

ALQ | عَلْق

IT 497: Graduation Project Report
Product Release-2

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ALQ | علق

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Abstract (English):

ALQ is a software application developed to enhance the learning experience of young learners at the age of 10 to 15 who are interested in anatomy. The purpose of developing this app is to provide an interactive and engaging platform for students to learn about the human body. The main methodology used in the development of this app was augmented reality technology, which allows users to view 3D models of the human body and interact with them in real-time. The app also includes quizzes to test the user's knowledge and understanding of the material. The results from our evaluations showed that learners who used the AR anatomy learning app had a better understanding of human anatomy compared to those who used other supports. Additionally, learners found the apps to be engaging and enjoyable, which motivated them to learn more about the subject. In conclusion, ALQ is an effective tool for enhancing student learning and engagement in human anatomy education.

Abstract (Arabic):

"علق" هو تطبيق تم تطويره لتحسين تجربة التعلم لمن تتراوح أعمارهم بين 10 و 15 عاماً المهتمين بالتشريح ، والغرض من تطوير هذا التطبيق هو توفير منصة تفاعلية وجذابة للطلاب للتعرف على جسم الإنسان. كانت المنهجية الرئيسية المستخدمة في تطوير هذا التطبيق هي تقنية الواقع المعزز ، والتي تتيح للمستخدمين عرض نماذج ثلاثة الأبعاد لجسم الإنسان والتفاعل معها وكأنها على أرض الواقع. يتضمن التطبيق أيضاً اختبارات قصيرة لقياس معرفة المستخدم وفهمه للمحتوى، وظهور نتائج تقييمات آراء المتعلمين التي أجريناها على التطبيق أن الذين استخدموه تطبيقات تعلم التشريح باستخدام الواقع المعزز لديهم فهم أفضل للتشريح البشري مقارنة بأولئك الذين استخدموه وسائل أخرى. بالإضافة إلى ذلك وجد المتعلمون أن التطبيق جذاب وممتع مما حفظ لهم على معرفة المزيد عن التشريح. في الختام يعد علق أداة فعالة لتعزيز العملية التعليمية والمشاركة في تعليم علم التشريح البشري باستخدام التقنيات الحديثة.

Keywords: Anatomy; Augmented reality; Young learner; 3D models; text-to-speech; bookmark; achievements.



1 Introduction

Education is an important matter in an individual's life, and nations do not advance without knowledge. Methods of education differ from one place to another, and each instructor has his own way of communicating knowledge to others. When it comes to biology, young learners face difficulties understanding body parts clearly because they cannot apply anatomy to the real world due to its complexity. In this context, augmented reality anatomy seems to be the best alternative. In this project, we will provide an augmented reality mobile application ALQ that provides suitable resources to young learners between 10-15 years about human anatomy.

1.1 The Problem

In adolescence, youngsters' curiosity increases, and they try to experiment and explore everything that is new and strange. Human body and what's inside of it are the most mysterious and interesting things and discovering it is an exciting experience.

Human anatomy is one of the ways to explore the human body, but it remains a complex subject and consists of one of the most challenging topics for students to learn.

Although there are some means that facilitate the understanding of anatomy lessons using modern technology, there are no suitable means for young people to experience anatomy.

To be convenient to young users, instruments should be easy to use, easy to learn, attractive, and suitable for their age and limited knowledge. Also, practical experiences make the learning closer to reality.

So, it is always beneficial to provide ludic tools to learn while enjoying your time. ALQ doesn't follow any specific curriculum but provides basic knowledge about the human body components for young users



1.2 The Solution

We decided to create ALQ, a mobile application that targets young learners (10 to 15 years old), providing basic knowledge about human anatomy, that uses augmented reality and 3D graphics to enable young people to see the inside structure of the human body and to explore and enjoy an engaging experience.

The application is organized based on the various systems of the human body, and it provides detailed information about the organs within each system. Additionally, users can test their knowledge through quizzes that cover the content provided.

In each system the user can view the human organs in the form of augmented reality and learn more about it using 3D graphics and a quiz about what he learned.

The application comes with a smart AR technology. The user scans the area around him using the phone's camera and the AR technology illustrates the 3D component, based on the related content.

The user can rotate the 3D representation, select a specific organ, and get information about it.

Along with expanding his knowledge, learning is quick and enjoyable because there is a quiz at the end of each system to determine the extent of the learner's development and to encourage him to study more.

1.3 Objectives

Human anatomy has always been one of the most challenging topics for students either because of its complexity, or because of lack of interest. For this purpose, we want to help young learners winning the challenge by making anatomy simple and fun. Thus, we were able to deduce the objectives of ALQ and they were as follows:

- a. It combines learning and enjoyment without prejudice to the information.
- b. provides basic knowledge and does not delve into complex details.
- c. uses AR (Augmented Reality) and provides a 3D representation of organs and systems.
- d. dividing anatomy according to the human body systems makes it easy to comprehend.
- e. It evaluates information by providing quizzes.



- f. and most importantly, since it is a mobile application, this is what young people love and know these days.

1.4 Product Vision

For young learners (10 to 15 years old).

Who wishes to learn about human anatomy.

The ALQ (علق) is a mobile application.

That provides a basic knowledge about human anatomy using AR (augmented reality), and there is also a quiz at the end of each system.

Unlike Existing apps that use AR technology to visualize human anatomy (Anatomy AR application). [1]

Our product divides anatomy according to the human body systems which makes it organized and facilitates the learning process. Each system includes information about its organs presented in a special way to make learning active, and quizzes to evaluate the studied part.

1.5 Scope

The program teaches the basics of human anatomy to young learners (10 to 15 years old). There are human body systems in the application, each system focuses on one of the human organs. Each system contains: information about its organs and quizzes that measure the extent of understanding. The user doesn't have anything for the AR interaction. The 3D representation may be rotated, and the user can select a component to learn more about it. The user can take a quiz about the completed system and get the result right away. The application supports the English language and it's a multiplatform application.

1.6 Hardware/Software Tools and Cost

Hardware Tools	
None	
Software Tools	
Name and Description	Cost
Anatomy 3D models	0
Visual Studio code	0
Creately	0
Canva	0
Jira	0



miro	0
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Table 1 Hardware/Software Tools and Cost



1.7 Scrum Team

We used the agile methodology to complete this project, using Jira and confluence tools

1.7.1 Skill Set Requirements

Technical Skill Required	What is the current level of the team and the learning plan
Flutter Software	Level: beginner. Learning plan: Watching YouTube, learning from sites (there is an explanation from the flutter site), use educational platforms and engage in training courses, such as (SATR). [2][3]
AR Core	Level: beginner. Learning plan: Watching YouTube, learning from sites (ex: developers Google site). [4]
Android Studio	Level: intermediate. Learning plan: Learn from the team experiences, watching YouTube, learning from sites.
Dart language	Level: beginner. Learning plan: Watching YouTube, learn from websites
Firebase Software	Level: beginner. Learning plan: Watching YouTube, learning from sites.
Visual Studio Code	Level: intermediate. Learning plan: Learn from the team experiences, watching YouTube, learning from sites.

Table 2 Skill Set Requirements

1.7.2 Roles and Responsibilities

Scrum Team	
Product Owner:	Dr. Khaoula Hamdi
Developers:	Gehad Eid Hajar Alomar Jawaher Alotaibi Amirah Hadi Haifa Alzaid
Scrum Master (SM):	Dr. Hend Alrasheed

Table 3 Roles and Responsibilities



2 Background

This chapter provides a brief knowledge and concepts of anatomy and AR. This knowledge helps to understand the project's domain.

2.1 Anatomy

"Anatomy is a field in the biological sciences concerned with the identification and description of the body structures of living things" [5].

Anatomy is then a description of the body systems and organs. Classically we can study body structure by two methods: dissection and observation.

If we want to narrow the scope of anatomy, we are talking here about the human body only

There are two types of anatomy: Gross Anatomy and Microscopic anatomy. In this project, we mean to study the large structures of the body that we can examine without using specialized machines or technologies, while microscopic is the exact opposite, which is the study of small structures in the body so that we use tools or methods in order to observe them.

Anatomy is fundamental to anatomical research and the oldest record was with the Greeks.

The human body consists of systems and organs. Systems contain organs that work together in cooperation to perform a specific task, for example: the respiratory system, the nervous system, the digestive system, the urinary system, etc.

As for the organs, each of them performs a specific function or several functions, for example: the eye, the ear, the heart, the stomach, etc.

In conclusion, anatomy is a basic medical science, and it is one of the branches of biology, and it is a science that has many benefits. There are countless examples such as: it is used in forensic investigations and helps experts to know the causes of death, and also doctors may use it in diagnosis, understanding the effect of drugs on the body, etc.



Figure 1 and 2 show that the human body contains a lot of complex organs that anatomy simplifies.

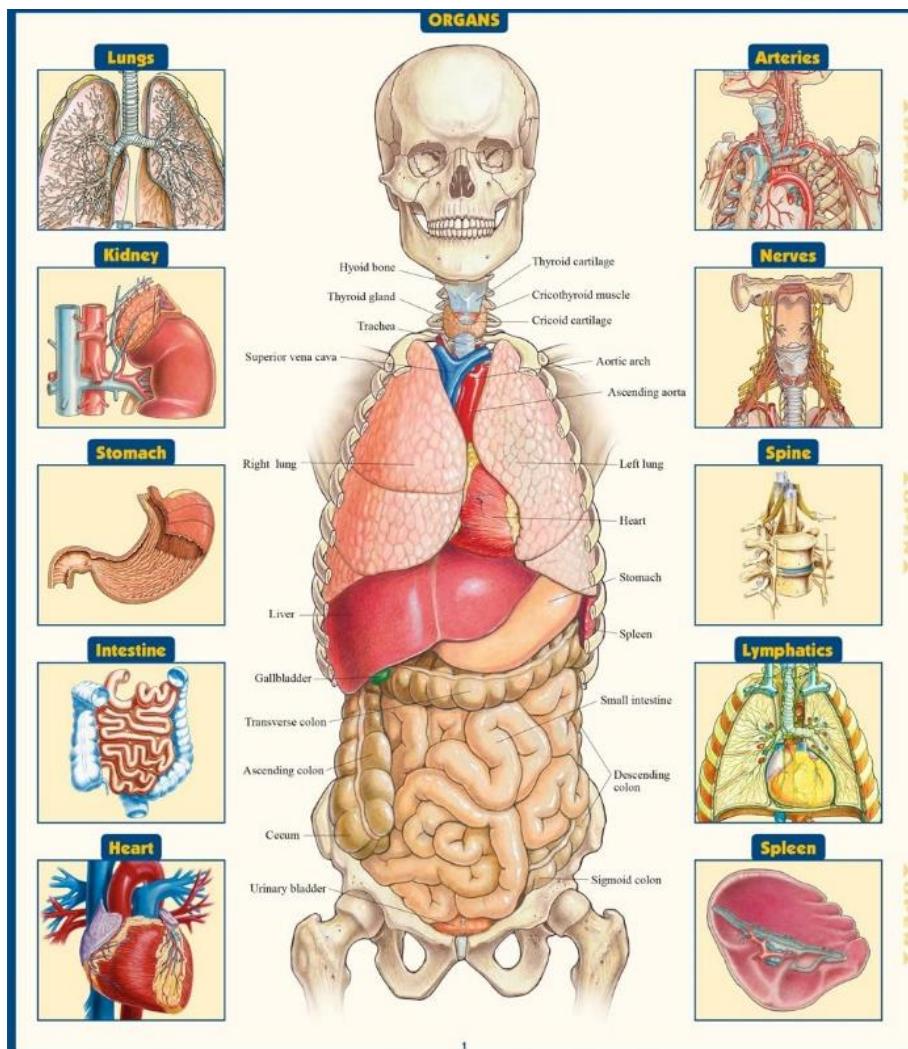


Figure 1 Important organs in the human body [19]

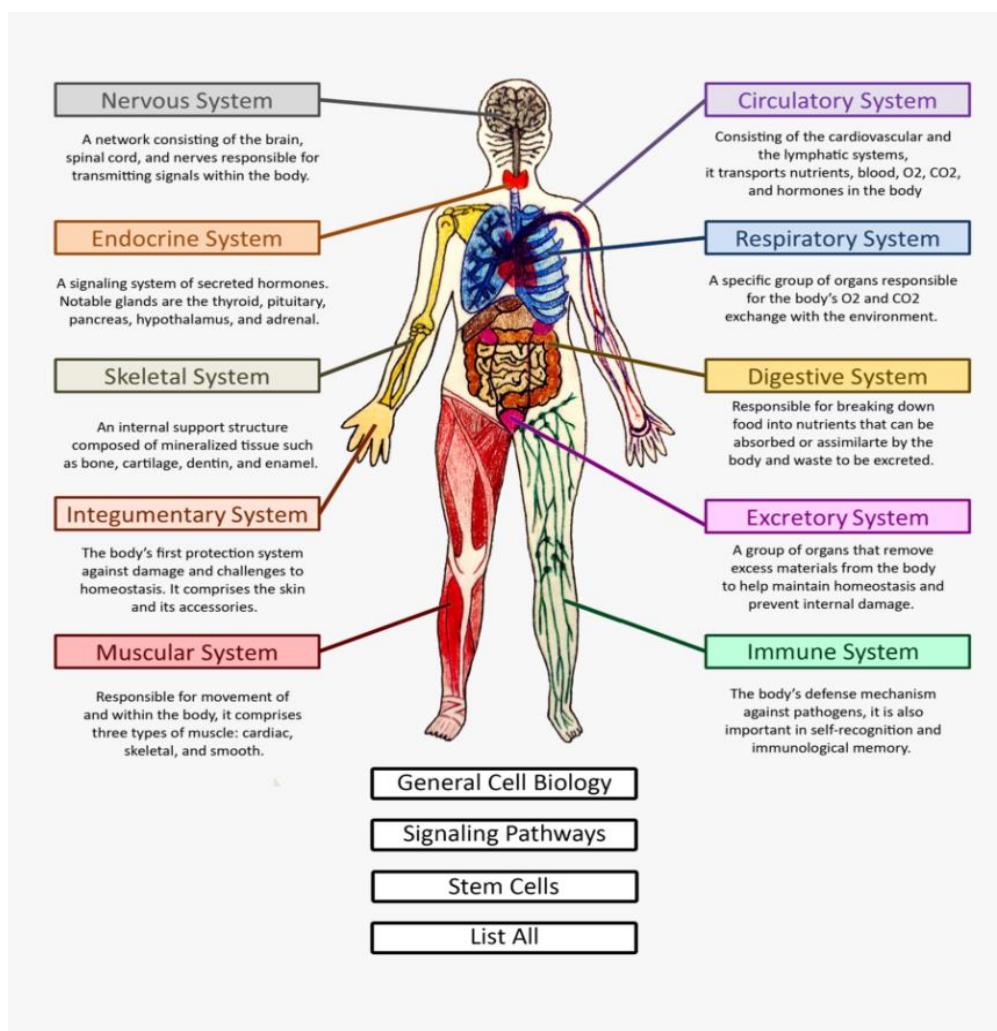


Figure 2 Human body systems [21]

2.2 Augmented reality

Augmented reality (AR) defined as: "is an enhanced version of the real physical world that is achieved through the use of digital visual elements, sound, or other sensory stimuli and delivered via technology" [6].

Fifty years ago, augmented reality technology helped us shape content in the real world, as you know, the technology is constantly increasing and evolving. Technology has come a long way from augmented reality use cases from NASA simulation to immersive marketing experiences [7].



AR began to flourish in 1992 and develops with the progress of time to our present era. Figure 3 tells the history of AR from 1969. Until today, the field is still witnessing remarkable and continuous changes.

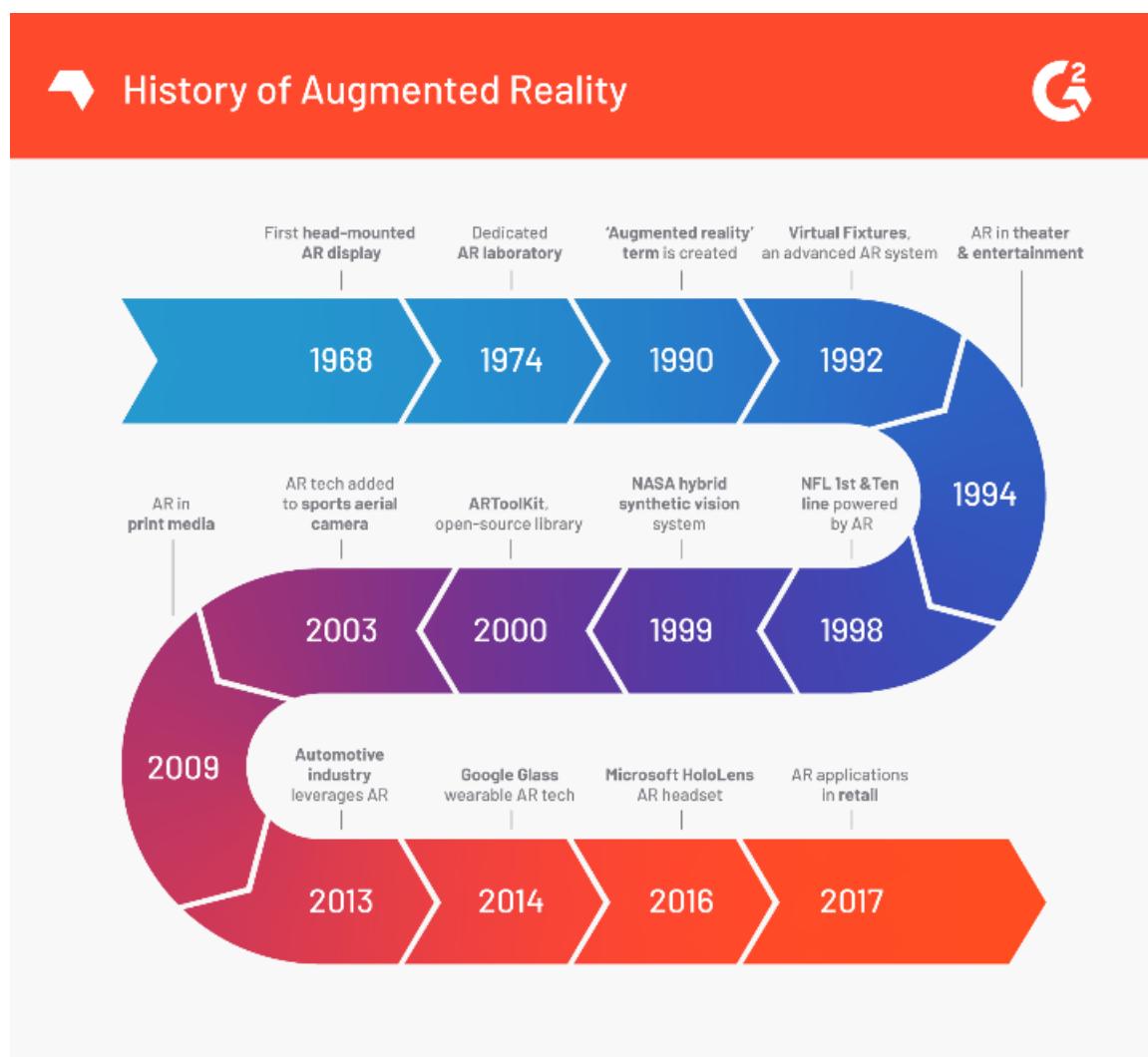


Figure 3 History of AR [20]

The implementation of augmented reality technology begins by using a smart device that is equipped with a camera such as: smartphone, tablet or smart glasses loaded with AR software. When the user points the device and looks at something that the program recognizes through computer vision technology, it analyzes the video stream [8].

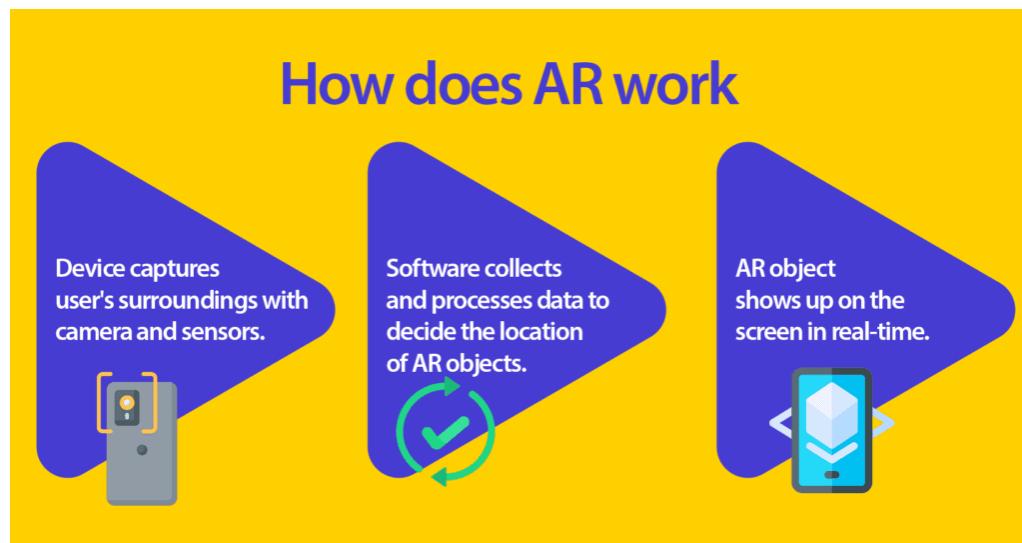


Figure 4 How dose AR work [9]

In the field of education in particular, technology has played a major role in helping to learn quickly, easily, and effectively, in particular using AR technology. One of its main goals is to shed light on the physical world and discover certain features or the ability to feel or notice things that are difficult for us to explore in nature, such as Anatomy. In fact, anatomy is a sensitive field and is not perceptible in the natural situation. The AR technology serves us a lot to create an environment similar to the physical world, so that learners can understand the subject by using AR technology in a perfect and enjoyable way.

