for training individuals in emergency response. By incorporating multimedia elements such as video tutorials, animations, and interactive decision-making processes, mobile applications can replicate realistic emergencies, providing users with a more engaging and practical learning experience.

Various mobile applications have emerged over the past decade that attempt to teach first aid using technology. Some of these apps include video demonstrations, text-based instructions, and decision-making scenarios. However, many of these applications fall short of providing an interactive, hands-on experience, which is essential for solidifying the knowledge and skills necessary to act effectively in a real-life emergency. The First Aid Simulation System developed in this study integrates several features—video demonstrations, animations, text instructions, and interactive scenarios—that engage users and enable them to participate in the learning process actively.

In particular, mobile applications like Baby Panda's Emergency Tips and iFirst Aid have pioneered the use of interactive simulations for teaching first aid (Technical Knowledge, 2023). These applications have demonstrated that incorporating real-life scenarios into training can improve user engagement and enhance retention. The current study builds on these advancements by offering an application that not only simulates emergencies but also provides users with the ability to make decisions during simulated crises, mimicking real-world situations where timely and correct decisions are critical.

4. Methodology

This study utilized the Agile Software Development Methodology to design, develop, and evaluate the Android-based First Aid Simulation System. The Agile model was selected due to its flexibility, focus on iterative development, and continuous feedback, which allowed the development team to refine the application progressively throughout its creation.

The development process followed five main stages: requirement gathering, design, development, testing, and deployment. During the requirement-gathering phase, the team identified the core features of the application, such as the types of first aid scenarios to be covered and the multimedia elements necessary to make the learning experience engaging, including animations, videos, and interactive simulations. The design phase focused on creating wireframes and user interface layouts, utilizing tools like Adobe Photoshop and Figma to develop the visual components. The development phase involved programming the application using C# and Unity Engine, ensuring that the app functioned seamlessly across Android devices. During this phase, multimedia resources were integrated, and features such as decision-making scenarios and video demonstrations were implemented.

After completing development, the testing phase started. Ten IT experts tested the app's performance, and 70 end-users evaluated it using the ISO 25010 software quality model. This model assessed the application on various dimensions, such as functional suitability, performance efficiency, usability, and reliability. The experts provided feedback through a Likert scale survey, and the usability evaluation focused on user interaction, learnability, and accessibility.

Finally, in the deployment phase, the app was made accessible to the intended users, with a downloadable QR code to ensure easy access. The feedback gathered during testing was used to make necessary adjustments before finalizing the application for public use. This methodology allowed for a comprehensive development process that integrated continuous improvement based on real-time feedback from both technical and end-user perspectives.

5. Results and Discussion

A. System Design

The First Aid Simulation application is designed to offer an interactive and immersive learning experience aimed at improving users' emergency response skills and knowledge. The system is based on game design principles, where users actively participate in decision-making scenarios to practice first aid.

Figure 1 shows the application's disclaimer, which users must read before starting the game to ensure they fully understand the system's purpose and limitations. This disclaimer is an essential feature that establishes clear expectations and protects both users and developers.
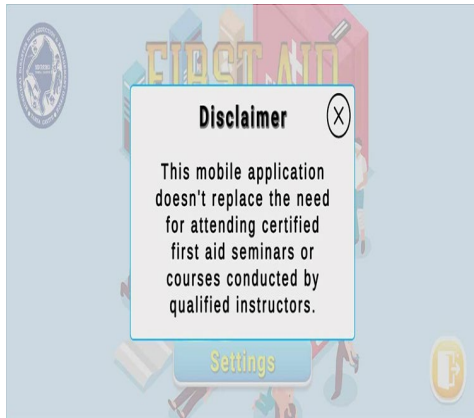

