

Hakeem: An Arabic Application Aimed to Teaching Children First Aid using Augmented Reality

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Abstract

Children are by nature curious and enthusiastic about learning and love to explore and search for everything they see around them, but as a result of this exploration they may sometimes be exposed to dangerous situations ranging from falls to poisoning and suffocation. That is why when supporting a child's natural desire to explore the world and supporting his awareness of dangerous situations and good handling of them, helps him build a conscious scientific mind and enhance his curiosity in the natural world. It is not easy to imagine a difficult situation in which we or one of our family is in danger, unable to help ourselves or to help them in time, due to our complete ignorance of the rules of first aid. Hence the importance of learning first aid not only for the child but for the community and the world at large. "Hakeem" is an Arabic E-health educational application that aims to teach children from the age of six to eleven years first aid, in our belief that the seed of renaissance lies in the care and education of children, and the lack of Arabic content that aims to teach children first aid skills. The idea is to create a scenario in which the child is responsible for saving the person who will be in a dangerous situation using Augmented Reality (AR) technology, to increase engagement and interaction and provides a rich user experience, and according to the child's performance, he will get reward points. The game will have several levels: Beginner, Intermediate, and Hakeem, and based on the player's points he will get a title and move to the next level, and when he reaches the end, he will get the certificate.

Keywords:

First Aid; Augmented Reality; Children; E-health applications; Gaming

I. INTRODUCTION

Children are usually active, and full of energy, they play and move from one place to another without realizing what might harm them. It's logical for parents to be concerned about the safety of their children and wants them to stay within a safe home nest for as long as possible, usually, in fear of the dangers, they could be exposed to. However, as a child develops, life becomes one big adventure for them. They don't have any worries, they are more active, independent, and keen to discover the world around them. children acquire a wider range of freedom of movement and become more independent from their parents. But with this freedom, there is more opportunity for dangerous situations to arise.

Teaching children First aid is vital [1]. First aid is usually taught, at request, later in life, but it should not be too late to encourage teaching first aid. First aid training provides important skills which bring various

opportunities with it. The more time children spend without an adult, they are more likely to encounter some situations; cuts, scrapes, burns, and bruises can happen even when being careful. Whether parents spend a little or a lot of time with their children, there comes a point when they will be venturing off on their own. It's important to raise our kids to be kind, curious, thoughtful, and smart. And let them make good decisions for themselves. But even when they do, injuries can happen. In that case, it should help them to be as prepared as they can be to take care of themselves and others.

Helping children learn new skills can be an important part of managing behavior. When children can do the activities, they want or need to do, they're more likely to cooperate [2]. They're also less likely to get frustrated and behave in challenging ways [3]. Injuries and medical care can be intimidating for many people, but it doesn't have to be. With a little knowledge, preparation, and forethought, children can be prepared to handle the basics of first aid. Helping children learn new skills can build independence, confidence, and self-esteem. Therefore, it can be an important part of supporting overall development too.

Both children and adults can become fearful and disoriented at the sight of someone bleeding or falling unconscious. First aid will teach children how to be calm and level-headed, even adults are prone to panic when they realize that something is wrong. This calm and level-headed approach to treating someone who is hurt can carry on well into adulthood. First aid bolsters communication and leadership skills at an early age [4]. First aid lessons will equip a child with a better vocabulary for complex situations. In addition, it will help them practice communicating clearly with each other and adults, assume roles of responsibility, and take the initiative to do something in case of an emergency [5].

The Saudi Red Crescent Authority makes great efforts with the whole community, they worked to educate community members and increase their awareness of how to avoid complications when someone is injured. All these roles are performed by the authority in cooperation with the best specialized educational and medical institutions. The statistics shows the total number of beneficiaries of training and awareness activities for the community in 2019 was (373408) compared to 2015 which was (15865) [6].