In figure 5 below, using AR technology we can discover the unseen, and that will improve the learners' ability to understand, and will give them a clear vision of what they learn.

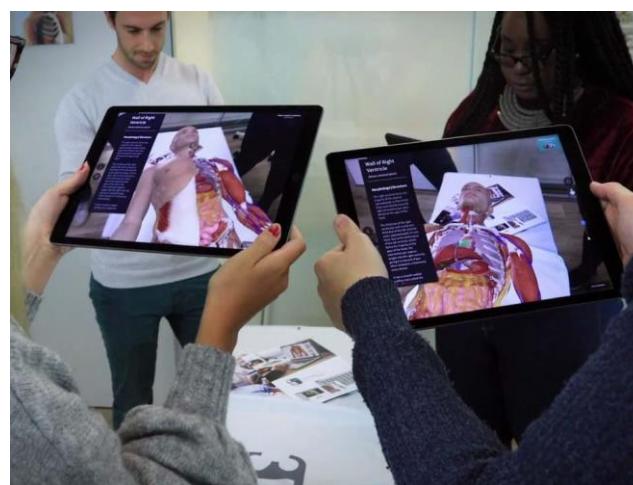


Figure 5 Students using AR in anatomy lecture [14]



2.3 The difference between augmented reality and virtual reality

AR is the consequence of using software to superimpose data on the world we see, like: noise, pictures, and writing [16]. AR let us see the real-life world right in front of us, for example trees swinging in the mall, cats hunting clubs, children playing soccer with a digital augmentation overlaid on it.

This is quite distinct from virtual reality. Virtual reality (VR) is the development of a virtual environment that is given to our eyes in such a manner that we experience it as if we were actually there. It utilizes a multitude of techniques to accomplish this objective and is a technically complicated process that must account for our perception and cognition. It has both entertainment and serious uses [17].

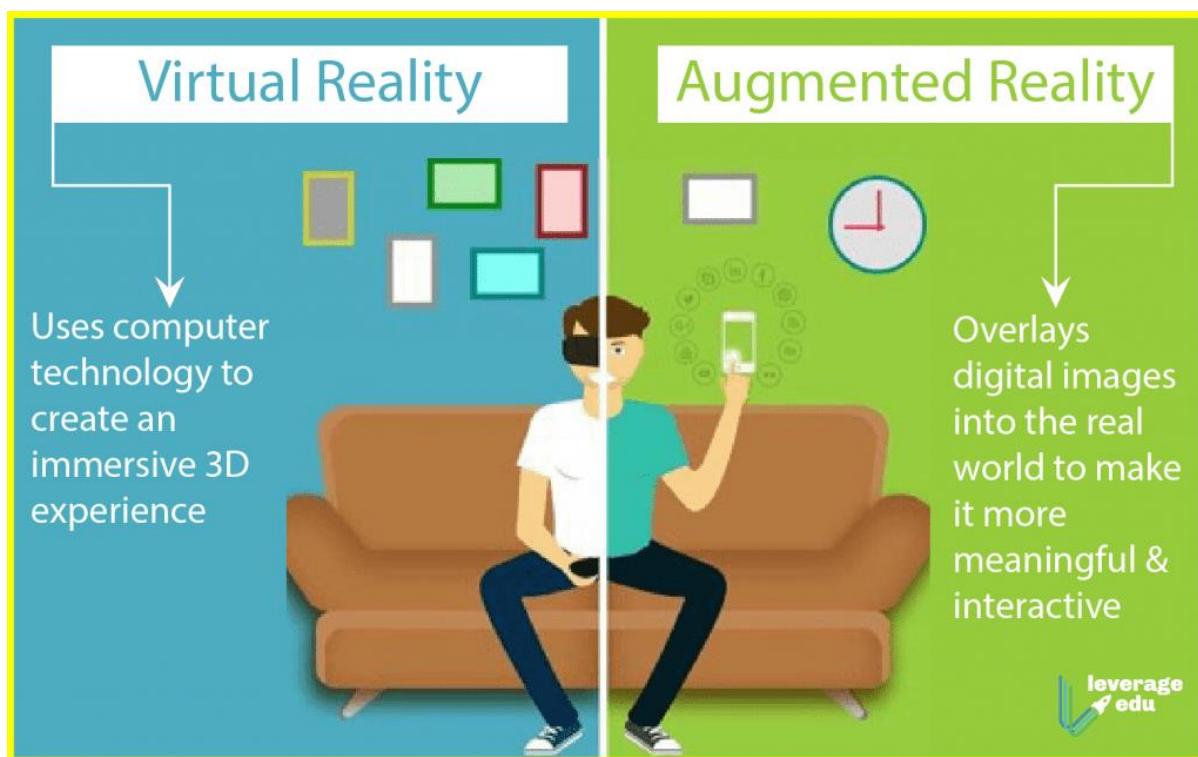


Figure 6 The difference between augmented reality and virtual reality [18]



2.4 Text-to-speech

Text to speech (TTS) is a technology that converts written text into spoken words. It is a useful tool for people who have difficulty reading or for those who prefer to listen rather than read. Text to speech software can be found in various devices such as smartphones, computers, and tablets. The software uses artificial intelligence and natural language processing. It can also adjust the speed, pitch, and volume of the voice to suit the user's preferences. Text to speech has many applications, including assisting people with visual impairments, providing audio feedback in educational settings, and improving accessibility in public spaces.

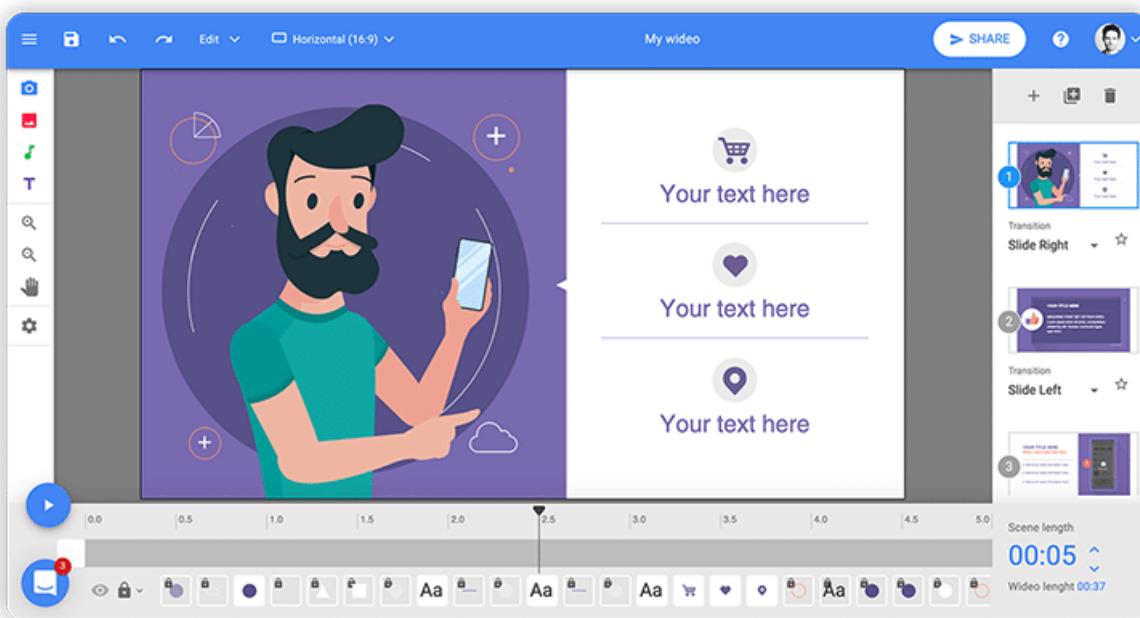


Figure 7 Text-to-speech used in creating animation videos [29]

The process involves several steps:

1. Text input: The first step is to input the text that needs to be converted into speech. This can be done through various means such as typing, copying and pasting, or importing a document
2. Text analysis: Once the text is inputted, it is analyzed by the TTS software to determine the appropriate pronunciation of each word and sentence structure.



3. Phoneme generation: The software then breaks down each word into its individual phonemes (the smallest unit of sound in a language) and generates an audio waveform for each phoneme.
4. Speech synthesis: The audio waveforms are then combined to create a natural-sounding speech output. This can be done using different techniques such as concatenative synthesis (where pre-recorded speech segments are combined) or formant synthesis (where artificial sounds are generated).
5. Output: Finally, the synthesized speech is outputted through speakers or headphones for the user to hear.

Overall, TTS technology relies on complex algorithms and linguistic rules to accurately convert written text into spoken words. Advances in machine learning and artificial intelligence have led to significant improvements in TTS quality and accuracy over the years.

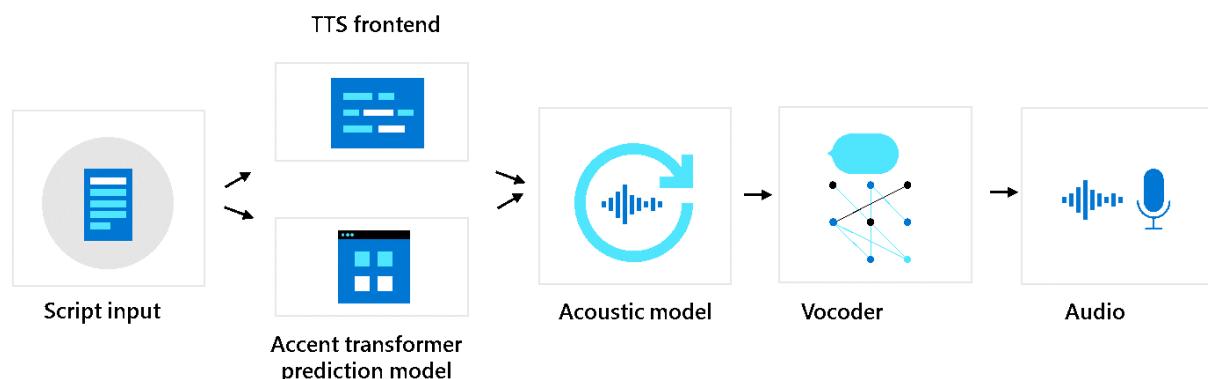


Figure 8 How dose Text to speech work [28]



3 Literature Review

3.1 AR Anatomy 4D+

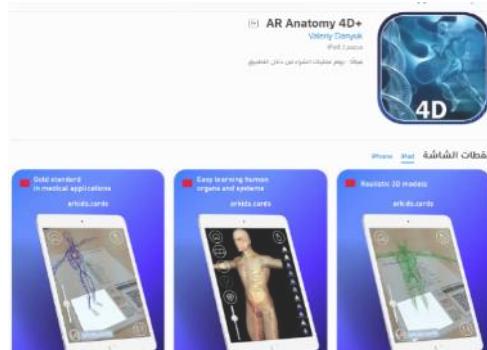


Figure 9 AR Anatomy 4D+

This app for learning anatomy has been specifically designed for children (6-8) to use without assistance. It can be extended for distance learning and be easily adapted for individual learning. [10]

Features:

- High-quality anatomy images, 3D-models.
- Augmented reality (body parts appearing in a tablet or a smartphone after pointing the camera at the marker).
- The app comprises the following parts: brain, heart, respiratory system, internal organs system, hand and wrist, dental system, hip, knee, ankle and foot, elbow, spine, pharynx, duodenum and ducts, kidneys, urinary system, venous system, arterial system, nervous system, digestive system, lymphatic system, skeleton.

Drawbacks:

One of the drawbacks of the application is that when performing any operation, it requires solving a mathematical problem.



3.2 Anatomy AR (by mouhsine hajji)

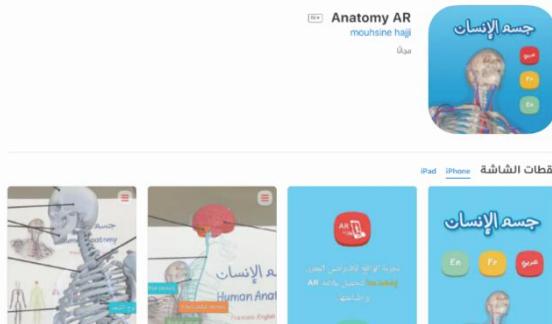


Figure 10 Anatomy AR

This application allows to learn about the different human body systems using augmented reality and is easy to use and provides short tests for all parts of the body

Features:

- Available in 3 languages: Arabic, English, French.
- Consists of Muscular system, skeletal system, circulatory system, nervous system, respiratory system, digestive system. [1]

Drawbacks:

The link that provides the AR printed QR is not working.



3.3 AR Anatomy (by Virtual Medicine)

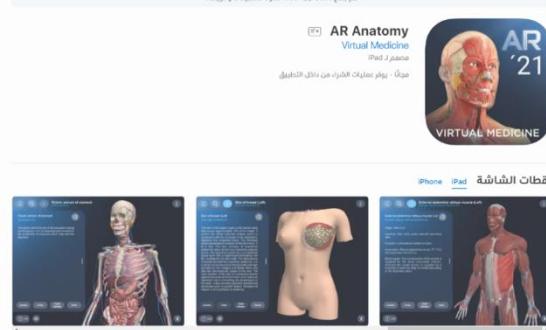


Figure 11 AR Anatomy

This immersive educational application let you view the human body to the slightest details [11].

Features:

It contains all the human body systems (skeletal, muscular, nervous, cardiovascular, respiratory, digestive, reproductive, lymphatic, c. tissues) with multiple functions to interact with (combine, layer, highlight, etc.).

Drawbacks:

To see all organs, a paid subscription is required for a specific period, which must be renewed.



3.4 AR Human Anatomy



Figure 12 AR Human Anatomy

It is a 3D anatomy reference app for healthcare professionals, students, and professors. Which allows you to rotate 360°, Zoom and move the camera around a highly realistic 3D model. The app includes comprehensive male and female 3D anatomy models [12].

Features:

- a. User friendly interface.
- b. Have a combination of modes (Selection Mode, X-ray mode, Hide and show mode, Animation Mode).
- c. Search options.
- d. Audio pronunciation for all anatomy terms.
- e. Info panel.
- f. Draw or write on screen and share screenshots.

Drawbacks:

It takes time to learn how to use it.



3.5 Anatomy AR 4D

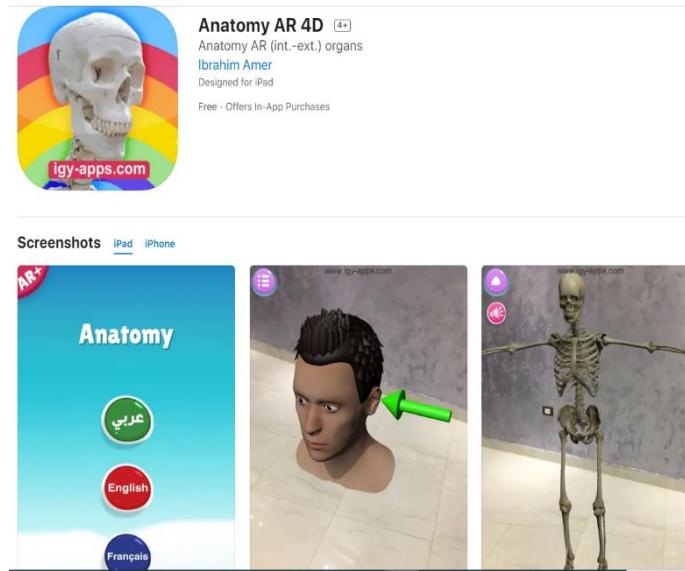


Figure 13 Anatomy AR 4D

This application allows to learn about internal and external organs anatomy and no cards required [13].

Features:

- a. 3D models appear when the user points with the camera to any surface.
- b. Uses AR to reflect human organ in the real world.
- c. Supports three languages: Arabic, English and French.
- d. Information about the parts of the human organs.
- e. The user can also control the size of the 3D object using two fingers on the phone screen.
- f. Anatomy cards are divided into two parts: external and internal organs of the human body.

Drawbacks:

The application takes some time to load things and some icons are overlapping each other.



Feature	Application	ALQ	AR Anatomy 4D+	Anatomy AR	AR Anatomy	AR Human Anatomy	Anatomy AR 4D
Uses Augmented Reality and provides a 3D representation		✓	✓	✓	✓	✓	✓
Provides basic knowledge about body organs		✓	-	✓	-	-	✓
Does not need an object/QR code to activate AR		✓	-	-	✓	✓	✓
Easy to use and clear interface		✓	✓	✓	-	-	✓
Audible content		✓	-	-	✓	✓	✓
dividing anatomy according to the human body systems		✓	-	✓	✓	✓	✓
Bookmarks easy to return to		✓	-	-	-	-	-
Evaluate with quizzes		✓	-	✓	-	-	-
Enable user to create a profile		✓	-	-	✓	-	-
Track of progress		✓	-	-	-	-	-
Supports multiple languages		-	-	✓	-	-	✓
Provides male and female anatomy		-	-	-	✓	✓	-
Suitable for young learners		✓	✓	✓	-	-	✓

Table 4 Competitive Product Analysis

ALQ stands out because it combines the most important features found in other applications that users desire. Due to its simple characteristics, ALQ will be most suitable for the age group between 10-15.



4 System Design and Development

4.1 Methodology

Agile is a software development methodology that has been selected as the optimal approach for our project due to its ability to provide a clear and comprehensive vision of the project, enabling us to address any potential obstacles or decisions that may arise during the development process. This methodology also offers flexibility, allowing us to make changes as needed, and promotes effective communication among team members to ensure successful progress. The Scrum Framework has been employed, leveraging the expertise, skills, and knowledge of the team to complete the project.

The Scrum team consists of a Scrum Master who facilitates problem-solving and obstacle removal, encourages skill development, and guides the team; a Product Owner who possesses complete knowledge of market and business needs, has a vision for success, and helps guide the work team towards achieving it; and developers responsible for developing sprint backlogs and determining outputs for each sprint.

The five events in this framework include Sprint Planning, Daily Scrum meetings between developers, Sprint Review with committee evaluation of output results, Sprint Retrospective for examining previous sprints and improving effectiveness/quality of team performance. Tools such as Jira and GitHub have facilitated project building/development by enabling easy sharing of implementation progress updates among team members.

4.2 System Requirements

4.2.1 System Users

The target audience for the "ALQ" application consists of young learners between the ages of 10 and 15 who possess a natural curiosity for learning and exploring new subjects. These individuals have completed at least the fourth grade in Primary School, where they were introduced to basic human anatomy. While a background in anthropology or anatomy is not required, a basic understanding is sufficient. Additionally, they possess moderate technical skills and general knowledge of mobile applications. It is anticipated that parents may also utilize the app to gain insight into their child's interests, while teachers may use it as a tool to assist in explaining complex concepts to their learners.



4.2.2 Requirements Elicitation and Analysis

In order to gather the necessary requirements for our application, we conducted extensive research on similar systems and sought the opinions of our primary stakeholders, the learners themselves. To achieve this, we conducted three interviews (see Appendix A) with 10-15-year-old student interviewees and distributed a questionnaire (see Appendix B) to gather additional data on the importance of active learning. We received responses from 30 individuals and were able to draw conclusions from that data.

Our interview findings indicated that the students showed a strong desire to learn and found anatomy to be an engaging subject. While some had prior knowledge of the topic, others were new to it, and one individual had experience with augmented reality. All of the interviewees endorsed active learning and expressed enthusiasm for our application. Regarding our questionnaire, we discovered that a mix of students and parents, mostly around the age of 15, responded to our survey. The majority of respondents (63.3%) reported a liking for science, with anatomy being a particularly popular subject. This information is advantageous for our application, as it suggests that there is public interest in the subject matter. While most survey participants (80%) enjoyed learning anatomy, they also described it as challenging or intermediate in difficulty. Our application serves as a useful tool for facilitating the learning process. Although the majority of respondents (76.7%) had never used an application to learn anatomy before, they agreed that using an educational game would make learning more enjoyable. When asked about the effectiveness of learning anatomy through 3D models and augmented reality, the majority of respondents stated that the technology was effective (63.3%), wonderful (43.3%), interesting (36.7%), and safe (20%). Interestingly, some (13.3%) found utilizing this technology challenging.