Fig. 1. Disclaimer's page

Figure 2 shows the game's main menu, which offers options such as Demo, Simulation, Settings, and Exit. This menu allows users to easily navigate between different sections of the application, helping them choose between learning through demonstration or engaging in interactive simulations.
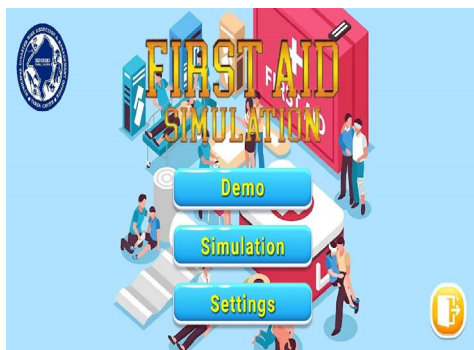

Fig. 2. Main menu

Figures 3 through 5 illustrate the demo videos that are provided under the Demo menu. These videos serve as instructional content, showcasing different first-aid scenarios that users might encounter, such as burns, poisoning, and breathing emergencies. Each category includes a short video demonstrating proper first-aid response steps. These videos serve as foundational learning material before users engage in simulations.
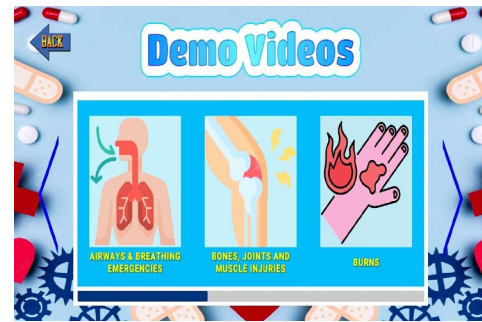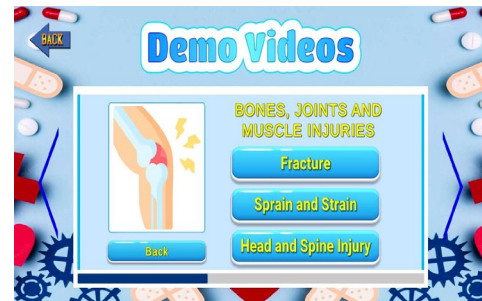

Fig. 3. Demo video categories
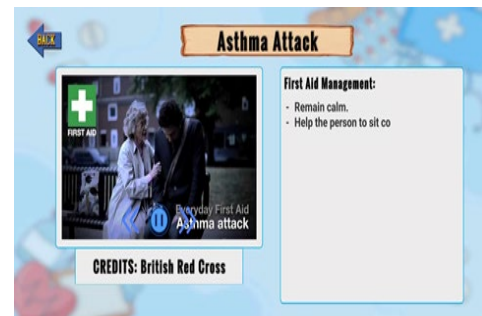

Figure 4. Category menu

Fig. 5. Sample video demonstration

Figures 6 through 10 depict the simulation feature of the game, where users can apply their knowledge by practicing first aid in various scenarios. Upon selecting a first aid scenario, users are first shown the Game Rules and are prompted to start the simulation by pressing a "Start" button. The story behind the injury is explained, followed by an NPC (Non-Playable Character) guiding the user to begin helping. Instructions for the first aid process appear step by step, allowing users to interact and make decisions. Users can tap or drag the image to get additional instructions if needed. This feature ensures that users are guided through each step of the emergency response process.

Fig. 6. Games rules
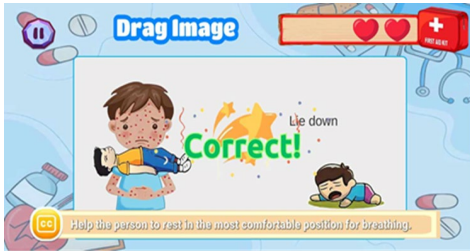
Fig. 7. Simulation categories