Having established the importance of teaching first aid, it is important to recognize that any attempt to build a new generation with good first aid skills and abilities must start with the children. On this basis, we decided to build the “Hakeem” application that aims to teach children first aid skills in a fun and enriching experience using Augmented Reality (AR) technology that makes education more easily and more efficiently and gives proper training on how to react and help themselves and cooperate to help others. Encourage children to be more confident, responsible, and in control of dangerous situations. “Start them young” definitely applies to first aid learning [7].

With the rapid development of augmented reality (AR) technology in recent years, the application of mobile AR has become more and more extensive [8]. AR has its magic; it can change the way of interacting with mobile apps and other visual graphic experiences [9]. In Hakeem, it will help children improve their real-life abilities in a safe environment. Therefore, it may help them to enhance their skills. Children will have a new opportunity to learn how to communicate and collaborate. AR provides children with opportunities to deepen their knowledge in several areas.

This paper is structured as follows. Section II illustrates the literature review that discusses related studies and applications. A comprehensive comparison against similar systems is shown in Section III. Section IV presents the application development process. Section V discusses the limitations and future work, and Section VI concludes the paper.

II. LITERATURE REVIEW

This section begins with a literature review to present previous studies that discussed topics related to the concept of first aid. Next, a comparison of similar applications based on differing features is presented. Finally, a discussion is presented that summarizes the results and outcomes.

A. Related Studies

First aid has a different meaning from many perspectives that contribute to the same meaning. First aid is the initial care of the ill or injured. It aims to preserve and protect life, prevent further injury or deterioration of illness, and help promote recovery [10]. In other terms, first aid is the assessments and interventions that can be performed by a bystander immediately with minimal or no medical equipment. Another perspective of First aid is the treatment to preserve life and minimize the consequences of injury and illness until help from a medical practitioner or nurse is obtained with minimal or no medical equipment [11].

First aid kits are designed to manage all types of injuries, including basic cuts, scrapes, and burns. Therefore, within homes, individuals can deal with various injuries and wounds, without making visits to medical and health care centers. In this manner, they will be able to recognize the importance of first aid. In addition, there are some cases, in which circulation is arrested for more than five minutes, which can

result in irreversible brain damage or even death. Therefore, in general, life-saving Basic life supports BLS procedures should immediately be applied by nonprofessionals who happen to be nearby at the time of the incident.

Principles of First Aid Through the application of the materials from first aid, the individuals can render a significant contribution in not only treating wounds and injuries but also promoting good health and well-being. The principles of first aid are, preventing injuries and wounds from assuming a major form, ensuring speedy recovery, facilitating the participation of individuals in various tasks and activities, taking precautions for future safety, and promoting health and well-being[12].

B. Related Applications

- RED CROSS

RED CROSS - Accident prevention and first aid for children is an application available for iOS users and it is designed in collaboration with the Red Cross to help adults and children avoid unpleasant surprises. With a text-free, intuitive interface, this app is intended for a global audience and can be used both as an educational tool by parents and as a learning supplement for teachers. Children can act out each simulation however they like and see the consequences of their actions. They will learn to take care to prevent falls, avoid cuts and burns in the kitchen, be prudent at the park, and recognize toxic products that may be found at home. They will also learn how to avoid traffic accidents, drowning at the beach or in pools, heatstroke, and sunburn [13].

- First Aid Tips

First-aid tips is an application available for Android users that has 17 first aid tips for kids. It teaches the user how to handle some situations: (such as being bitten by a pet, spraining an ankle, arm injured, and bruising after a fall). It also gives first aid advice for accidents such as burns, bee stings, and insects inside the eye [14].

- Safety for Kids 1

Safety for Kids 1 is an application available for both iOS & Android users this game for kids is designed to focus on inspirational learning, skill-building, and content to the young audience will bring kids a unique learning experience. It includes safety tips in case of strangers come, getting lost, robber invasion, fire escape, electric shock, earthquake, tsunami, lift trouble, and first aid procedures. Safety for Kids illustrates how children should react when those emergencies hit [15][16].