4.2.3 User Interactions

Based on the Figure below, there is only one actor "The user" who interacts with our system.

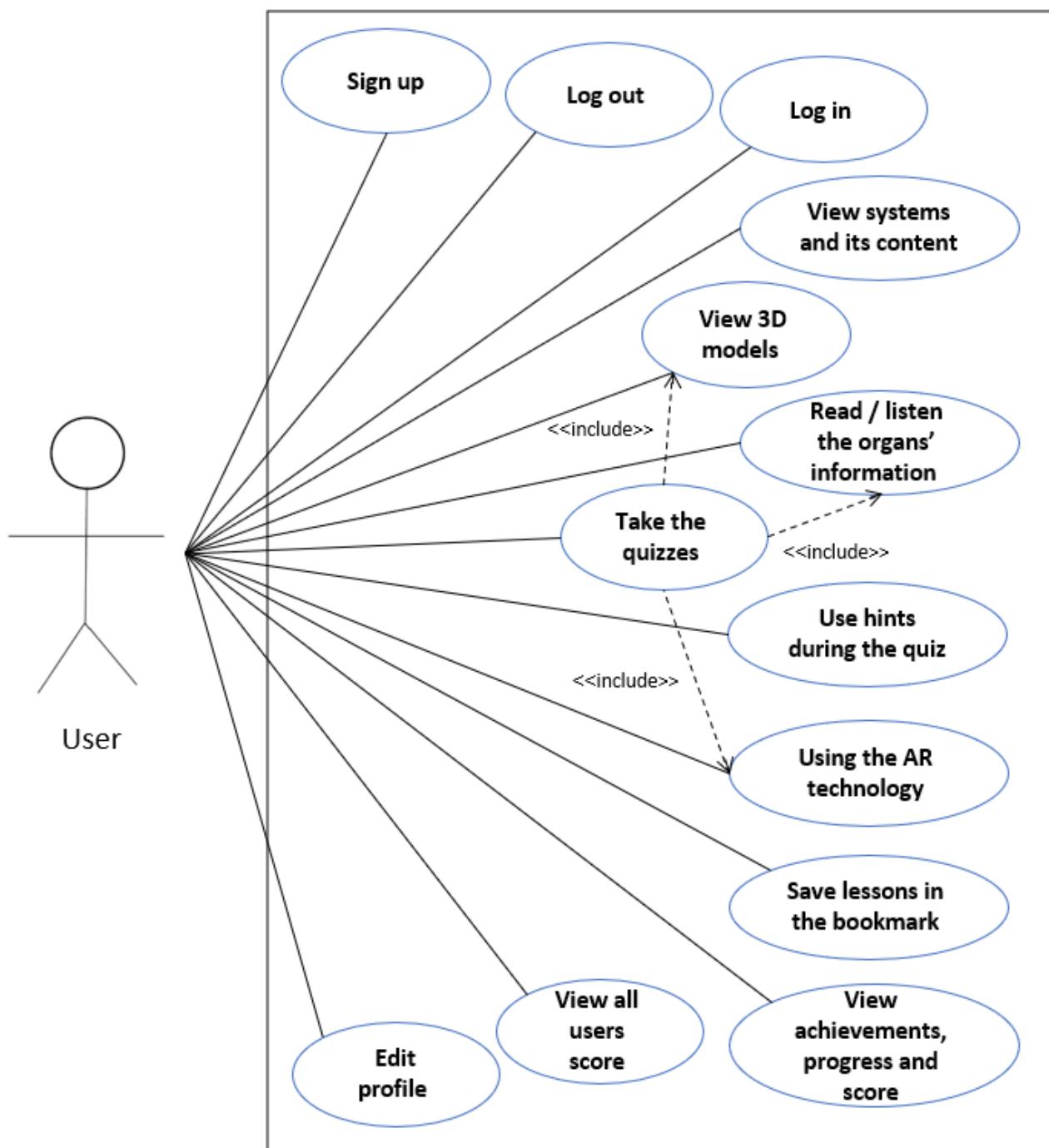


Figure 14 User Interactions



4.2.4 Roadmap and Product Backlog

- Roadmap

The project commenced with Sprint 0 on September 29th, 2022 and concluded on April 30th of the present year, resulting in a total duration of 7 months and 2 days. The release date is scheduled for May 15th of the current year, making the overall project timeline 7 months and 16 days. The project encompasses a total of 22 features and 5 non-functional features, as illustrated in the figure below.

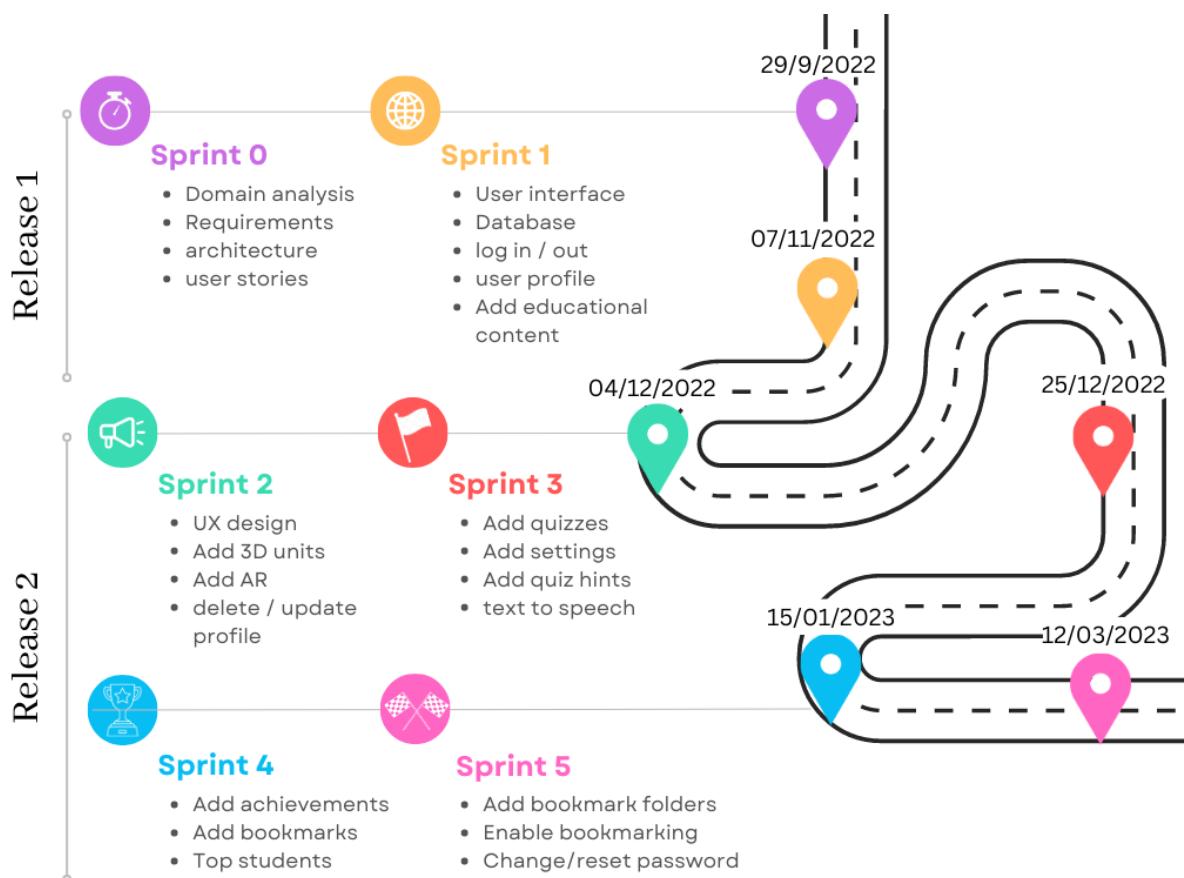


Figure 15 Roadmap



- product backlog

ID	PBIs (User Stories)	Size	Type	Status	Acceptance Criteria
1	As a learner, I want to be able to sign up so that I can have an account with a profile to get the ability to use the application and learn anatomy.	2	Feature	Done	<ul style="list-style-type: none">• As a learner, if I enter my name, email, Phone number, and password, and click on sign-up, then the system will create an account for me, so that I get the access to learn anatomy.
2	As a learner, I want to be able to log in so that I can have the authority to use the app's functions to learn anatomy.	2	Feature	Done	<ul style="list-style-type: none">• As a learner, if I sign up then I can log in.• As a learner, if I pressed on log in and entered my credentials then I'll be redirected to the home page and get the authority to use the app.
3	As a learner, I want to be able to log out so that I can end my session and protect my data from being accessed by unauthorized people.	2	Feature	Done	<ul style="list-style-type: none">• As a learner, if I log in then I can log out.• As a learner, if I click on the logout button, then I'll be disconnected of app.
4	As a learner, I want the educational content to be categorized according to their respective systems to ensure optimal comprehension and avoid confusion.	4	Feature	Done	<ul style="list-style-type: none">• As a learner, if I go to learning page then I'll see the content categorized into systems.• As a learner, if the content is categorized according to their systems, then I'll have the optimal understanding and avoid the confusion.
5	As a learner, I want to be able to have a clear vision of the system's content which are the organs, the AR and the quiz, so that I can start learning this system.	2	Feature	Done	<ul style="list-style-type: none">• As a learner, if I clicked on a system then I should be able to view the organs in this system, the AR and the Quiz.
6	As a learner, I want to be able to view a list of the system's organs, so that I can have a clear idea of what organs does that system have.	2	Feature	Done	<ul style="list-style-type: none">• As a learner, if I click on the system then I should be able to see a list of organs of that system to have a clear and organized idea of what I'll learn.



7	As a learner, I want to be able to read what the organs are and how they work, so that I can increase my knowledge.	1	Feature	Done	<ul style="list-style-type: none">As a learner, if I choose an organ from the organs list in a particular system, then I should be able to read the what it is.As a learner if I read the information provided on a particular organ, then it'll increase my knowledge about it.
8	As a learner, I want to be able to view the 3D model of the organ, so that I can visualize the actual shape of the system's organs and explore them.	2	Feature	Done	<ul style="list-style-type: none">As a learner if I choose an organ, then I should be able to see the 3D model of that organ clearlyAs a learner, if I can view the 3D model, I can understand and comprehend the organs clearly.
9	As a learner, I want to be able to update my profile, so that I can keep my information up to date.	1	Feature	Done	<ul style="list-style-type: none">As a learner, if I want to update my information then I should go to my profile and click on the edit button.As a learner, I should edit what I want then click on the edit profile button and my information will be updated.
10	As a learner, I want to be able to delete my account, so that I can act freely with my data and get the control.	1	Feature	Done	<ul style="list-style-type: none">As a learner, if I want to delete my account then I should go to my profile and press on the delete button, then my account will be deleted.
11	As a learner, I want to be able to use the settings, so that I can personalize my experience with the app.	1	Feature	Done	<ul style="list-style-type: none">As a learner, if I want to use the settings' features in the settings page.As a learner, if I want to switch to dark mode then I should be able to toggle between the moods in the app.
12	As a learner, I want to be able to view the AR model for a particular system, so that I can see the human systems' organs using the augmented reality technology.	6	Feature	Done	<ul style="list-style-type: none">As a learner, if I pressed on the AR icon then I can scan the area around me then I can see the organs and the human system using AR technology.



13	As a learner, the information regarding the organs to be presented audibly, in order to facilitate multiple means of comprehension and guaranteeing a thorough grasp of the information presented.	2	Feature	Done	<ul style="list-style-type: none">As a learner, if I press on the speaker icon then I'd be able to hear the presented information and have a grasp of it.
14	As a learner, I want to be able to take a quiz when I finish all the listed organs and view the AR, so that I can test my acquired knowledge.	4	Feature	Done	<ul style="list-style-type: none">As a learner, if I am ready to take the quiz and I finished all the organs and viewed the AR then I should click the “take the quiz” button in a particular system to test my knowledge.As a learner, I should be able to take the quiz several times.
15	As a learner, I want the quiz to have more than one hint, so that I can have many chances to get help when I face a difficult question.	4	Feature	Done	<ul style="list-style-type: none">As a learner, if I need a hint while taking the quiz then I should be able to click on the hint to use it.As a learner, if I choose a hint and click on it, then I can get help by increasing the time or deleting two answers.
16	As a learner, I want to be able to see the results of the quiz when I finish, so that I can improve myself and know how much I comprehend.	1	Feature	Done	<ul style="list-style-type: none">As a learner, if I finished the quiz, then I should be able to see the results afterward.As a learner if I see the results of the quiz, then I can know how much knowledge I understood.
17	As a learner, I want to be able to bookmark the organs that I am interested in so that I can easily return to them when I want to.	3	Feature	Done	<ul style="list-style-type: none">As a learner, if I read the organs information, I can put a bookmark to refer back to it whenever I want.
18	As a learner, I want to be able to see my overall score, so that I can be motivated to learn more.	2	Feature	Done	<ul style="list-style-type: none">As a learner, if I take the quizzes, then I can see my overall score.As a learner if I can see my overall score, then I can be motivated to learn more.



19	As a learner, I want to be able to change my password so that I can maintain the security of my account	1	Feature	Done	<ul style="list-style-type: none">As a learner, if I create my account, then I should be able to change my password.As a learner, if I got the ability to change my password then I'd be able to maintain the security of my account.
20	As a learner, I want to be able to reset my password in case I forgot it so that I can regain the access to my account	2	Feature	Done	<ul style="list-style-type: none">As a learner, if I create my account, then I should be able to reset my password whenever I forget it.As a learner, if I asked for my password to be reset then an email should be sent to me with my new password.
21	As a learner, I want all my achievements to be listed so that I can get a clear vision of my progress and to be encouraged to keep learning.	1	Feature	Done	<ul style="list-style-type: none">As a learner, if I did not take any quiz, then I would not have any achievements.As a learner, if I made an achievement, then I should be able to see my achievements listed on the achievements list.
22	As a learner, I want the application to have settings sections so that I can know about the application or communicate with the developers.	1	Feature	Done	<ul style="list-style-type: none">As a learner, if I want to report a bug in or send a feedback then I should go to settings to do so.As a learner, if I want to know about ALQ or see the frequently asked questions then I should go to information section to do so.
23	As a learner, I want to be able to make bookmark folders so that I can organize my bookmarks into folders.	1	Feature	Done	<ul style="list-style-type: none">As a learner, if I want to add a bookmark, then I should be able to add it to an existing folder.
24	As a learner, I want to know the top 5 learners and the other learners with their scores so that I can compete with them.	2	Feature	Done	<ul style="list-style-type: none">As a learner, if I want to know who are the top 5 learners and the scores of the other learners then I should be able to through the all users section.



- Justification for deleted user stories:

- 1 We have deleted the user story with ID 12 to provide learners with the freedom to navigate through the app, especially if they are already familiar with the organ.
- 2 The user story identified by ID 24 has been removed because there is now an achievements list which accomplishes the same objective.
- 3 The user story identified by ID 26 has been removed as there is an alternative feature available that serves the same purpose, namely the achievements list.



5.3 System Design

5.3.1 Architectural Diagram

We used a Client-server architecture. As its name suggests, client-server architecture consists of a client and a server. The server is where all the work processes are, while the client is where the user interacts with the service and other resources (remote server). The client can then request from the server, and the server will respond accordingly. This is the most fit architecture for our application because all the interaction will be on the client side while the process will be on the server.

We have one type of user which is the learner.

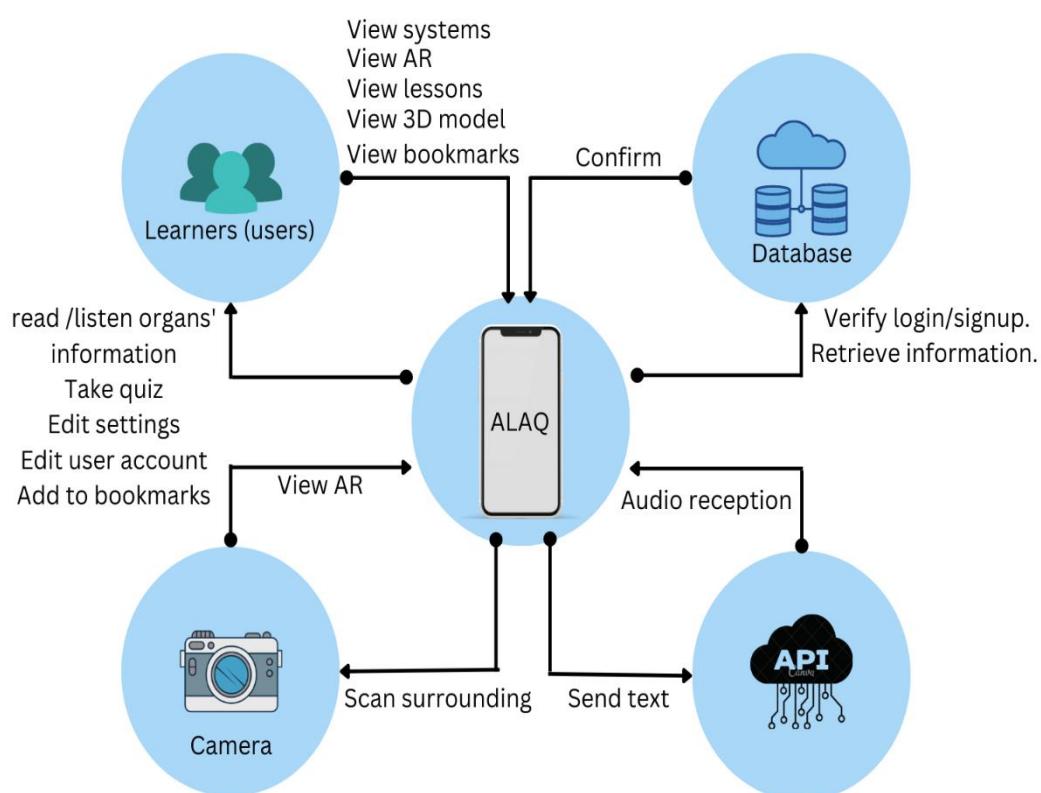


Figure 16 Architectural Diagram



5.3.2 Class Diagram /DFD

ALQ system is decomposed into Learner, Systems, Organs, AR Lab, Quiz, Question, and bookmark classes as shown in Figure below. To design the class diagram, we used the Miro Web site [15].

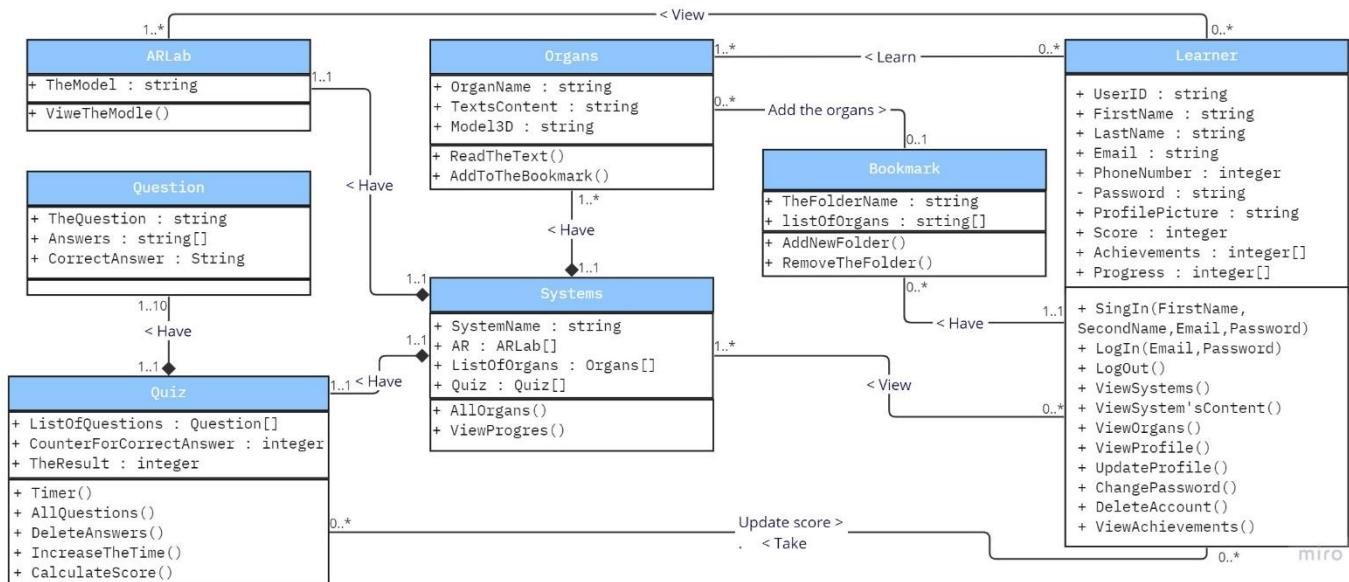


Figure 17 Class Diagram

5.3.3 Component Level Design

This section includes details of major system features: read organs' information, add a bookmark, use the AR scanner, take a quiz, and see a list of achievements. To design the flowcharts for those components, we used the Miro Web site [15].