Fig. 8. Simulation game

Fig. 9. Simulation – Help button

Fig. 10. Simulation – Drag object

Figure 11 shows the settings menu, which allows users to customize the game to their preferences. Users can adjust the volume, toggle the sound on or off, and access developer options. These settings provide flexibility to the users, ensuring a personalized experience.
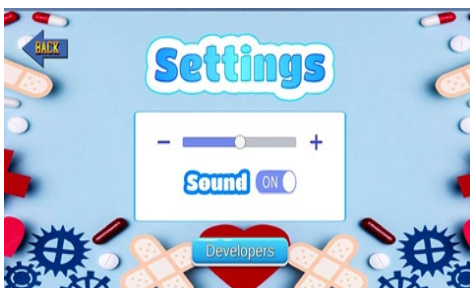

Fig.11. Settings

B. System Development

The First Aid Simulation application was developed using several software tools to ensure both functionality and visual appeal. The core development platform is Unity Engine, which enables seamless integration of various game mechanics, object alignment, and animations. The Unity Remote app was used to test the app's performance across Android devices.

For media assets, Freepik, Pinterest, and Canva provided source materials, which were customized using tools such as Figma, Photoshop, and Paint 3D. These assets enriched the game with appealing visuals, while Figma was used to design the user interface (UI) and user experience (UX). ElevenLabs was employed to create realistic voiceovers, and Freesound provided background audio for immersive sound effects.

The game mechanics were programmed using C# within the Unity environment, and Mono was employed to ensure cross-platform compatibility. This allowed the game to work seamlessly across various Android devices, making it accessible to a broader audience.

C. System Testing

Upon completing the development phase, the First Aid Simulation system underwent extensive testing to ensure quality and functionality. Using ISO/IEC 25010, the testing focused on several quality measures, including functional suitability, performance efficiency, compatibility, usability, reliability, maintainability, and portability.

A total of 10 IT experts participated in the testing process, using a rating scale from 1 to 5 to evaluate the system's performance in different areas. The results from the testing were overwhelmingly positive, as shown in Table 1, with functional suitability, performance efficiency, and usability all receiving excellent ratings, indicating that the system was highly functional, efficient, and easy to use. For example, functional appropriateness received the highest mean score of 4.70, while overall performance efficiency scored 4.63, suggesting that the app performed well under regular operation.

Further testing on usability revealed that the system was highly effective in helping users learn how to use the application, with learnability and operability both scoring 4.80. Other areas, such as user error protection and user interface aesthetics, also received high ratings, underscoring the system's user-friendly design and ability to minimize mistakes.

The compatibility and portability testing confirmed that the system could operate effectively across multiple devices and environments, with scores of 4.45 and 4.53, respectively. The reliability tests, assessing how the system performs under stress and in different scenarios, revealed an overall rating of 4.53, suggesting a highly reliable application.

In conclusion, the system was found to meet or exceed the expected standards in all areas, with an overall mean score of 4.56, classifying it as excellent.

Table.1. System testing results

CRITERIA FOR TESTING	MEAN	INTERPRETATION
Functional Suitability	4.60	Excellent
Performance Efficiency	4.63	Excellent

Compatibility	4.45	Very Good
Usability	4.68	Excellent
Reliability	4.53	Excellent
Maintainability	4.52	Excellent
Portability	4.53	Excellent
OVERALL RESULT	**4.56**	**Excellent**

D. System Evaluation

Following system testing, the First Aid Simulation was evaluated based on usability criteria by a group of 70 respondents, including 10 local unit staff members, 10 trainers, and 50 potential learners. Table 2 highlights the usability evaluation results, with the system receiving excellent ratings across all criteria. The highest mean score was 4.76 for appropriateness recognizability, indicating that users found the system's content highly relevant to their needs. The lowest score, 4.51, was for user error protection, which still reflected an excellent standard of protection against common user mistakes.

Overall, the system was rated excellent, with a mean score of 4.64, confirming that users found the First Aid Simulation to be a compelling, engaging, and accessible tool for learning first aid skills.