- Emergency Rescue Service

Emergency Rescue Service Games is an application available for iOS users and is designed for children to be enrolled with the police, emergency medical service, or firefighter department and take on rescue missions unique to each service in a big city. It has several scenarios such

as: driving a rescue ambulance toward the accident site and rescuing people. Each emergency department has its vehicles like a police car, fire truck, ambulance, and equipment for you to operate while on duty [17].

- Hyper Help!

Hyper Help! is an application available for iOS & Android users, and it is designed to help patients and rescue them with your ambulance. The user should save people with an ambulance, drive to accidents, treat people with different tools, and save their lives. It has mini-games and puzzles to help the user solve each task in this ambulance simulator. Scan for fever, treat them with a bandage, measure their blood pressure and make them feel great again [18][19].

III. COMPARISON WITH RELATED APPLICATIONS

Comparing similar applications in a table demonstrates the differences between the applications easily. Table I illustrates the six applications including Hakeem’s application and compares them in terms of various features that enhance the concept of first aid. Such as supporting the Arabic language, educational videos, and augmented reality technology. It can be seen that “Hakeem” has several of the important features that exist in similar applications, such as the free of charge and encouragements elements. On the other hand, it provides features that are not supported in some other applications like educational videos, Augmented reality, and game timers.

TABLE I. COMPARISON WITH SIMILAR SYSTEMS

Applications Features	Red cross [13]	First-aid tips [14]	Safety for Kids [15][16]	Emergency Rescue Service[17]	Hyper Help! [18][19]	Hakeem
AR technology	X	X	X	X	X	✓
VR technology	X	X	X	✓	✓	X
Encouragement element	X	✓	✓	X	X	✓
Free of charge	✓	✓	X	✓	✓	✓
Audio guide	X	✓	✓	X	X	✓
Educational videos	X	X	✓	X	X	✓
Game timer	X	X	X	✓	X	✓
Arabic language	X	✓	X	✓	X	✓

IV. APPLICATION DEVELOPMENT

A. Information Gathering.

Interviews are one of the most important ways to gather information; it helps collect a richer source of information on behavior, opinions, knowledge, and preferences. Therefore, three experts were selected to gain insight from their experiences.

The first interview was conducted with an Assistant professor and a child adolescent psychiatrist consultant. He stated that the children’s age has a strong impact on their understanding of first aid skills and according to the theory of cognitive development, the stage from 7-11 years is the most appreciated age stage to teach children a new skill. And he confirms that teaching children a life-saving skills, will build confidence in themselves and will reduce their anxiety levels.

The second interview was conducted with a Director of Academic Affairs and Training Department of the Red Crescent Authority. she stated that they received several incidents, and it was the child who called the Red Crescent to ask for help, and she emphasized that the goal and the most important thing is to teach the child how to call the Red Crescent in an emergency. and she emphasized that it’s not enough, for now, it must be intensified, but the most important thing is that we need the community to realize that it needs a first aid course and that it should not be postponed until the time of need or after danger occurs.

The third interview was conducted with a general pediatric consultant, He confirmed how it is worthwhile to teach a child first aid and how saving a person in the first 2-5 minutes makes difference, because it could reduce the risk of doubling the injury and prevent further damage, even if by knowing from whom he can request assistance to save the person life.

The second method was conducted with an online questionnaire. The sample of the questionnaire covered more than 1200 citizens from Saudi Arabia of varying ages. The focus of the questionnaire was to measure the average usage time and usage fields of electronic devices by the children and to discover the probability of happening dangerous situations for children and their ability of them to react calmly, as well as the utility of teaching children the first aid skills. According to the responses, 35.6% of the sample were children’s parents and 36.5% were siblings. The average time of using electronic devices by 45.2% of the children was from 2-6 hours during the day as opposed to more than 6 hours during the day by 38.3% of the children. Many children (43.7%) use electronic devices in education and 75.7% in gaming. Therefore, this abdicates that educational applications can be beneficial for children. In terms of