Feature	Read organs' information	Classification	function
Definition	user will be able to view a list of organs in each system and begin her/his educational journey by reading the organs' information in that system.	Constraints	<ul style="list-style-type: none"> Input value: no input required. Pre-condition: user must have an account and log in using email and password. Post-condition: user will be able to read organs' information and increase her/his knowledge.
Flow chart			

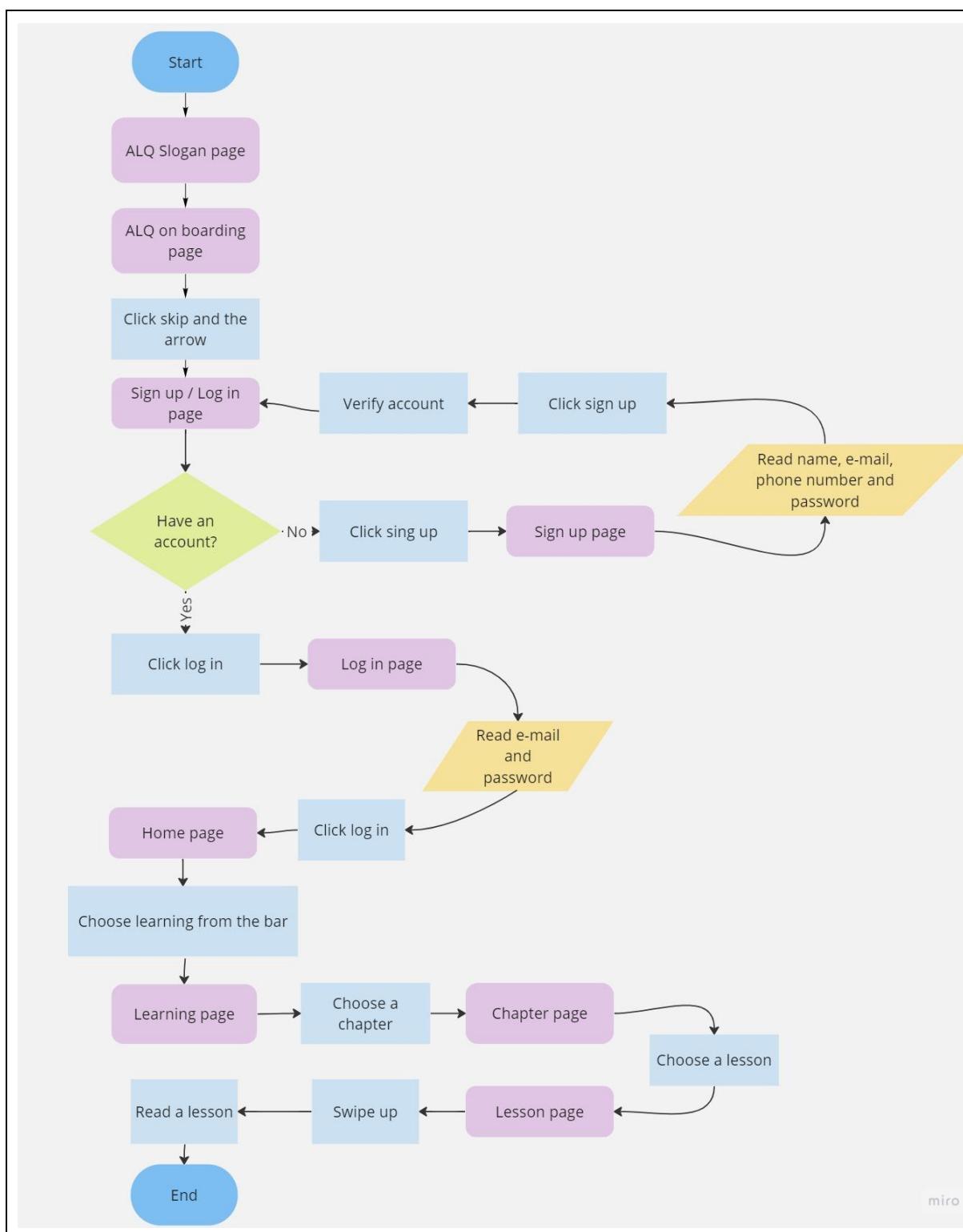


Table 5 Read organs' information component level design



Feature	Add a bookmark	Classification	function
Definition	user will be able to bookmark an organ when s/he is interested in it and that will allow her/him to easily return to the it.	Constraints	<ul style="list-style-type: none"> Input value: enter a bookmark folder name and choose a color for it. Pre-condition: user must log in and create at least one bookmark folder. Post-condition: the bookmark icon will turn into yellow instead of blue and the bookmarked organ will be found in the bookmark section under the chosen folder.
Flow chart			
<pre> graph TD Start([Start]) --> LoggedIn[Logged in user] LoggedIn --> ChooseBar[Choose bookmarks from the bar] ChooseBar --> BookmarksPage[Bookmarks page] BookmarksPage --> ChooseAdd[Choose add] ChooseAdd --> ReadName{Read folder name and color} ReadName --> ClickAdd[Click add button] ClickAdd --> ReadLesson[Read a lesson] ReadLesson --> ClickIcon[Click bookmark icon] ClickIcon --> BookmarkFolders[Bookmark folders] BookmarkFolders --> ChooseFolder[Choose a folder] ChooseFolder --> BookmarkResult[Lesson is bookmarked] BookmarkResult --> End([End]) </pre>			

Table 6 Add a bookmark component level design



Feature	View the AR model	Classification	function
Definition	user will be able to see human organs and body systems using the most important feature in the application, which is the AR technology by scanning the area around her/him until the appearance of three-dimensional coordinates.	Constraints	<ul style="list-style-type: none">• Input value: no input required.• Pre-condition: user must log in and grant permission to access the camera.• Post-condition: a body system with organs will appear on the phone through augmented reality technology.

Flow chart

```
graph TD; Start([Start]) --> LoggedIn[Logged in user]; LoggedIn --> Chapter[Chapter page]; Chapter --> ClickAR[Click AR scanner button]; ClickAR --> Permission[Permission page]; Permission --> Grant[Grant permission for camera]; Grant --> ARScanner[AR scanner]; ARScanner --> Scan[Scan the surrounding area]; Scan --> Organs[Human organs and body system in three-dimensional coordinates appears]; Organs --> End([End]);
```

Table 7 View the AR model component level design



Feature	Take a quiz	Classification	function
Definition	user will be able to take a quiz at the end of each system to test her/his gained knowledge.	Constraints	<ul style="list-style-type: none">• Input value: no input required.• Pre-condition: user must log in, finish the system's organs information and use the AR scanner.• Post-condition: user will see her/his quiz results and each attempt will be added to the achievements list.

Flow chart

```
graph TD
    Start([Start]) --> LoggedIn[Logged in user]
    LoggedIn --> ChapterPage[Chapter page]
    ChapterPage --> Decision1{Finish the chapter's lessons and use the AR scanner?}
    Decision1 -- No --> DisableButton[Disable the take the quiz button]
    Decision1 -- Yes --> EnableButton[Enable the take the quiz button]
    EnableButton --> ClickButton[Click take the quiz button]
    ClickButton --> QuizPage[Quiz page]
    QuizPage --> Decision2{Last question?}
    Decision2 -- No --> AnswerNext[Answer the question then click next]
    AnswerNext --> QuizPage
    QuizPage --> Complete[Answer the question then click complete]
    Complete --> End([End])
```

Table 8 Take a quiz component level design



Feature	View the achievement list	Classification	function
Definition	user will be able to see her/his quiz result for each system and each attempt s/he made for taking the same quiz as a list of achievements.	Constraints	<ul style="list-style-type: none">• Input value: no input required.• Pre-condition: user must log in and take at least one quiz.• Post-condition: a list of every attempt for taking a quiz that shows how the user performed, the result and the system's name.

Flow chart

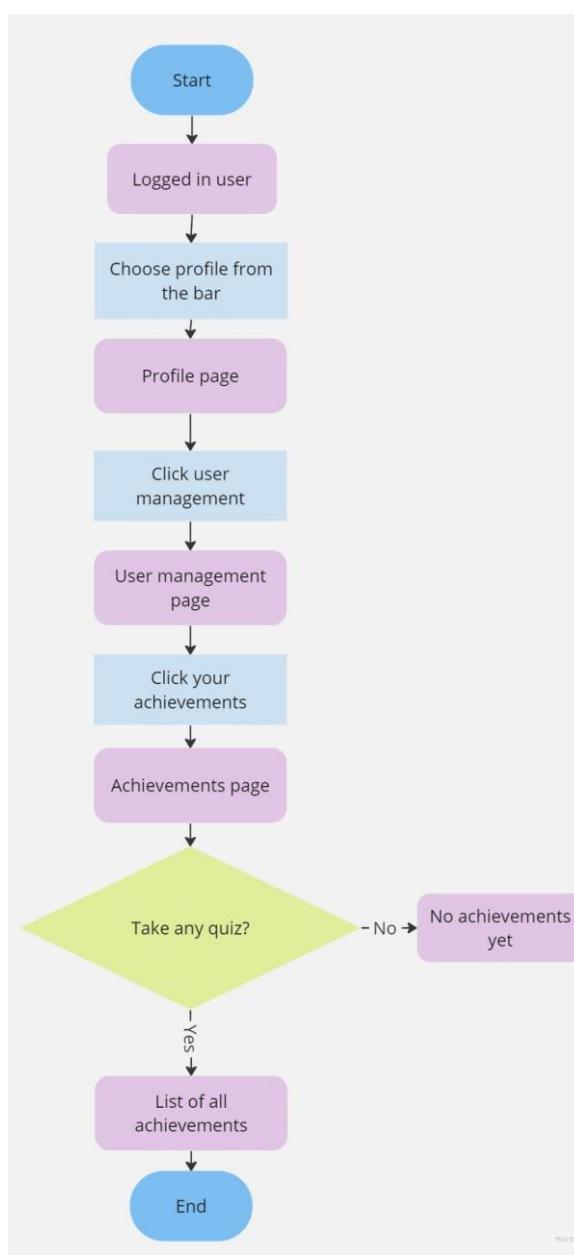


Table 9 View the achievement list component level design



5.4 Data Design

The ALQ system depends on Cloud Firestore, which is a cloud-hosted, NoSQL database that Apple, Android, or web apps can access directly via native SDKs. Cloud Firestore is also available in native Node.js, Java, Python, Unity, C++ and Go SDKs, in addition to REST and RPC APIs.

Following Cloud Firestore's NoSQL data model, we store data in documents that contain fields mapping to values. These documents are stored in collections, which are containers for documents that we can use to organize our data and build queries. Documents support many different data types, from simple strings and numbers, to complex, nested objects. We can also create sub collections within documents and build hierarchical data structures that scale as our database grows. The Cloud Firestore data model supports whatever data structure works best for the app [22].

To design the data design, we also used the Miro Web app [15].

5.4.1 Data Models

Since ALQ system uses a NoSQL database, we will describe the data structure and contents using ER diagrams, and non-relational data models.

- ER diagram

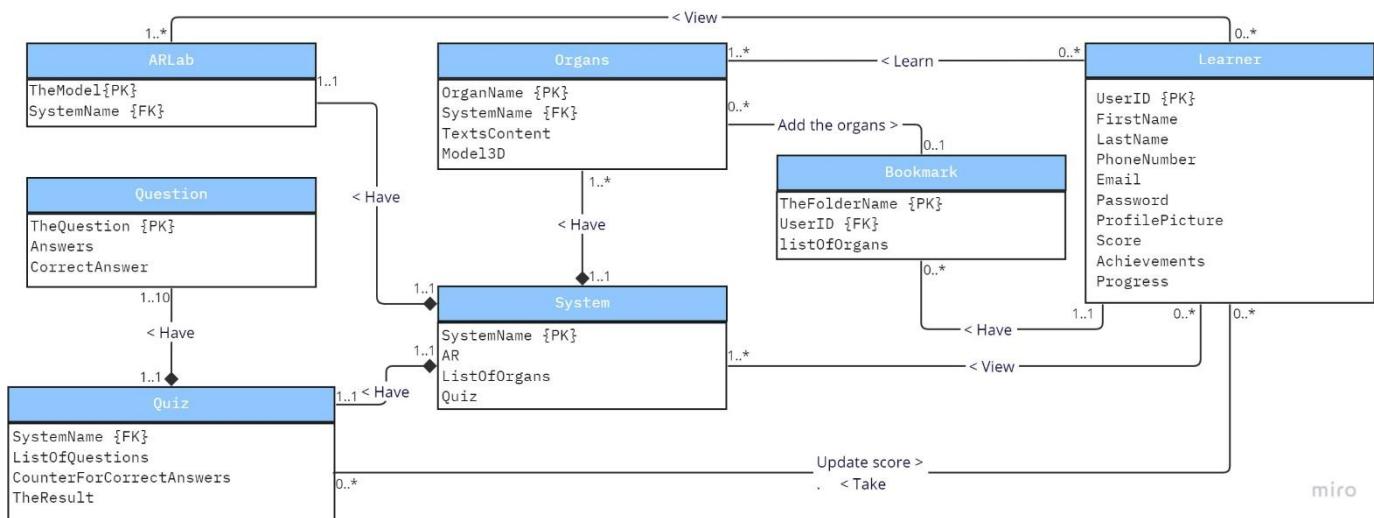


Figure 18 ER diagram



ALQ system has 7 entities, Learner, System, Organs' information, ARLab, Quiz, Question and finally the bookmarks, each of which has a unique identifier and special attributes to each entity.

The user can view at least one System (that is, she/he can view one or more Systems), and the Systems can still remain in the app even if there is no learner. The user can learn at least one organ in specific System, and the organs' information are there even if there are no users to learn from it, the same thing with AR lab, user can view at least one AR lab but AR lab is still available even if no user is viewing it, Also the user may not have any bookmark or he/she may have many bookmarks, but the bookmark belongs to only one user. The user may take the quiz many times or may he/she not take it, and the quiz can update the score of the user many time (each time the user re-takes the quiz, the quiz updates her/his score) and the quiz doesn't update the score if he/she didn't take it.

Each System has at least one organ (it contains a list of organs depending on the System), but each organ belongs to one and only one System, also each System has only one AR lab and each AR lab belongs to one System only. Similarly, a System has only one quiz, and each quiz belongs to one System only. All the organs, AR lab and quiz are having composition relation with the System, that means if the System disappears these three will disappear too, without the System, they don't exist.

The quiz has one to 10 questions, but each question belongs to one quiz only.

The organ can or can't be added to only one bookmark, but each bookmark can contain many organs or the bookmark can be empty.



- Non-relational data model

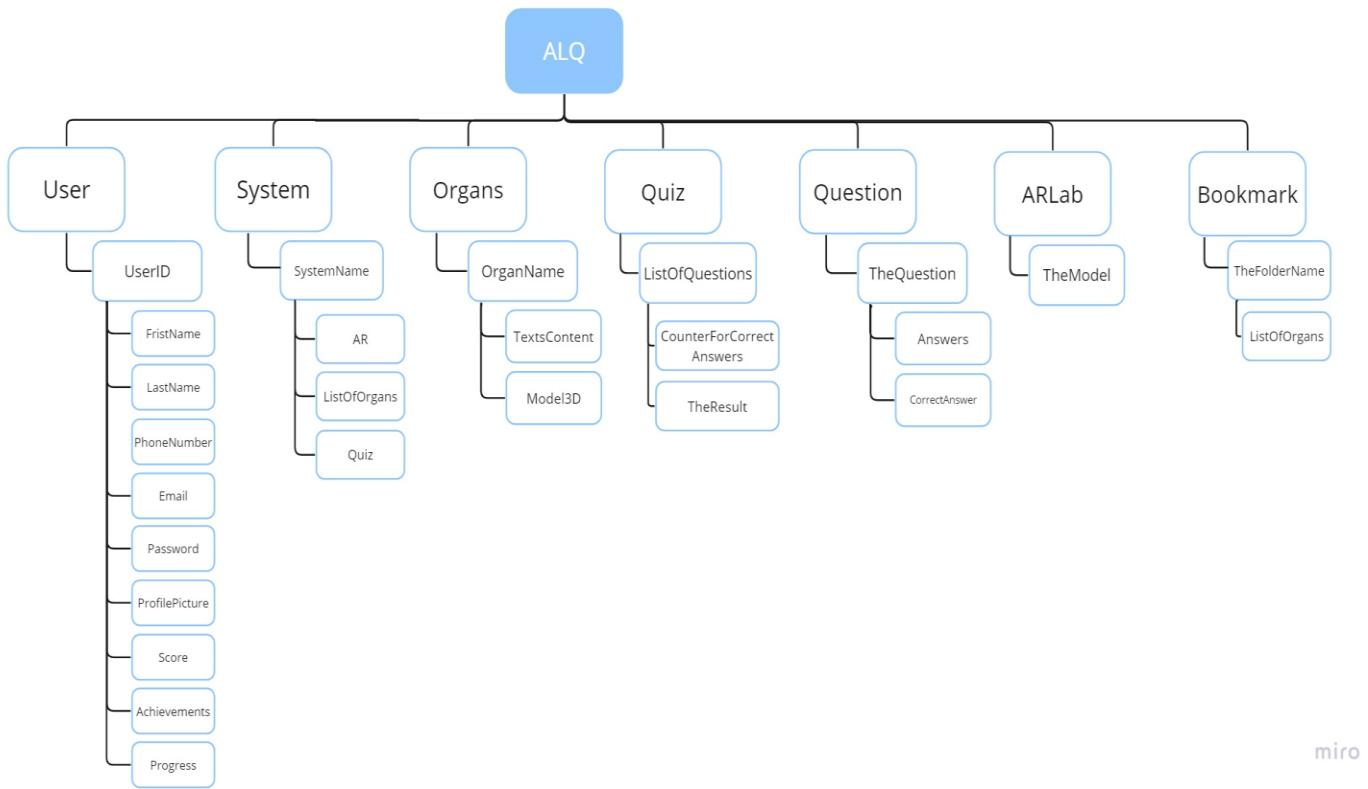


Figure 19 Non-relational data model

As shown in figure above, the ALQ system contains multilabel nodes, the user node, the System node, the Organ node, the ARLab node, the Quiz node, the Question node, and finally the bookmark node.

The UserID which is the child node of the user, represent a unique identifier for each user and entered automatically by the firebase when the user creates his/her account, and It consists of random letters and numbers for example:"CwOXTEn6jhRM6ljryjiV4LU7MRn1", the other children under the UserID represents the attributes of each user and they are the firstName, LastName, PhoneNumber, Email and password which are the information of user that he/she entered when creating the account. Also we have ProfilePicture that he/she can change, and the achievement, progress and score attributes. The achievement is about display for each System and its latest quiz result. The progress shows how much the user has done from each System. The score is initially defined as zero and increases with the user's progress from his/her results in the quiz.



The SystemName which is the child node of the System, represent a unique identifier for each System, and the other children under the SystemName, represents the attributes of each System that are: the AR which is a model of one of the systems of the human body (depending on the current System) using AR technology, listOfOrgans that contain a list of organs and depend on the current System, and all Systems have a start organ which is a definition and clarification of the general picture of the system in this System as a whole. Finally, the Quiz, which contains a set of questions for all organs in the current System.

The OrganName which is the child node of the Organs, represents a unique identifier for each organ in the list of organs, and the other children under the OrganName, represents the attributes of each Organ, that are: the TextsContent which is the list of all titles and description in the current organ, and the Model 3D, which is a 3D model of the organs in the current organ.

The ListOfQuestions which is the child node of the Quiz, represents a unique identifier for each Quiz in the System, and the other children under ListOfQuestions, represents the attributes of each Quiz that are: CounterForCorrectAnswers which is a counter that counts the number of questions that were answered correctly during the quiz, to be used later to calculate the score, and TheResult attribute which contains the result obtained by the user for the current quiz (the number of questions that he/she answered correctly, and the result is often out of 10).

The TheQuestion which is the child node of the Question, represents a unique identifier for each Question in the quiz, and the other children under TheQuestion, represent the attributes of each question, that are: Answers which is an array that have all the choices for this question, and one of them is the correct choice which is saved also in CorrectAnswer to compare the chosen answer with CorrectAnswer, and finally Hint which contains a hint of this question to help the learner.

TheModle which is the only child node of the AR lab, represents a unique identifier for the AR lab in each System.

Finally we have TheFolderName which is the child node of the Bookmark, represents a unique identifier for each folder in the bookmark, and the other child under TheFolderName, represents the attribute of each bookmark is ListOfOrgans which is an array that contains all names of the organs that the user saved in the bookmark.

All children nodes that represent the attributes of each System, organ and question were previously entered in the Database and are called during the code.