Table.2. System usability evaluation results

USABILITY CRITERIA	MEAN	INTERPRETATION
Appropriateness Recognizability	4.76	Excellent
Learnability	4.69	Excellent
Operability	4.66	Excellent
User Error Protection.	4.51	Excellent
User Interface Aesthetics	4.66	Excellent
Accessibility	4.57	Excellent
OVERALL RESULT	**4.64**	**Excellent**

E. Implementation

The implementation of the First Aid Simulation system began on September 20, 2024, at a concerned unit in Tanza, Cavite. The researchers presented and installed the system, followed by an awareness campaign using social media, posters, and flyers. The installation process was completed efficiently, taking approximately 30 minutes.

The system's demonstration lasted 1 hour and 30 minutes, and the researchers ensured that all staff members and learners were familiar with the application. Information distribution via social media and offline channels continued for two days, reaching a broad audience within the local community.

These efforts aimed at maximizing the system's usage and ensuring that the target audience could fully benefit from the educational tool.

6. Conclusion

Based on the findings and results of the study, the researchers conclude that the First Aid Simulation Mobile Application successfully met the objectives outlined in the study:

- The mobile application was designed to provide users with comprehensive information on first aid for a range of injuries and illnesses. It effectively incorporated multimedia elements such as video demonstrations and animations. The decision-making scenarios and interactive simulations allowed users to practice first aid skills in virtual emergencies, making the learning experience both engaging and practical.
- The application was successfully developed using C# programming and Unity Engine for mobile application development. Multimedia tools such as Adobe Photoshop, ElevenLabs for voiceovers, Freepik for image assets, and Figma for design elements enhanced the visual appeal and functionality of the application, making it both user-friendly and informative.
- The application was thoroughly assessed using the ISO 25010 model. The results showed that the application performed excellently in all evaluated areas. The overall mean rating of 4.56 indicated that the system met most expectations in terms of functional suitability, performance efficiency, compatibility, usability, reliability, maintainability, and portability.
- The usability evaluation, conducted with local unit staff, trainers, and learners, yielded an excellent rating of 4.64. This reflects the application's effectiveness in meeting the criteria for appropriateness recognizability, learnability, operability, user error protection, user interface aesthetics, and accessibility, ensuring that the application is easy to use and caters to a wide range of users.
- An implementation plan was prepared and successfully executed. The system was implemented at a local unit, and the process included approval, system demonstration, installation, and information distribution. The application was made accessible to staff, trainers, and learners, allowing them to benefit from its interactive training features.

In conclusion, the study has successfully developed a functional, user-friendly, and interactive First Aid Simulation Mobile Application that meets the objectives set forth. The application provides an effective tool for learning first aid, and its positive testing and evaluation results indicate that it is a valuable asset for a local unit's training program.

7. Recommendations

Based on the study's findings and conclusions, the following recommendations are suggested to enhance the First Aid Simulation Mobile Application further:

- *Develop Windows (Emulator) and iOS versions.* To expand the application's reach, it is recommended that versions be developed for Windows and iOS platforms. This would allow users with different operating systems to access the application and benefit from its features.
- Introduce light/dark mode. Including a light/dark mode option will allow users to choose a display that suits their preferences or environmental conditions, improving user comfort during prolonged usage.
- Include a module for patches and updates. Developing a module for regular patches and updates would ensure that the application remains up-to-date with new first-aid practices and improvements in functionality. This would also help address any bugs or user-reported issues.
- Integrate Virtual Reality (VR) and Augmented Reality (AR) features. Integrating VR and AR features could offer users an even more immersive and interactive experience. For example, users could practice first aid skills in a virtual environment or use AR to visualize proper techniques in real-world scenarios.
- Add a Web-Based Content Management System (CMS). A web-based CMS would allow administrators, trainers, and medical experts to quickly update and manage content within the application, such as first aid protocols, video demonstrations, and simulations. This would ensure that the app remains current with evolving best practices and guidelines.

Implementing these recommendations would further improve the functionality, accessibility, and user engagement of the First Aid Simulation Mobile Application, making it a more comprehensive and versatile tool for training and learning first aid.

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