children being left unattended, 47.5% of respondents answered that their children stay alone for 2 to 4 hours and more than 6 hours during the day. Another important question was whether people think that injuries are common, and 47.2% of respondents believe that the possibility of injuries is probable, therefore, the children need to be skilled in first aid. When people were asked if children are equipped with the necessary skills to act appropriately in case of emergencies, 48.1% of respondents believe that their children are unable to act properly in dangerous situations and 48.1% of them are partly able. Also, most respondents think that it's necessary to teach children first aid skills and they can learn it. Additionally, 91.5% of the respondents believe that teaching children first aid skills may give their children the ability to distinguish the dangerous situations and then avoid them. Another question asked whether the respondents tried to teach their children first aid skills, 31.2% answered "Yes" while 68.8% answered "No", and that is why Hakeem aims to teach the children first aid skills. In addition, many of the respondents give some suggestions and shared some features that may attract their children to use the application such as Video-based Content, friendly user interface, interactive content, live tutorials, and Gamification. Finally, the need for Hakeem is evident when 96.9% answered that they would like to have an Arabic application that teaches their children first aid skills in a joyful manner.

B. System Implementation

Hakeem uses the unity platform to program the application by using the C# programming language. Furthermore, to execute and test Hakeem, the unity [20] remote provided by unity and available in App Store on iPhone 13 was used. Moreover, Figma [21] was used to create and design the interfaces of Hakeem. Therefore, Animaker [22] used to create and edit educational videos that were included in Hakeem. For the Hakeem database, we chose Playfab [23] provided by unity to store player information and scores in the game. Playfab is a Realtime Backend / API category, and it is most suitable since it's built exclusively for games.

In the beginning, the child will go through a series of interfaces starting with the Hakeem launch screen and then the sign-in interface if he had an account, and if he does not have an account, he will move from the sign-in interface to the sign-up interface to create an account. Next, the map interface shows several locked levels that the child must unlock to reach the last level. Each level contains an educational video and game, the child must watch the video before playing the game, the game will be with Augmented Reality technology to help the child simulate what he has learned and measures the child's understanding. A "Hint" option will be provided to assist the child if needed. The child will visit four levels that provide four first aid basic concepts, first aid kit, first aid for wounds, first aid for burns, and first aid for nosebleeds. Hakeem follows the reward strategy to motivate children.

Once the child completes the game, feedback will be given to show whether the child complete the game correctly or not. If the gained score is enough, the child will be congratulated and be able to move to the next level. Otherwise, the child will be encouraged to repeat the game until the minimum score is achieved. The child's score will be shown throughout the scoreboard interface, as well as the five highest players' scores in the application. Finally, when the child finishes all the levels successfully, he will deserve a certificate of completion. The certificate will contain the child's name and it can be saved to the camera roll on the child's device.

C. System Design

For Hakeem, the most suitable architecture is a combination of an MVP and client-server architectures as shown in Figure 1. A client-server system can be defined as a software architecture made up of both the client and server, whereby the clients always send requests while the server responds to the requests sent [24]. The importance of incorporating the Client-Server Architecture in Hakeem's software architecture lies in the fact that the Hakeem application will act as a client to a web server such as a cloud database to access the Hakeem user's database. Some noteworthy benefit of MVP is that it is lost couples from UI therefore, the application stays loose couples from code behind page (UI) to business layer or any other next latter. Moreover, it increases code maintainability by keeping the code more maintainable throughout the lifetime of the project, especially during the maintenance phase therefore, code reusability will be provided by the separation of concern principle. The design will have a proper domain model and business logic in its logical unit [25]. The integration between these two architectures will be by placing the view layer on the client-side, and on the server-side, it will contain both presenter and model layers. For the interactive gaming environment, Hakeem needs great performance and responsiveness, which is done by grouping components with frequent interactions together and putting additional components on the server side. Because the presenter will make frequent requests to the model layer, it's desirable to have them on the same side, preferably the server-side, for better performance. To achieve increased responsiveness, the view layer, which is responsible for the user interface, was moved to the client-side. This resulted in quicker answers.