5.4.2 Data Collection and Preparation

Since our application is about anatomy learning, we had to use scientific and verified information. We collected a large amount of data related to the body systems that were selected, namely (Circulatory system, Respiratory system, Digestive system, Urinary system, Muscular system) and ensured that they are from reliable sources. Then, we revised and simplified this information and replaced the complex terms with simpler ones and made it more interesting, such as comparing the size of the kidney to a computer mouse to make it easier to visualize, instead of describing its size in metrics only and adding enriching and exciting information to attract the learner and encourage him to learn more. The collected data was also revised with the collaboration of an Internist to confirm their reliability.

To gather information, many sources were referred to, some of them were modified to make them fit the target group, and most of the sources were educational YouTube videos from a trusted channel such as: MagicBox Animation channel, so there is no specific source from which the content was written, but we will mention the most important ones in the references.
[Content resources section]



5.5 Interface Design

5.5.1 Sitemap Diagram:

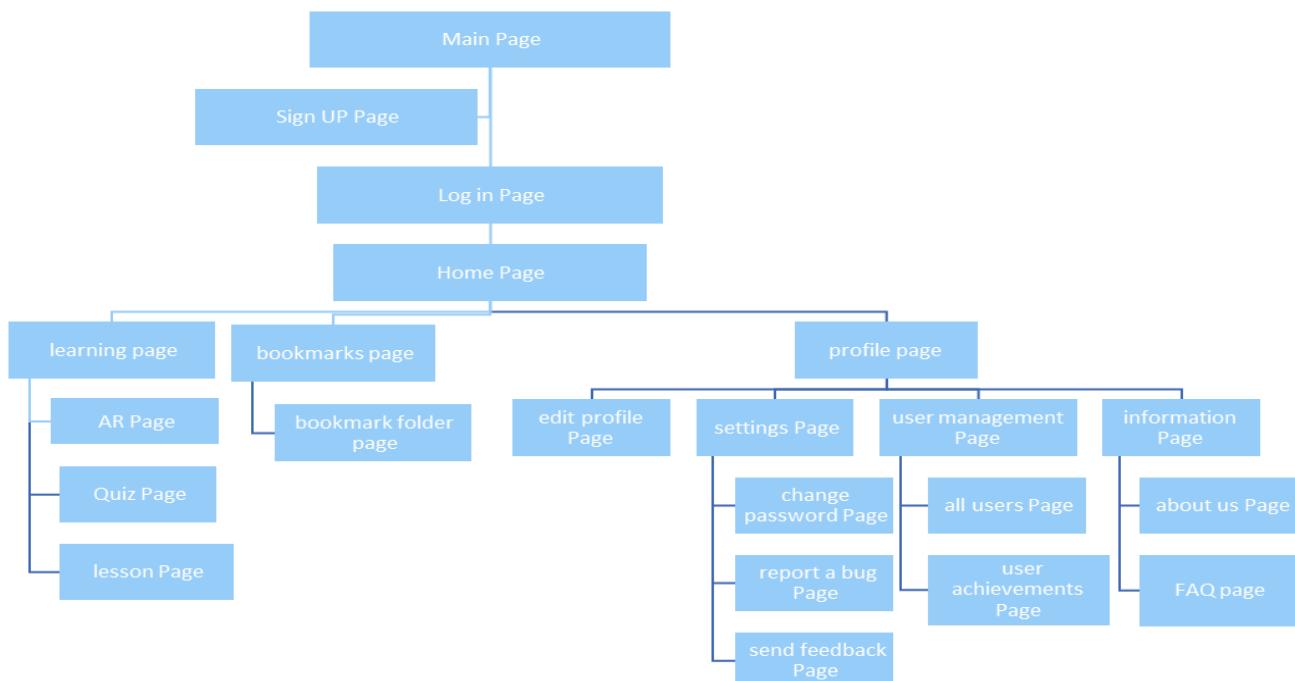


Figure 20 Sitemap Diagram

5.5.2 UX guidelines:

- Consistency in text: all the text in the Application uses (Roboto) font.
- Aesthetic and minimalist design.
- Designers should assume users are unable to understand technical terminology.
- Predictability in buttons: we used a predictable meaningful word in each button.
- Make relevant information easy to find.



5.5.3 User interactions

- When opening the application

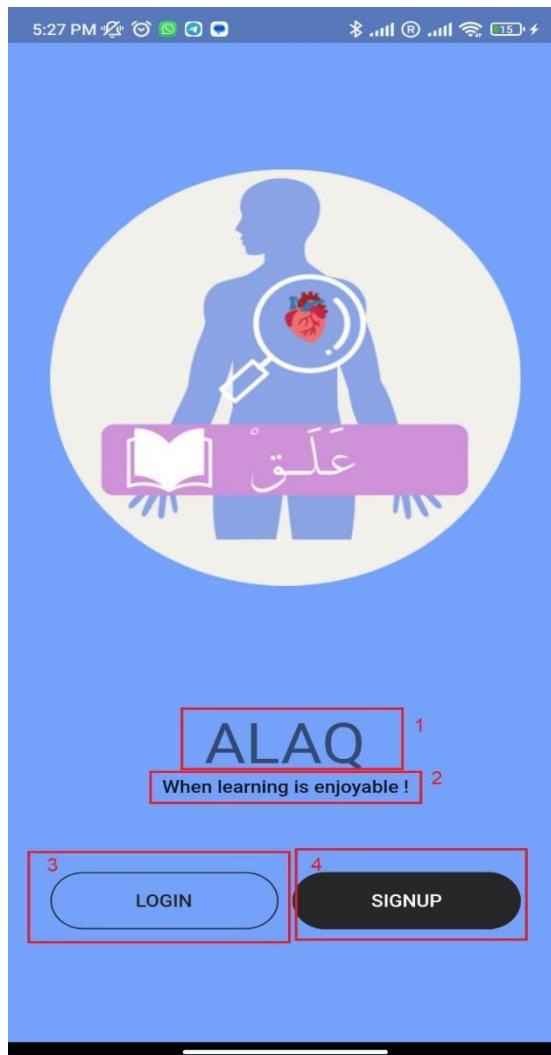


Figure 21 Main page

1	Application name
2	the subtitle
3	Is a button, when pressed will lead to the log-in page
4	Is a button, when pressed will lead to the sign-up page



- When sign up pressed

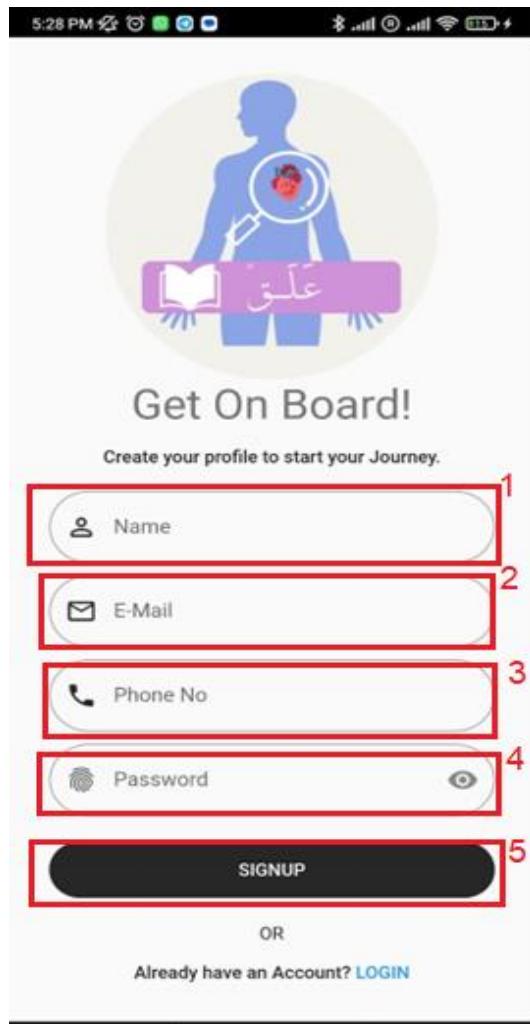


Figure 22 Sign up page

1	Is the input field to take the user's name
2	Is the input field to take the user's email
3	Is the input field to take the user's Phone number
4	Is the input field to take the user's password
5	Is a button, when pressed will lead to the home page



- When the login button is pressed.

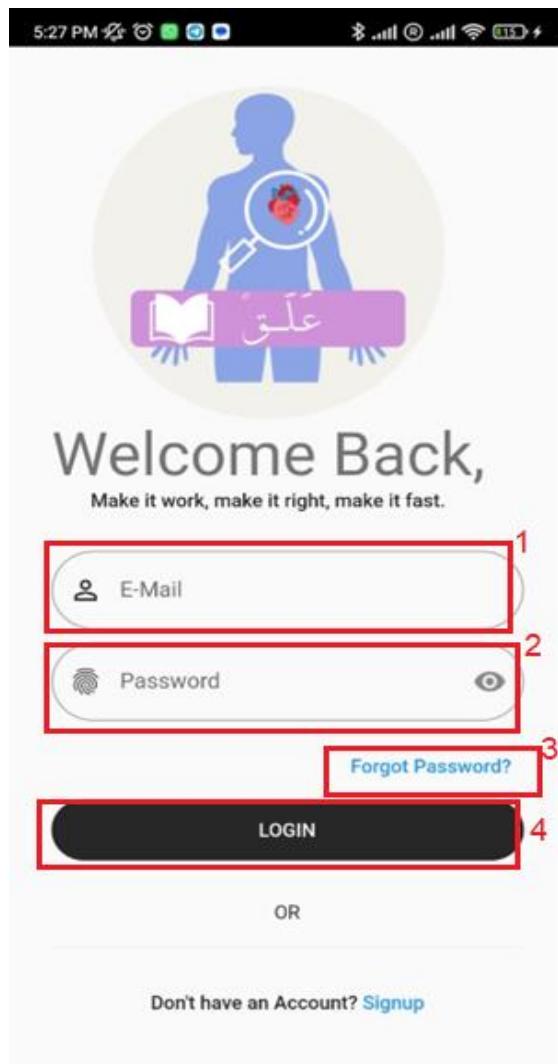


Figure 23 Log in page

1	Is the input field to take the user's email
2	Is the input field to take the user's password
3	Is a button, it is pressed in case you forget the password
4	Is a button, when pressed will lead to the home page



- When the user logs in

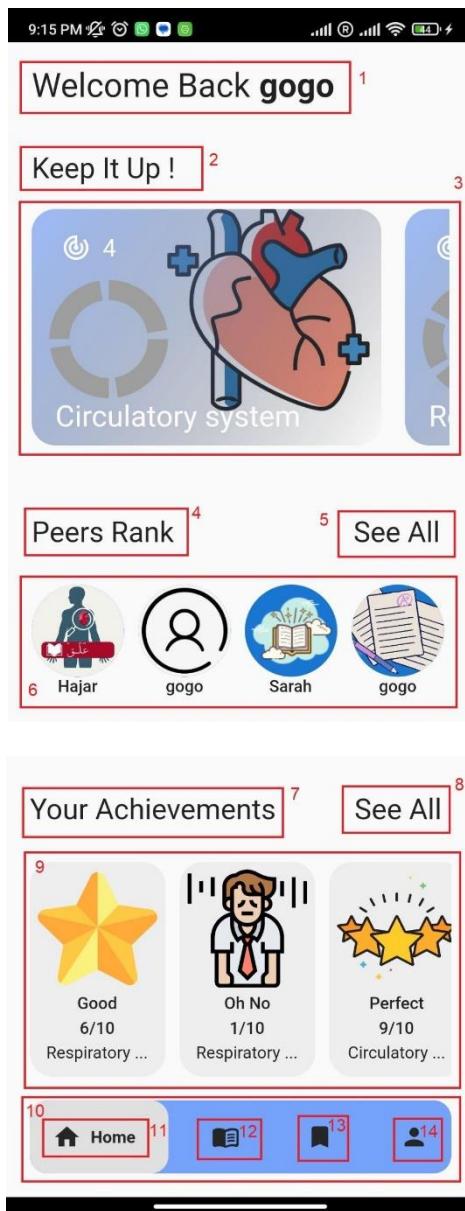


Figure 24 Home page

1	A welcome message
2	A header for the systems list
3	A list of systems with the user progress, on click it redirect to that system's content
4	A section title.



5	A text button that redirects the user to the “All Users” page.
6	A list of users ordered by their score.
7	A section title.
8	A text button that redirects the user to the “Achievements” page.
9	A list of the user achievements.
10	A navigation bar
11	A tap that redirects the user to the home page
12	A tap that redirects the user to the “Learning” page
13	A tap that redirects the user to the “Bookmarks” page
14	A tap that redirects the user to the “Profile” page



- When the learning tab is pressed

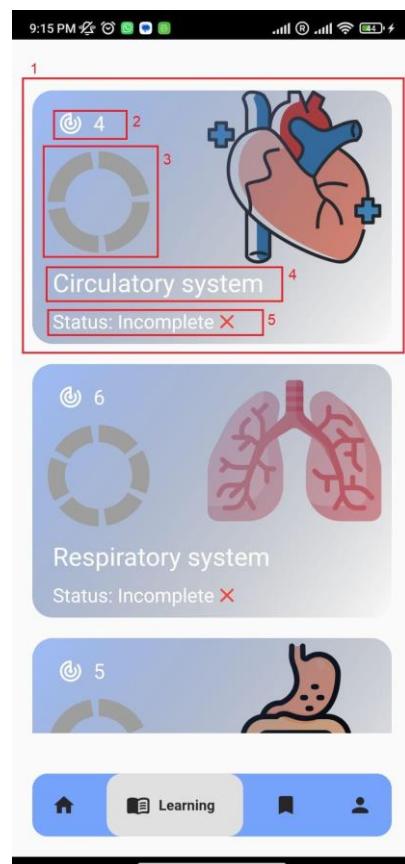


Figure 25 Learning page

1	The system card, on click it redirects the user to that system content
2	The number of organs in that system
3	The user progress in that system
4	The system name
5	The user's status in that system



- When the bookmarks tab is pressed

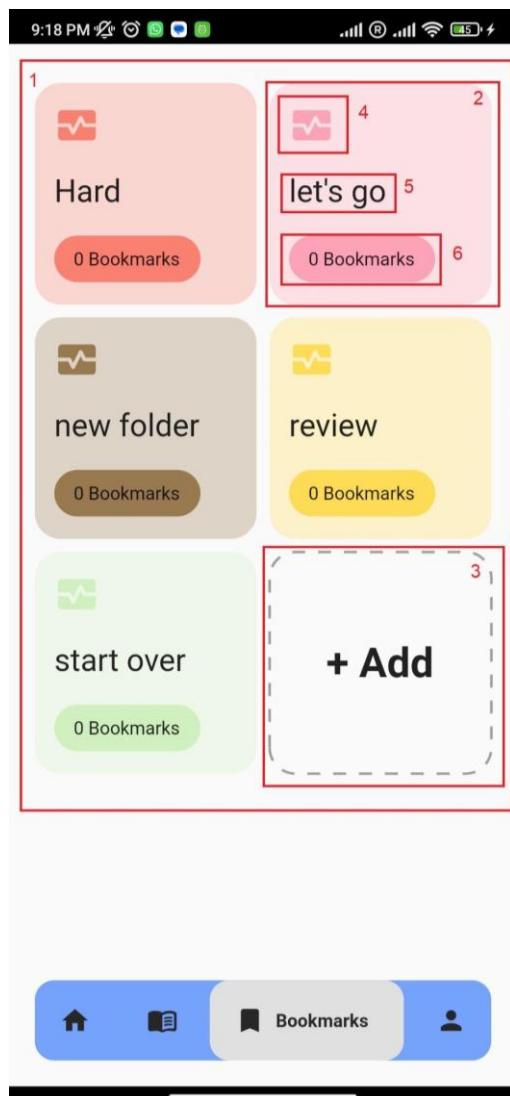
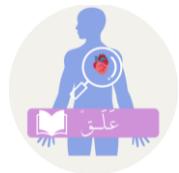


Figure 26 Bookmark page

1	A list of bookmark folders
2	A bookmark folder, on click it redirects the user to that folder's content
3	Add bookmark folder button, on pressed it opens a bottom sheet to add new folder
4	An icon for the folder
5	the folder's name
6	The number of bookmarks in that folder



- When the profile tab is pressed

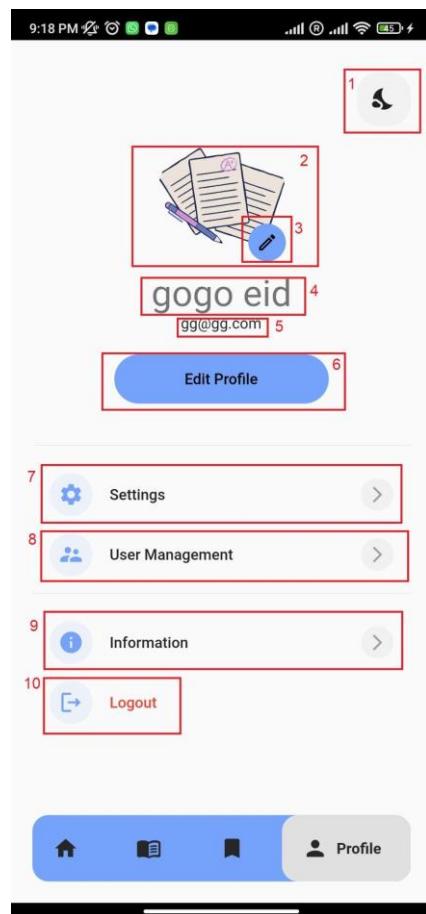


Figure 27 Profile page

1	A flat button that changes the theme of the app
2	the user profile picture
3	a flat button that redirects the user to the edit profile page
4	the user's name
5	the user's email
6	a flat button that redirects the user to the edit profile page
7	a menu button that redirect the user to the settings page
8	a menu button that redirect the user to the user management page
9	a menu button that redirect the user to the information page
10	a menu button that logs the user out



- When the system card in the home or the learning screens are pressed

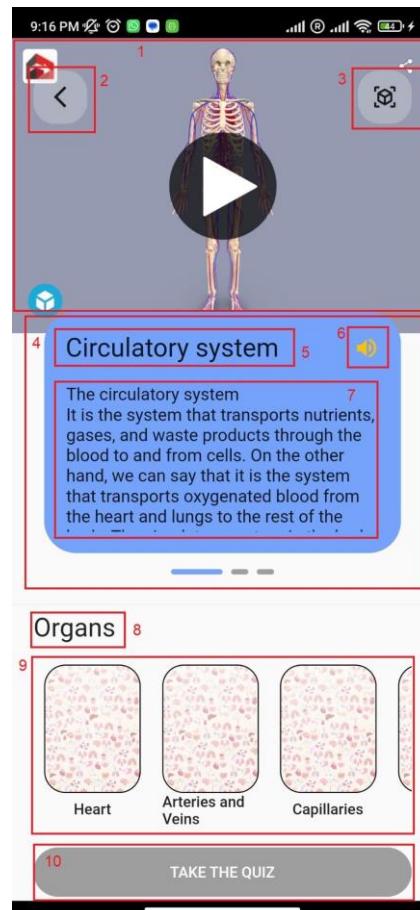


Figure 28 System content page

1	the 3D model section
2	a back button
3	a button that leads to the AR page
4	a list of paragraphs that describes the system organs and how it functions
5	the system's name
6	a flat button that starts/ stops the text to speech function
7	a paragraph that describes the system organs and how it functions
8	A section title.
9	a list of organs, on clicked it redirects the user to that organs information page
10	a button that redirects the user to the quiz page



- When the “AR” button is pressed.



Figure 29 AR page

1	the AR model area
2	It is pressed when we want to add or remove an object



- When the “take the quiz” button is pressed

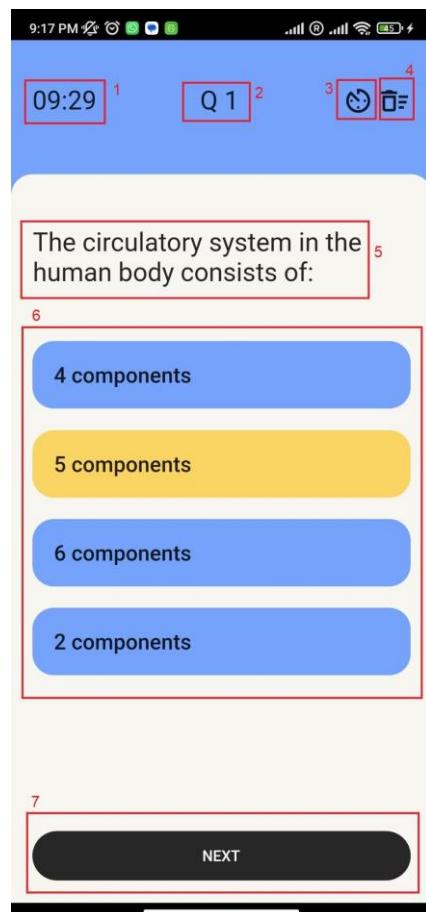


Figure 30 Quiz page

1	A timer
2	the question number
3	“increase time” hint that adds 10 seconds to the timer
4	“delete two answers” hint that deletes two answers
5	the question text
6	the answers text list
7	a button leads to the next question



- When the “complete” button in the quiz is pressed

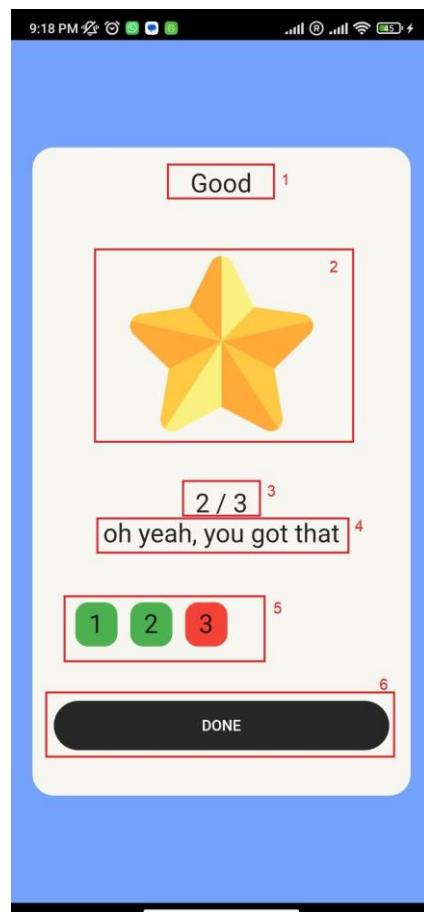


Figure 31 Quiz result

1	A header indicates on the user work
2	a picture that shows the user his page
3	a text that shows the user's correct answers number
4	an encouragement message
5	a list of correct and wrong answers in the quiz
6	a button that leads the user back to the system's content page



- When the organ card in the system content is pressed

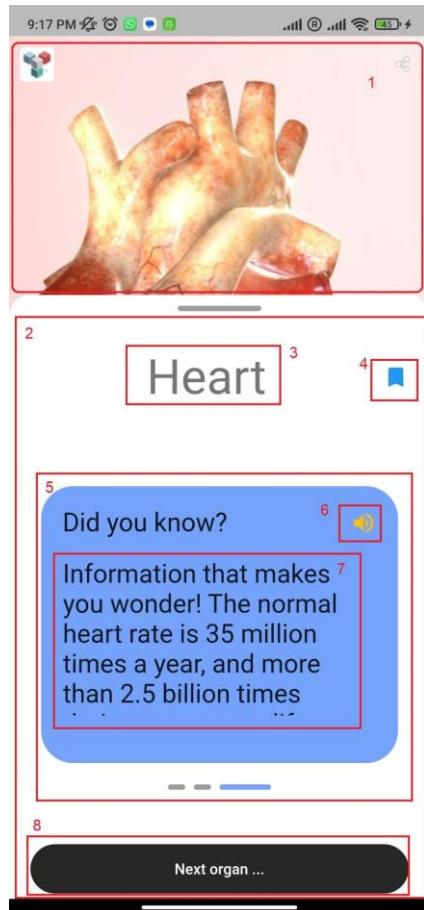


Figure 32 Organ information page

1	the 3D model area
2	the organ's information area
3	the organ's information name
4	a flat button. when clicked it will open a bottom sheet
5	a list of cards contains an information about that organ
6	a flat button. when clicked it will start the text to speech function
7	an information about that organ
8	a button. when clicked it will lead the user to the next organ



- When the bookmark button in the organ's page is pressed

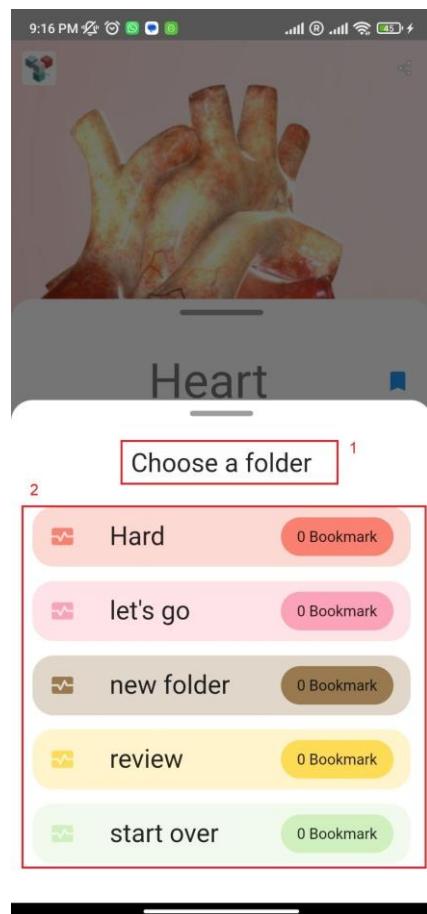


Figure 33 Add a bookmark to a folder

1	a header of the bottom sheet
2	a list of bookmark folders, on click it'll add the organ to that folder



- When a bookmark folder is pressed

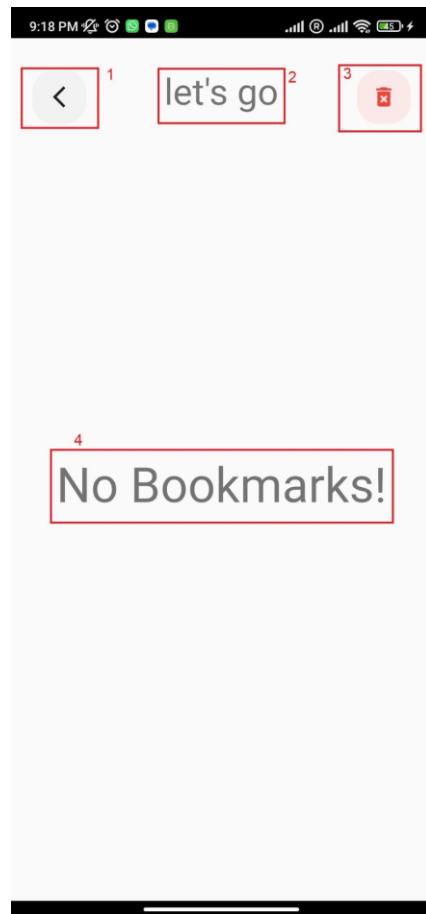


Figure 34 Bookmark folder content page

1	a back button
2	the folder name
3	a flat button. when clicked it will delete the folder and its content
4	a text that indicates that the folder is empty



- When the settings menu button in the profile page is pressed

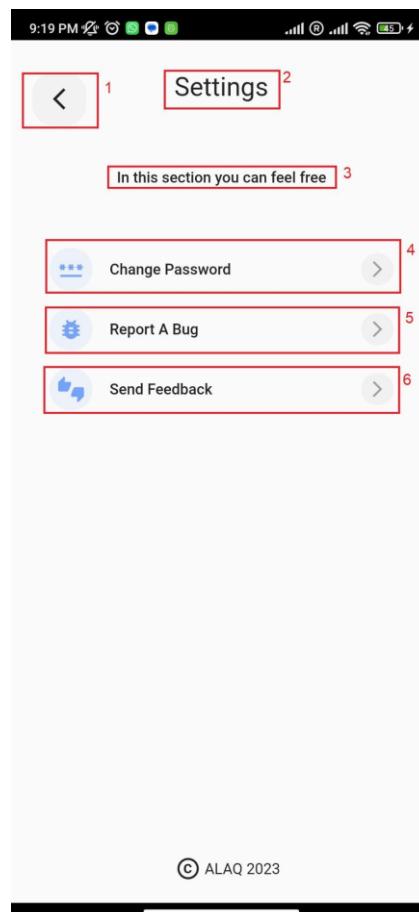


Figure 35 Settings page

1	a back button
2	the page name
3	a text
4	a menu button. when clicked it'll redirect the user to the change password page
5	a menu button. when clicked it'll redirect the user to the report page
6	a menu button. when clicked it'll redirect the user to the report a bug page



- When the change password menu button is pressed

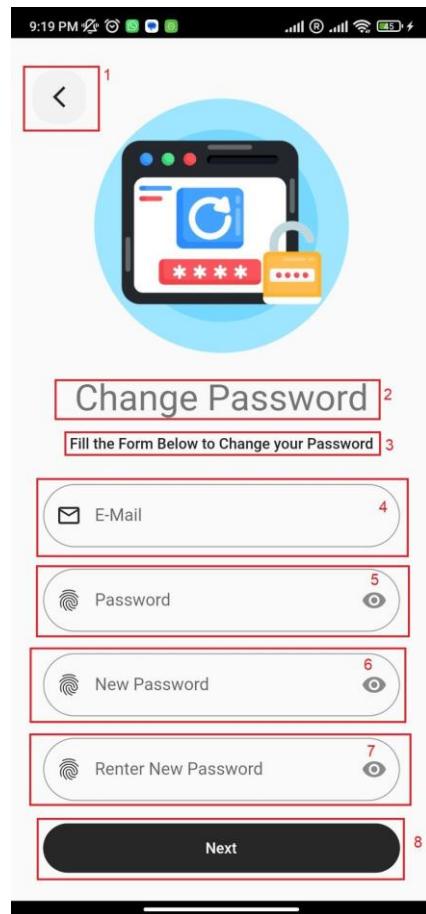


Figure 36 Change password page

1	a back button
2	the page name
3	a text to instruct the user
4	an input field, to input the email
5	an input field, to input the old password
6	an input field, to input the new password
7	an input field, to confirm the new password
8	a button that submits the user new password and change it



- When the report a bug menu button is pressed

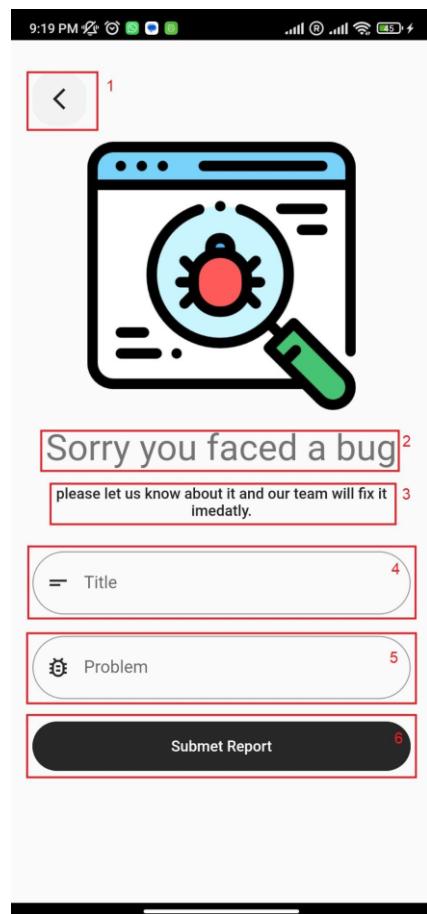


Figure 37 Report a bug page

1	a back button
2	the page header
3	a text to instruct the user
4	an input field, to input a title for the problem
5	an input field, to input the issue details
6	a button that submits the user bug report



- When the send feedback menu button is pressed

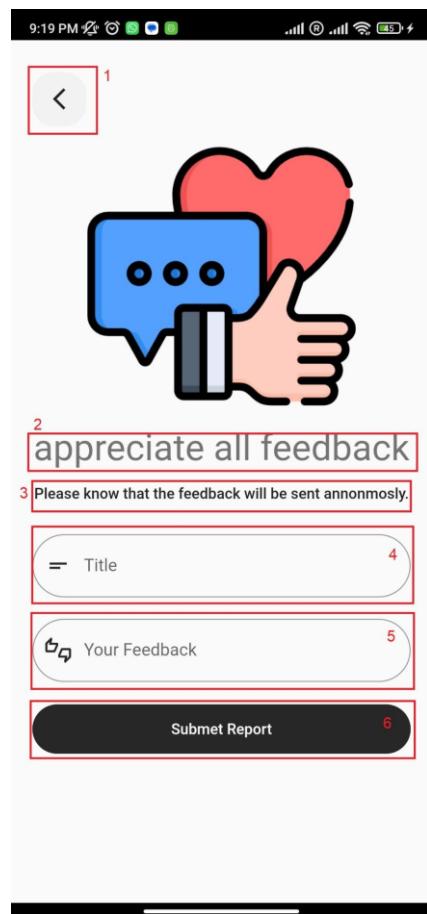


Figure 38 Send feedback page

1	a back button
2	the page header
3	a text to instruct the user
4	an input field, to input a title for the feedback
5	an input field, to input the feedback details
6	a button that submits the user's feedback



- When the user management menu button in the profile page is pressed

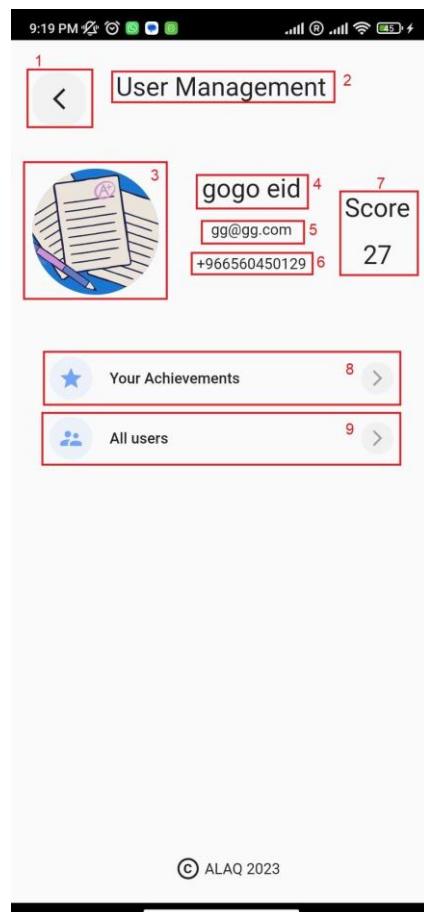


Figure 39 User management page

1	a back button
2	the page name
3	the user's profile picture
4	the user's name
5	the user's email
6	the user's phone number
7	the user's score
8	a menu button that directs the user to the achievements page
9	a menu button that directs the user to the "All users" page



- When the all users menu button is pressed



Figure 40 All users page

1	a back button
2	the page name
3	a list of the user's achievements
4	the user's profile picture
5	the user's name
6	the user's score



- When your achievements menu button is pressed

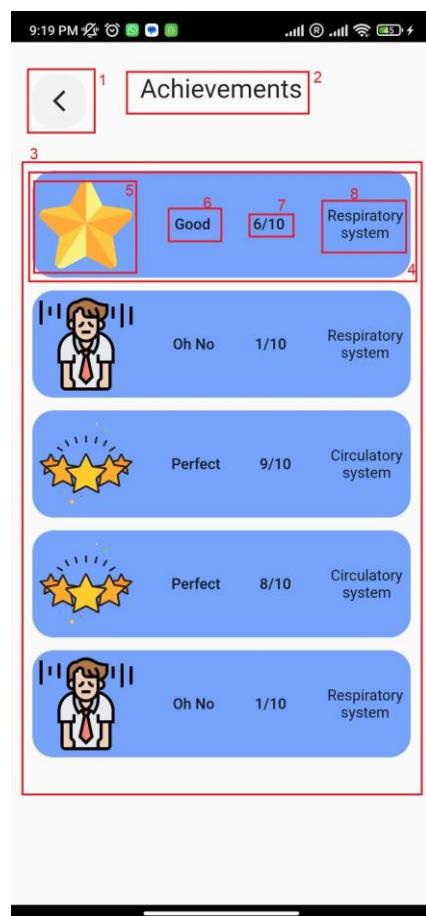


Figure 41 Achievements page

1	a back button
2	the page name
3	a list of the user's achievements
4	achievement card
5	a picture that indicates what type of badges the user got
6	the title the user got with badge
7	the user's score
8	the name of the system that the user got that achievement from



5.6 Implementation

To implement ALQ, we used several tools to help us develop the software. To begin, we constructed a database using Firebase (Firestore database), and because our app is educational, we need the scientific content to be reliable. We ended up gathering material about human anatomy from a variety of trustworthy sources, then the selected information was simplified to meet the needs of our target customers. For programming, we used the Flutter framework in Dart, which requires several applications, including Visual Studio Code, Android Studio, and Visual Studio. We faced some difficulties while installing and setting up the environment, but we were able to overcome most of them. Since augmented reality is one of the major parts of ALQ and the most important and complex feature, of course we encountered several problems that forced us to postpone the feature from sprint-2 to sprint-3. One of these problems is that we changed the algorithms more than once and used different sources to try solving the code errors, and we also had a problem that the API level that suits the used augmented reality algorithms which is 24 does not work on all devices. Regarding the APIs we used some packages in Flutter like: ar_flutter_plugin and vector_math to implement AR and flutter_tts to implement the text-to-speech feature. To submit our software and keep it up to date for the entire team we used Github.

The most challenging and major parts of ALQ are: read organs' information as a major part, add a bookmark as a major part, use the AR scanner as a challenging part, take a quiz as a challenging part, and see a list of achievements as a major part.

Below are the major and challenging parts of the code for each feature:



Function	Read the organs' information
Description	This function allows the users to view a list of organs in each system and begin their educational journey by reading the organ's information in that system.
Function's flow	The user must already have an account and log in with their email and password. When the user is logged in, the application will redirect him to the home page and the user should choose learning from the bar in order to view all systems. When the user chooses a system the content of that system will appear. The user should choose one of the system's organs. When an organ is chosen a 3D model of it will appear, and the user must swipe up to read the organ's information which its content will be retrieved from the database. If the user is done s/he should click next to move to the next organ in the system.
Code	
<pre>// direct the user to next organ nextLesson() { if (currentLessonIndex + 1 >= lessonsList.length) { Get.back(); } else { Get.delete<LessonController>(force: true); Get.offAndToNamed("/lesson", arguments: { "lessonData": lessonsList[currentLessonIndex + 1], "lessonsList": lessonsList, "currentIndex": currentLessonIndex + 1, "chapterNum": chapterNum, }); } //get the system's organs Stream<List<lesson>> getLessons(int chapterNum) { return _db .collection("chapters") .doc("Chapter \$chapterNum") .collection("Lessons") .snapshots() .map((data) { List<lesson> lessons = []; data.docs.forEach((element) { lessons.add(lesson.fromsnapshot(element)); }); return lessons; }); }</pre>	



Function	Add bookmark
Description	This function allows the users to bookmark an organ when they are interested in it and allow them to easily return to it.
Function's flow	The user must already have an account and log in with their email and password. Also, the user must have previously created a folder and choose a color for it. When the user is logged in, s/he must first navigate to bookmarks from the bar then start creating a folder by clicking the add button. Once a folder is created it will be given an id and name linked to the user id. The user can navigate to an organ from her/his choice to bookmark it by clicking the bookmark icon then choose in which folder the organ will be and the system's and organ's ids will be linked with that folder.
Code	
<pre>// add an organ to a bookmark folder Future<void> addBookmark(String id, int chapterNum, String folderID, String name, int count) async { final uid = _authRepo.firebaseioUser.value?.uid; final snapshot = await _db .collection("Users") .doc(uid) .collection("bookmarks") .doc(folderID) .collection("lessons") .add({ "name": name, "lessonID": id, "chapterNum": chapterNum, }); final snapshot1 = await _db .collection("Users") .doc(uid) .collection("bookmarks") .doc(folderID) .update({ "count": count, }); }</pre>	



Function	Use the AR scanner
Description	This function allows the user to see human organs and body systems using AR technology by scanning the area around him until the appearance of three-dimensional coordinates.
Function's flow	The user must already have an account and log in with their email and password and grant permission to access the camera in order to start scanning the surrounding area. When the user is logged in, s/he should choose a system since every AR model is connected to a system number then the user can click the AR scanner and give permission to the camera to start scanning the area around him. When three-dimensional coordinates appear then a body system with organs will appear on the phone through augmented reality technology.
Code	<pre>// using the AR extension child: ARView(onARViewCreated: onARViewCreated,), when threeewCreated(ARSessionManager arSessionManager, ARObjectManager arObjectManager, ARAnchorManager arAnchorManager, ARLocationManager arLocationManager) { this.arSessionManager = arSessionManager; this.arObjectManager = arObjectManager; this.arSessionManager.onInitialize(showFeaturePoints: false, showPlanes: true, customPlaneTexturePath: "images/Beatingheart.glb", showWorldOrigin: true, handleTaps: false,); this.arObjectManager.onInitialize();} // a function that selects the 3D model based on the chapter number // then it creates a node for it to show on the display Future<void> onWebObjectAtButtonPressed(int name) async { String urlLink = ""; if (webObjectNode != null) { arObjectManager.removeNode(webObjectNode!); webObjectNode = null;} else { var newNode = ARNode(type: NodeType.webGLB, uri: urlLink, scale: Vector3(0.5, 0.5, 0.5)); bool? didAddWebNode = await arObjectManager.addNode(newNode); webObjectNode = (didAddWebNode!) ? newNode : null;}}</pre>



Function	Take a quiz
Description	This function allows the user to take a quiz at the end of a system to test their gained knowledge.
Function's flow	The user must already have an account and log in with their email and password and must finish reading the system's organs information and use the AR scanner. When the user is logged in, s/he should choose a system since every quiz is connected to a system's id then the application will check if the user finished reading the organs' information and use the AR scanner if yes, the user will be able to take the system's quiz. The quiz question will be retrieved from the database randomly each time the user takes the quiz. At the end of the quiz the user will see their results and each attempt will be added to the achievements list.
Code	
<pre>@override void OnInit() { super.OnInit(); // qstream the questions from database to keep track of the changes questionsList.bindStream(_databaseRepo.getQuestions(chapterNum)); } // get the chapter's Questions Stream<List<Quiz>> getQuestions(int chapterNum) { return _db .collection("chapters") .doc("Chapter \$chapterNum") .collection("Quiz") .snapshots() .map((data) { List<Quiz> questions = []; data.docs.forEach((element) { questions.add(Quiz.fromSnapshot(element)); }); questions.shuffle(); return questions; }); }</pre>	



Function	See a list of achievements
Description	This function allows the users to see their quiz score for each system and each attempt they made for taking the same quiz as a list of achievements.
Function's flow	The user must already have an account and log in with their email and password and take at least one quiz in order to have achievements. When the user is logged in, s/he should choose the profile from the bar then click user management then click your achievements. If the user has any, a list of every attempt for taking a quiz that shows how the user performed, the score and the system name will appear as achievements list.
Code	
<pre>// Streams the Achievements from db Stream<List<Achievement>> getAchievement() { final uid = _authRepo.firebaseioUser.value?.uid; return _db .collection("Users") .doc(uid) .collection("Scores") // .orderBy("title") .snapshots() .map((data) { List<Achievement> achievement = []; data.docs.forEach((element) { achievement.add(Achievement.fromSnapshot(element)); }); return achievement; }); }</pre>	

For further details about the system implementation, ALQ GitHub repository link:

<https://github.com/Gehad1995/2022-GP1-Group23>



5 System Evaluation

6.1 User Acceptance Testing

We evaluated the ALQ system to ensure it fulfills the business requirements and can be used by the end users. We created a testing panel composed of 22 end users aged between 10 and 15 years old, who are curious to learn and explore new subjects.