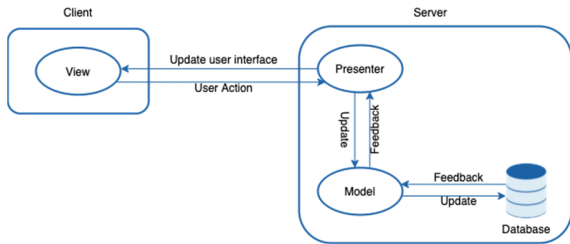


Fig.1 Hakeem Client-Server MVP Architecture

D. User Interface

This section presents a sample of screens in the Hakeem application to illustrate the user interface design (Fig. 2 to Fig. 7).

E. System Evaluation and Testing

To assure that the system performs all requirements, meets the objective, and uncovers errors there must be a testing method performed. Hakeem’s application applied several test strategies such as unit testing, integration testing, user acceptance testing, and performance testing.

User Acceptance Testing UAT is done by targeted end-users to make sure that the application can perform intended functionality and feedback is taken to further

enhance the quality of software. boys and girls were selected, and their ages range from 6 to 11 years, to gain insights from their experiences and expectations. Two stages of testing were conducted. The first stage is to calculate the time each user spent on each task. The second stage is the user. Table III displays a sample of the user acceptance testing.

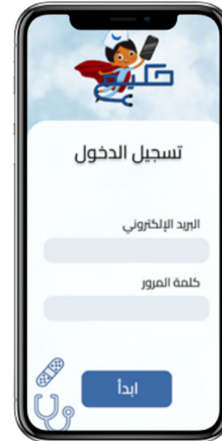


Fig.2 Hakeem Sign-in interface



Fig.3 Hakeem map interface



Fig.4 Hakeem’s educational video



Fig.5 Hakeem AR game



Fig.6 Hakeem scoreboard



Fig.7 Hakeem certificate

TABLE II. ACCEPTANCE TESTING RESULTS

Task	Number of Errors	The time needed Min:sec: msec	User Feedback	Completion status
Sign up	0	02:01:13	-	Completed
Sign in	0	01:46:01	-	Completed
Select level	0	00:06:00	Wow!	Completed
Watch educational video	0	00:54:17	New information	Completed
Ask to open the camera	0	00:03:09	-	Completed
Play game	0	00:36:10	I like it	Completed
Interact with AR technology	0	00:16:04	Wow! Great things	Completed
View hints	0	00:02:34	Oh wrong!	Completed
View feedback message	0	00:11:26	-	Completed
View scoreboard	0	00:13:42	Oh! My name	Completed
View certificate	0	00:34:19	-	Completed
Save certificate	0	00:03:08	I will send it to my friends	Completed
Sign out	0	00:02:05	-	Completed

V. LIMITATIONS AND FUTURE WORK

Hakeem has some limitations, which we hope will be worked on shortly. One of these limitations is that Hakeem only supports IOS, which can only use by iPhone users, thus we are seeking to increase our range by providing support for Android as well. Hakeem also provides the Arabic language only, and we intend to add more languages such as the English language. One of the limitations is that Hakeem specializes in teaching children only, and we hope that other age groups will also be included due to the importance of first aid for all ages. There is another limitation, which is that Hakeem covers some basic skills in first aid. Therefore, we will be keen to add more skills to teach first aid more efficiently.

VI. CONCLUSION

This paper introduced Hakeem application, an interactive mobile application that aims to teach children the basics of first aid skills in a fun and entertaining way using AR. Although children are becoming more aware and capable of handling simple first aid situations, many problems regarding safety arise when children stay alone and far from their parent's eyes, such as lack of sufficient experience in dealing with emergencies and fear of trying and learning new life skills like first aid. Hakeem's application aims to teach children first aid skills interactively and joyfully. Since Saudi Arabia gives great importance to the development of education, Hakeem seeks to teach

children the basics of first aid to respond to dangerous situations, and to enrich Arabic content in the health education field. Therefore, it plays a role in reducing the likelihood of injuries which conforms to Saudi's 2030 Vision strategic objectives for healthcare.

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