We gave them the mobile application so that they could use and experience the system, and after that we asked them to answer a questionnaire (see Appendix C) consisting of 10 questions, then we conducted a small interview (see Appendix D) to get more insights about their reaction and impressions of the application.

We chose to conduct both a questionnaire and an interview, given the age of our users in order to get the clearest and best answers.

The questionnaire and interview were about user interface, technical aspects, main strengths and main weaknesses as listed in appendix A.

6.1.1 Demographics of Participants

Figure 42 and 43 are pie charts with the demographic information of the UAT (User acceptance testing) testers of our system, which are the age and gender.

We obtained varying ages between 10 - 15, but most of them were 15 years old, and we also found that half of them are males and half are females.

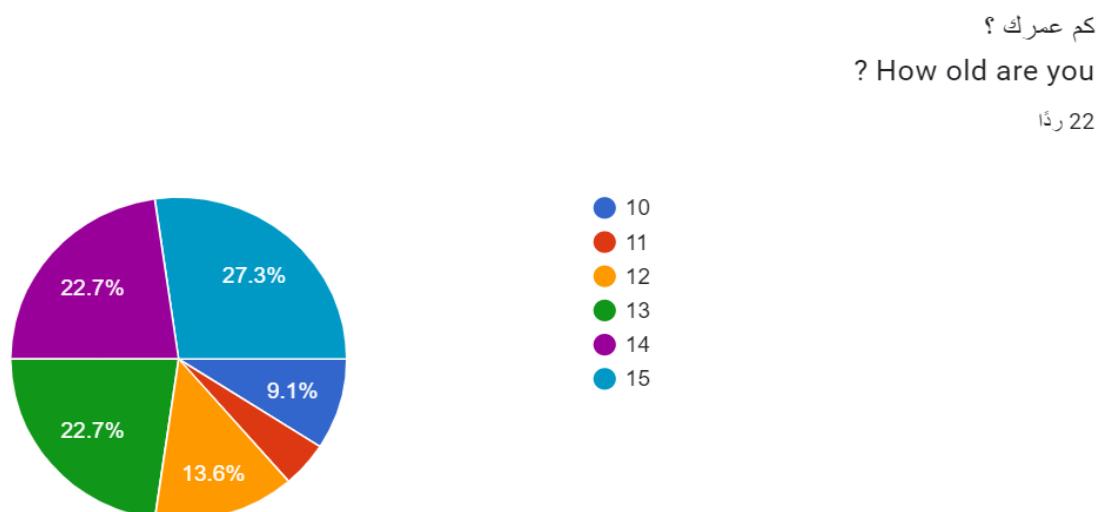


Figure 42 Questionnaire result: the tester age

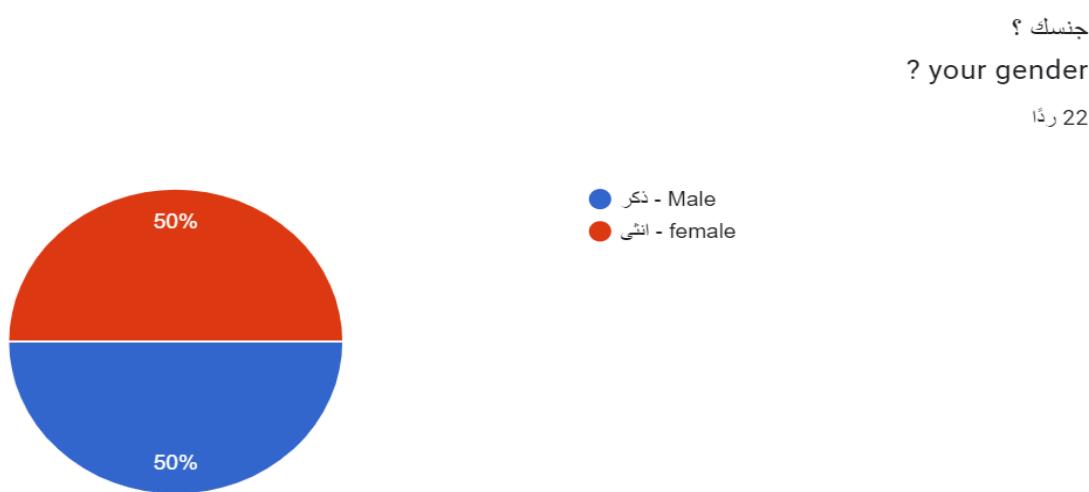


Figure 43 Questionnaire result: the tester gender

6.1.2 Questionnaire/Interview Results

The majority of users found that the application was easy and clear, but we found that some of them encountered a problem while using the application (see Appendix D), and through the interview we were able to conclude and discover what problems they faced. Most of it was because the application does not support the Arabic language.

Most of them agreed, with a percentage of 95.5%, that navigating within the application was easy, and when they make a wrong choice, they can undo the operation. Moreover the guiding messages were clear and easy to understand. Generally, we can conclude that the application was clear, easy, and smooth to deal with.

86.4% of the users answered yes when they were asked about the application being responsive, while a few of them were neutral and the others disagreed. After conducting the interviews, we discovered that they meant the speed of the appearance of 3D objects and AR technology. In fact, the speed of their display depends on the speed of the Internet, not on the application itself.

When they were asked about the application interfaces in terms of colors and location of things, most of them believed that it was convenient, while some of them had a different opinion. From the interviews, we discovered that some of them would like the application to be in different colors, which is a subjective matter as each person has his/her own taste. However, most of them appreciated the interface.



The majority of them agreed that they found in the application all the functions they expected from it, but some of them were neutral in their answer. Most of them also agreed that they wanted to try the application continuously every time they wanted to learn anatomy and repeat the experiment, but a small percentage was neutral.

We also concluded from the interview that what the users liked the most was the 3D models and the AR technology, which was a new and enjoyable experience for them. In addition, some users liked the application's design and colors. We also got many great suggestions that we may include in the next version of the application in the future.

6.2 Quality Attributes (NFR testing)

The table below presents the non-functional requirements measurements:

User story	Quality Attribute	Measure	Results
As a learner I want the application to be usable so that I can use it easily and effortlessly.	Usability: How clear and easy to understand the application for a learner once they see the interface?	observing the learner's interaction with the Interfaces without asking for help from anyone.	<p>The test scenario:</p> <p>1- Giving users the application to try it. 2- Observing them while using the application, did they need help, or was the application easy and clear. 3- Asking them about their opinion in the application.</p> <p>22 of young learners tested the application, and without any instruction nor guidance from the testers, all of them didn't need any guidance.</p>
As a learner I want the application to be loaded within 5-10 seconds from opening it so that I won't have to wait long for the application to load.	Performance: How long does it take to load the application?	Compute the system loading time. Users need less than 10 seconds to load the app	<p>The test scenario:</p> <p>1- Giving users the application to use and trying it. 2- Observing them while using the application, how long does it take to load the application. 3- Asking them about how the application was.</p>



			22 users used the application, and on average it took 5 seconds to load the application and its pages.
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As a learner I want the provided educational content to be accurate and from reliable resources so that I feel relieved and confident while learning.	Reliability: Is the provided educational content accurate and from a reliable resource?	Content validity by verifying that the content is reliable and consistent with the references so that it is not different or false if it is found elsewhere.	<p>The test scenario:</p> <p>1- Give the application to reliable people and specialists in human sciences to review and verify it.</p> <p>The content of the application and the practical information it contains have been reviewed and verified by reliable people and specialists in human sciences "Dr. Marwa Ahmed".</p> <p>After using the application for 22 users, we did not get or find any comments or criticisms in the content, in addition to that we provided to our users the ability to report any comments or problems in the application that may appear in the future.</p>
As a learner I want the system to be updated and maintained every 2 months or less, so that I won't have to face troubles and use an up-to-date application.	Maintainability:	Perform application maintenance every two months.	<p>The test scenario:</p> <p>1-The application has been maintained and the practical information it contains has been verified by reliable and specialized</p> <p>2-people who perform maintenance every two months to avoid any problem in the application.</p>
As a learner I want the application to be available at any time except for the application maintenance period so that I can use it whenever I want.	Availability:	The application is available to everyone outside of maintenance times	<p>The test scenario:</p> <p>1- Giving users the application to use and experience it.</p> <p>2- Monitoring them while using the application. Can they access the application outside of maintenance times or not.</p> <p>We monitored 22 test subjects while using the app and found that they can access the app outside of maintenance times</p>
As a learner, I want the email and phone number used in signing up to be verified so that I can verify my account and make it secure.	Security: Is the user's email and phone number really his/her real information?	Sending a one-time password to the registered email or phone number and making the	<p>The test scenario:</p> <p>1- Giving users the application to use and try it.</p> <p>2- Sending a one-time password after the user signs up to the registered email or phone number and making the user enter it before enabling him/her to log in.</p>



	Has this been verified?	user enter it before enabling him to log in.	22 users received a one-time password to the registered email or phone number, and they entered it before enabling him/her to log in.
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Table 10 Quality Attributes

6.3 Discussion

As it seems we get the users' approbation, but we still need to do some improvements in the portal usability. The results of the questionnaire and interviews point to things we should take into consideration, which is that most of the interviewees liked the idea of the application but we noticed that it is not as we expected because of the problems we faced during the test process, such as the nature of the interviewee's lack of focus (the interviewees don't have patience enough to understand the application), explaining and translating all the application for those who don't understand English.

So, we look forward to improving and developing it better in the future and to ensure the understanding of all users, we decided to add the Arabic language to the application and to make the application more fun for the user.



6 Conclusions and Future Work

This report presents the stages of our project. The first system provides a general introduction, then comes the background which provides the necessary domain knowledge for the reader to understand the details of ALQ, such as augmented reality technology and anatomy of the human body. We reviewed and discussed similar applications that serve the same field and compared them with ALQ in the literature review system. The following system was dedicated to the design ALQ application components, to facilitate the implementation of ALQ application and understand the components and their interaction. Finally, there is the implementation system. We developed ALQ using flutter and we tested it to make sure it is free of errors and in the end, we have a high-quality educational application that serves education

6.1 Global and local impact.

Saudi Arabia is a prosperous country that cares about education. Moreover, children are an important part of the population. Their education is very important for the development of the Kingdom of Saudi Arabia vision. In this context, ALQ encourages children to search and discover knowledge. It also contributes to the digital transformation of KSA by combining technology and education.

On the other hand, globally, everyone may face difficulties understanding or visualizing the internal components in the human body. ALQ solves that problem by using AR technology and benefits from it to help users everywhere visualize human anatomy, as its content is in English. ALQ encourages the availability and accessibility of knowledge and serves educational goals worldwide.



6.2 Problems and challenges encountered during the software development

As expected, not everything we want is easy to achieve. We encountered many difficulties, starting with the choice of topic and the search for sufficient information. It was a time-consuming phase. We also had problems with the programming environment and framework. We intended to use dart language initially, and then we ended up using another one, which is Flutter. And there were also many problems in the programming and testing phases, and there were also problems in terms of the number of programs that we had to download and these things consumed a lot of space in our devices.

6.3 Limitations of the system.

ALQ is an English-language mobile application designed primarily to help children learn easily and enjoyably, it does not support the classroom learning under the supervision of teachers. There are no parent or adult accounts. The app is targeting the children themselves.

6.4 The main contribution of the project

Our project contributes to encouraging the use of the application in education and therefore has an impact on the learners themselves. They will learn with ease, fun while discovering new technologies. It helps parents as well teaching their children effectively and helps teachers to have a background and perception among learners about the anatomy of the human body.

Finally, the app helps the homeland in building a rising generation characterized by extraordinary possibilities in education because it is the basis of the formation of the individual.

6.5 Future work.

As a future work, we will include a feature that allows teachers to connect this program with their learners to interact during the class, and we will also give parents access to the program to know the level of their children.



7 Acknowledgements

We thank Allah always and forever for facilitating us to complete the graduation project. Our journey was completed thanks to Allah first, then with the help of the people who supported us psychologically and scientifically. We especially thank Dr. Khaoula Hamdi for her efforts, support, encouragement, and invaluable guidance throughout the ALQ project. Her knowledge, dedication, and work ethics have been a constant source of inspiration. Without her patience and understanding in difficult times, it would most probably not be possible to complete this work.

We also thank the Computer and Information Department, and King Saud University because it teaches us and tries to graduate students with great knowledge.

We thank Dr. Marwa Ahmed for her help in reviewing and validating the information related to the human body in our application.

Finally, we thank our families for their support and encouragement through this project and their understanding of its difficulties and their help to ensure we get the best results.



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9 Appendix

Appendix A: Requirements Elicitation and Analysis Interviews

- First interview

Interview Outline	
Interviewee name: Sarah Age: 12	Interviewer: Haifa
Location/Medium: Interviewee's home	Date: 23/9/2022
Objectives:	Agenda: <ul style="list-style-type: none"> Introduction Topic 1: Question 1 Topic 2: Question 2 Topic 3: Question 3 Topic 4: Question 4 Topic 5: Question 5 Topic 6: Question 6 Topic 7: Question 7 Topic 8: Question 8 Closing
Questions	Answers
Question: 1 What is your favorite subject? Why?	My favorite subject in school is biology or science in general. I feel that I am excited into the class, and I do not feel that I am learning it because I enjoy it and the information enters my brain smoothly. I do not have to memorize it because I understand it.
Question: 2 What do you think about science?	Science in my opinion is a subject that includes future jobs that I would love and would like to be employed in them in the future, and I would very much like to delve deeper into science or biology.
Question: 3 Describe anatomy?	What I understand and know for now is that it represents the brain, tongue, heart, lungs, stomach, small intestine, these organs. Haifa: Well, do you know that the digestive system consists of a stomach, a small intestine, etc.? (the objective is to measure the extent to which information is linked and if she knows the complete composition). Sarah: No, I don't know the composition completely and accurately, I just know the basic things (she meant the organs).
Question: 4 How do you find anatomy?	Anatomy is an interesting thing for me and contain new things to learn I do not feel it is difficult. There are people who feel that science is difficult,



	<p>but I feel it is easy and interesting, and I understand the information more than I memorize it.</p> <p>Haifa: So, you see that anatomy is....</p> <p>Sarah: Interesting.</p>
Question: 5 Which way/s do you think will make anatomy more enjoyable?	When they provide us with a model, clip or pictures of the human body and explain each organ and where it is located, this makes it easier to understand the information and does not make me bored from the lesson.
Question: 6 Have you ever used AR technology in education? If yes, how was it? If no, how do you think it will be?	(Haifa had to explain what AR is because Sarah did not understand it) No, I did not try it, but I feel like I want to, and I find it fun and interesting.
Question: 7 If there was an application that helps explaining anatomy, what will you think about that?	It would be a very wonderful thing and I would be excited to use the application, and if it sometimes costs me money, I will collect money and try to use this application. Haifa: Even if it requires that you buy a specific item for the application, will you buy the item? Sarah: Yes.
Question: 8 Would you use an application that helps to understand anatomy using 3D models and AR technique? why?	Of course, I will use it to gain information. Currently this semester in science I do not expect us to have a biology chapters, so now I need something that teaches me about biology, it will help me to understand and gather more information about biology for my future because I would like to enter a field like that.
Observations: Before starting the interview, Sarah thought that there were right and wrong answers, but as soon as the interview started, she discovered that the answers were based on her point of view and felt more comfortable while answering the questions. Sarah showed her love for science and how she enjoys it and anatomy and sees herself working in this field in the future. Her knowledge of anatomy was simple, but she was ready to learn more. She believes that interactive learning is important in the educational process and yields good results. Sarah has never tried augmented reality, but she is impressed with the idea of our application and willing to try it, even if it cost her money. The biggest motivation for her is that this semester she will not learn biology at school, so she needs other sources of learning.	



- Second interview

Interview Outline	
Interviewee name: Amira Age: 13	Interviewer: Amirah
Location/Medium: Interviewee's place	Date: 23/9/2022
Objectives:	Agenda: <ul style="list-style-type: none"> Introduction Topic 1: Question 1 Topic 2: Question 2 Topic 3: Question 3 Topic 4: Question 4 Topic 5: Question 5 Topic 6: Question 6 Topic 7: Question 7 Topic 8: Question 8 Closing
Questions	Answers
Question: 1 What is your favorite subject? Why?	Art because I love to draw.
Question: 2 What do you think about science?	Science is an interesting subject that also makes me think about the creation of living creatures and the sciences of matter.
Question: 3 Describe anatomy?	I think the anatomy is the ability to see the organs clearly.
Question: 4 How do you find anatomy?	I think it's an excellent science because it allows for a better understanding of the picture.
Question: 5 Which way/s do you think will make anatomy more enjoyable?	By competitions or activities.
Question: 6 Have you ever used AR technology in education? If yes, how was it? If no, how do you think it will be?	Yes, it was a great experience, and it became clear to me the shape of the body better.
Question: 7 If there was an application that helps explaining anatomy, what will you think about that?	It will be great.



Question: 8

Would you use an application that helps to understand anatomy using 3D models and AR technique? why?

Yes, because this will enhance the understanding in an entertaining way.

Observations:

love of learning and of exploring the details of living things. I noticed the person I interviewed knew about anatomy, and this impressed me, as well as her ideas. When I asked her about ways to make anatomy more interested, she said competitions and activities and impressed me that she had prior experience with the AR technology. At the end of the interview, I noticed that she would like to use an anatomy application that serves education and provides them with service and ease.



- Third interview

Interview Outline	
Interviewee name: Tariq Age: 15	Interviewer: Amira
Location/Medium: Interviewee's place	Date: 23/9/2022
Objectives:	Agenda: <ul style="list-style-type: none">IntroductionTopic 1: Question 1Topic 2: Question 2Topic 3: Question 3Topic 4: Question 4Topic 5: Question 5Topic 6: Question 6Topic 7: Question 7Topic 8: Question 8Closing
Questions	Answers
Question: 1 What is your favorite subject? Why?	My favorite subject is mathematics because I love it since childhood.
Question: 2 What do you think about science?	Wonderful and very beautiful.
Question: 3 Describe anatomy?	I don't know what anatomy is.
Question: 4 How do you find anatomy?	Hard science.
Question: 5 Which way/s do you think will make anatomy more enjoyable?	Putting anatomy into a game like reality for people to know.
Question: 6 Have you ever used AR technology in education? If yes, how was it? If no, how do you think it will be?	No, I think it would be cool to learn with augmented reality technology.
Question: 7 If there was an application that helps explaining anatomy, what will you think about that?	I think it will be a great and good app because by using the app you will learn more about anatomy.



Question: 8

Would you use an application that helps to understand anatomy using 3D models and AR technique? why?

Yes, because it helps me understand and visualize things.

Observations:

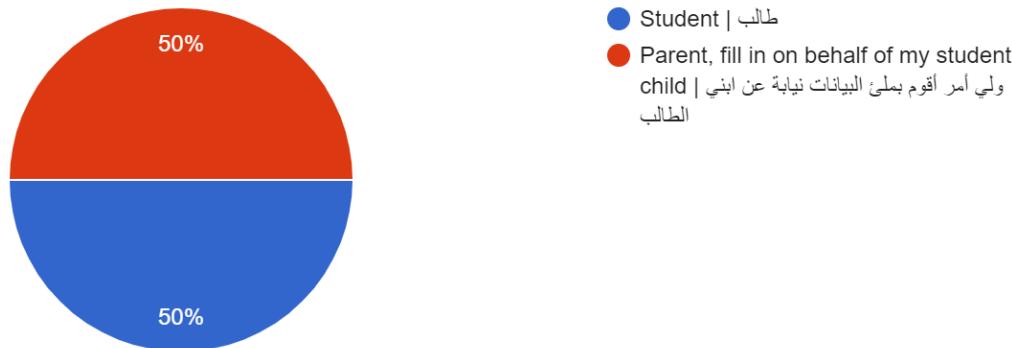
I noticed here that there are people who may not have a background in anatomy and they think that it is difficult to learn, and there are those who have never tried the AR technique, and at the end of the interview I discovered that they would like to use an application that provides the technique of AR and provides them with learning anatomy and visualizing that science in an easy and fun way.



Appendix B: Requirements Elicitation and Analysis Questionnaire

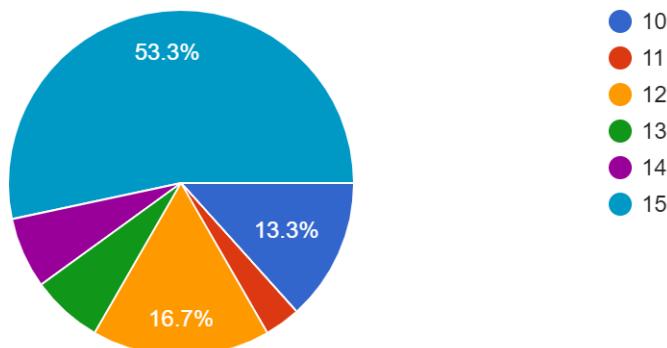
أنا | I am a

رداً 30



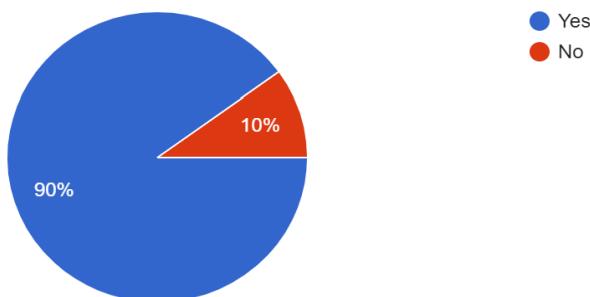
كم عمرك | ? How old are you

رداً 30



هل تحب العلوم؟ | ?Do you like science

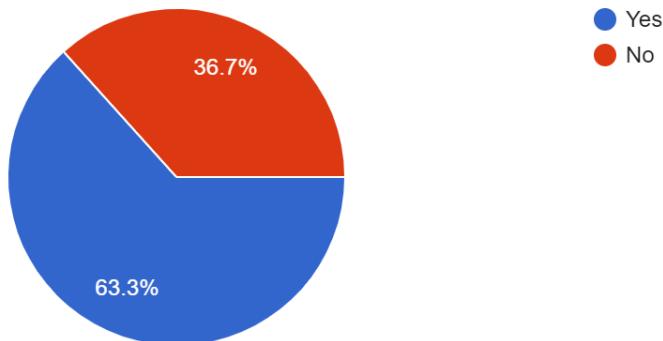
رداً 30





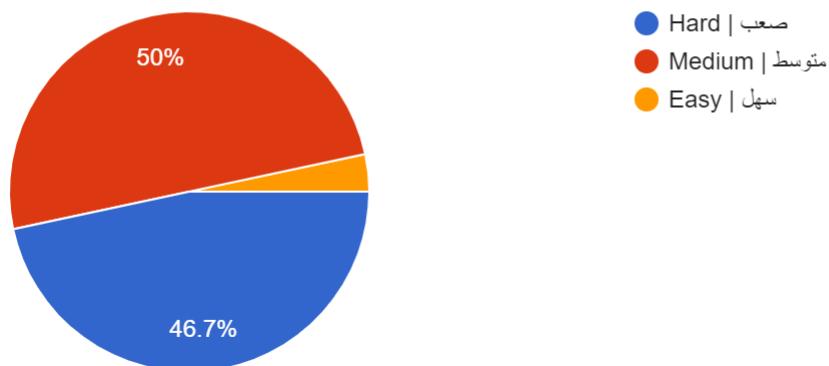
هل علم التشريح هو سبب اعجابك أو عدم اعجابك | Is anatomy the reason for like or unlike science
للعلوم؟

رداً 30



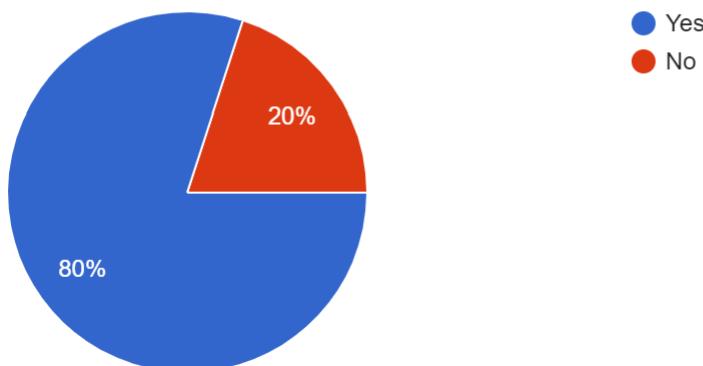
كيف تجد علم التشريح؟ | ?How do you find anatomy

رداً 30



هل تستمتع بتعلم علم التشريح؟ | ?Do you enjoy learning anatomy

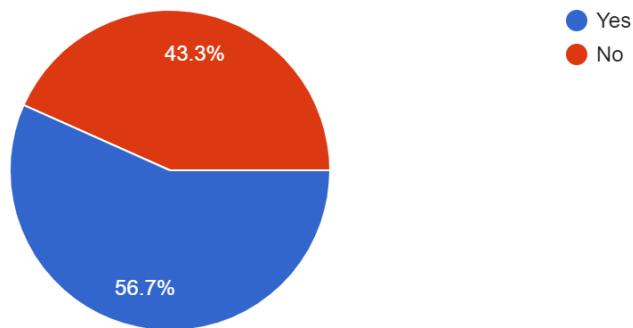
رداً 30





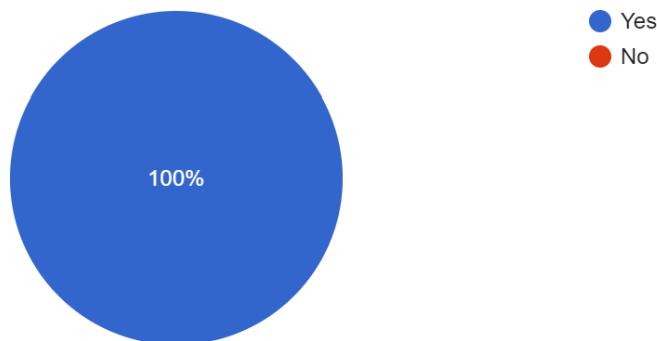
هل تستخدم التطبيقات التعليمية في المدرسة أثناء التعلم؟ | ?Do you use educational applications in school while learning

رداً 30



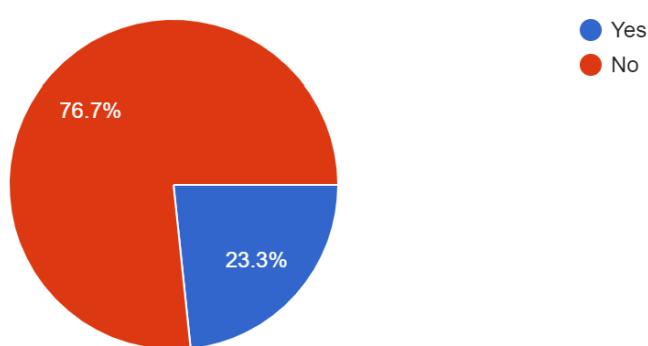
هل سيحدث فرق إذا كان تعلم علم التشريح عن طريق لعبة تعليمية؟ | ?Will it make a difference if learning anatomy was an educational game

رداً 30



إن كان نعم فما هو؟ | ?what is it | هل سبق لك استخدام تطبيق أو برنامج ساعدك في فهم علم التشريح؟

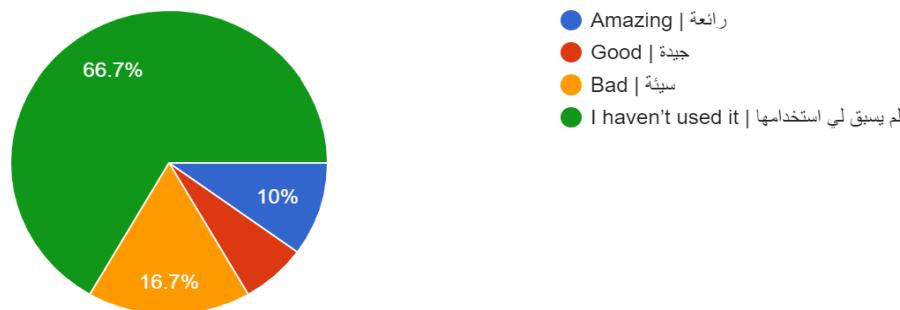
رداً 30





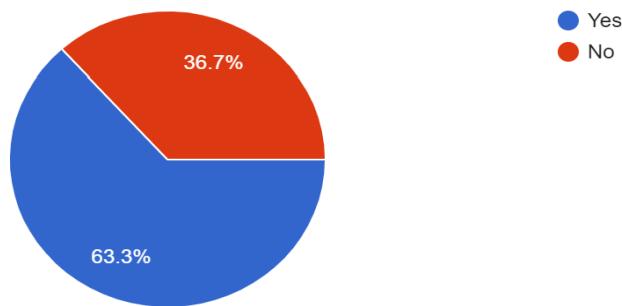
إذا سبق لك استخدام تقنية الواقع المعزز في التعليم ، فكيف كانت؟

30 ردًا



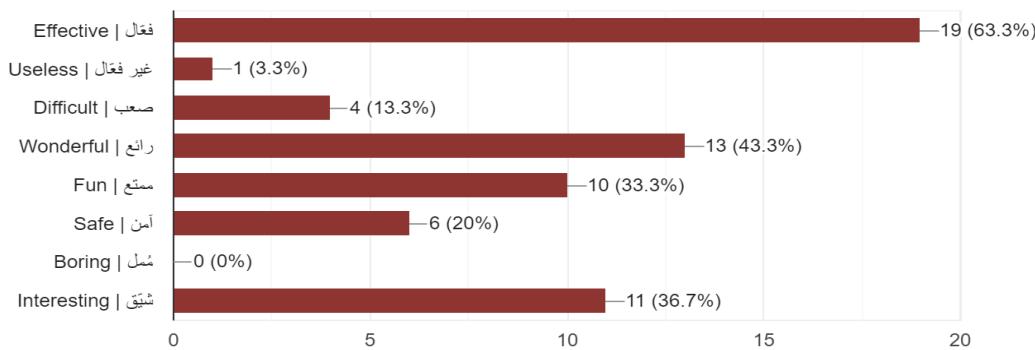
Would you use an application that helps to understand anatomy using 3D models and AR technique | هل ستستخدم تطبيقاً يساعد في فهم علم التشريح باستخدام نماذج ثلاثية الأبعاد وتقنية الواقع المعزز؟

30 ردًا



كيف ترى تعلم علم التشريح باستخدام النماذج ثلاثية الأبعاد وتقنية الواقع المعزز؟ | How do you see learning anatomy using 3D models and AR technology

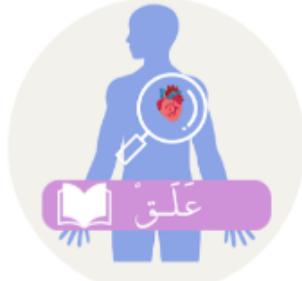
30 ردًا





Appendix C: UAT Questionnaire Form and results

- The questionnaire form:



علق

لا شك أن علم التتربيخ علم متبر وممتع ولكن من الصعب تطبيقه على ارض الواقع .
 تطبيق "علق" يهدف الى مساعدة المراهقين على تعلم علم التتربيخ من خلال استخدام نماذج 3D وتقنية الواقع المعزز ليخوضوا تجربة فريدة من نوعها تكون اقرب للواقع . 

فيما يلي بعض الأسئلة التي ستساعدنا في معرفة رأيك عن التطبيق . 

رأيك يهمنا !!


*مطلوب

كم عمرك ؟
 ? How old are you

10	<input type="radio"/>
11	<input type="radio"/>
12	<input type="radio"/>
13	<input type="radio"/>
14	<input type="radio"/>
15	<input type="radio"/>



علق | ALAQ

* جنسك ؟

? your gender

Male - ذكر -

female - أنثى -

* كان نظام التطبيق سهل و واضح ؟

Was the application system easy and clear?

Yes - نعم -

No - لا -

little bit - قليلاً -

* واجهتني مشكلة أثناء استخدام التطبيق ؟

? Did I encounter a problem while using the application

Yes - نعم -

No - لا -

little bit - قليلاً -



* استطيع التنقل داخل التطبيق بسهولة ؟

? Can I navigate within the application easily

Yes - نعم

No - لا

little bit - قليلاً

* عندما اقوم باختيار خاطئ ، استطيع التراجع ؟

? When I make a wrong choice, can I undo

Yes - نعم

No - لا

Neutral - محايد

* كانت الرسائل الارشادية لاستخدام التطبيق واضحة وسهلة الفهم ؟

The guiding messages for using the application were clear and easy to understand

Yes - نعم

No - لا

Neutral - محايد



* كان نظام التطبيق سريع الاستجابة ؟

?Was the application system responsive

نعم - Yes

لا - No

محيط - Neutral

* واجهات التطبيق مريحة ؟ - من ناحية الألوان و مواقع الأشياء -

- Convenient application interfaces? - In terms of colors and locations of things

نعم - Yes

لا - No

محيط - Neutral

* وجدت في التطبيق جميع الوظائف التي توقعتها منه ؟

?Did you find in the application all the functions that you expected from it

نعم - Yes

لا - No

محيط - Neutral



* أرحب في تجربة التطبيق بشكل دائم في كل مرة أريد تعلم التشريح؟ أو هل أريد تكرار التجربة مره أخرى؟

I want to try the app permanently every time I want to learn anatomy? Or do I want
?to repeat the experience again

Yes - نعم

No - لا

Neutral - محايد

محو التموزج

إرسال

لم يتم إنشاء هذا المحتوى ولا اعتماده من قبل Google. الإبلاغ عن إساءة الاستخدام - شروط الخدمة - سياسة الخصوصية

نماذج Google

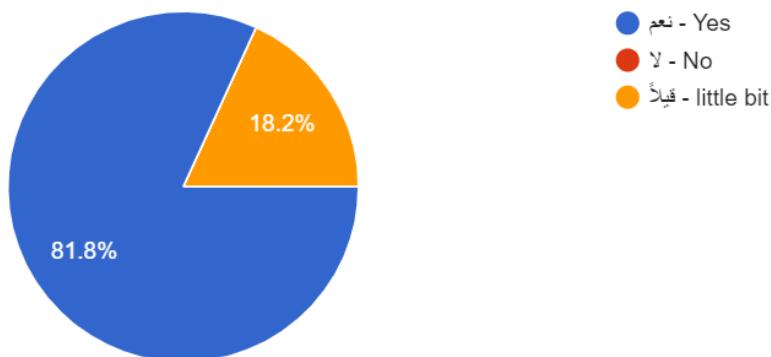


- The questionnaire result:

كان نظام التطبيق سهل و واضح ؟

Was the application system easy and clear?

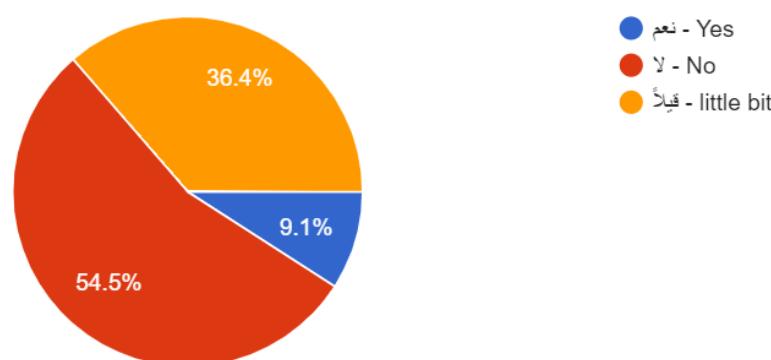
رداً 22



واجهتني مشكلة أثناء استخدام التطبيق ؟

? Did I encounter a problem while using the application

رداً 22



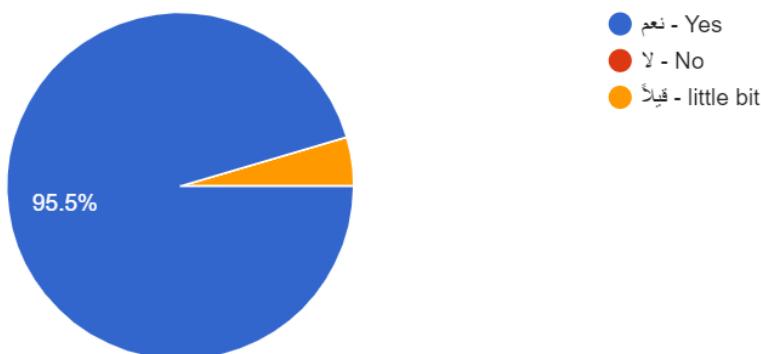


علق | ALAQ

استطيع التنقل داخل التطبيق بسهولة ؟

? Can I navigate within the application easily

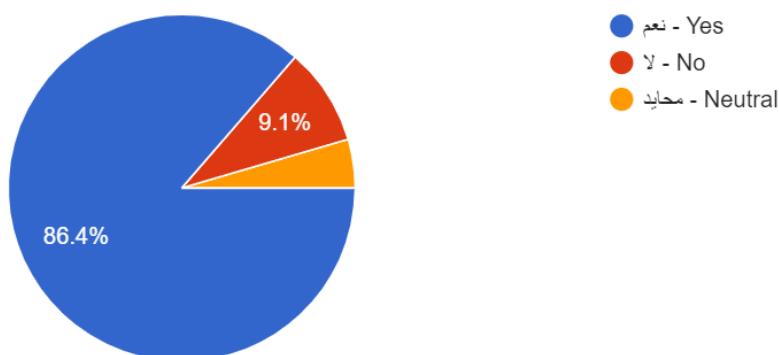
رداً 22



كان نظام التطبيق سريع الاستجابة ؟

? Was the application system responsive

رداً 22

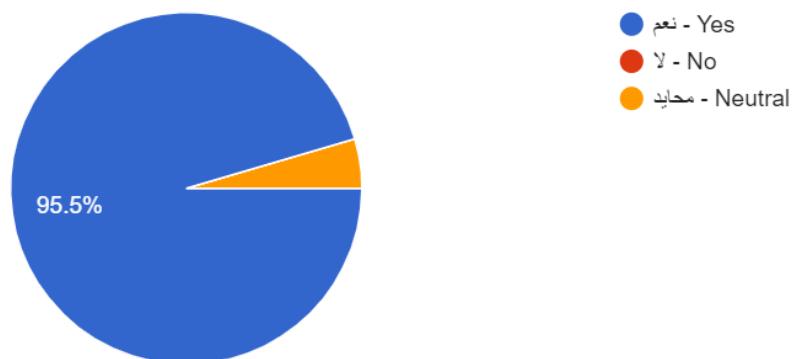




عندما اقوم باختيار خاطئ ، استطيع التراجع ؟

?When I make a wrong choice, can I undo

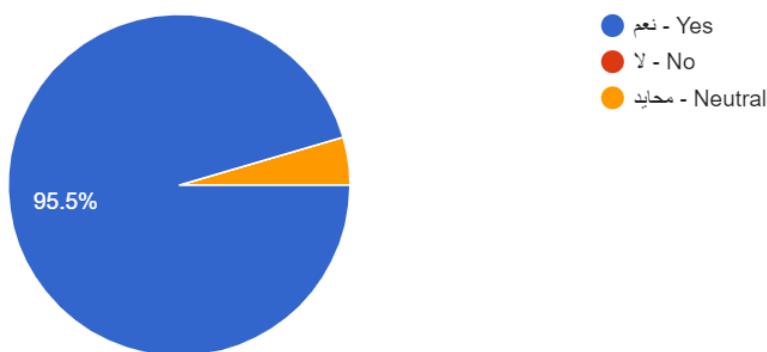
رداً 22



كانت الرسائل الارشادية لاستخدام التطبيق واضحة وسهلة الفهم ؟

.The guiding messages for using the application were clear and easy to understand

رداً 22

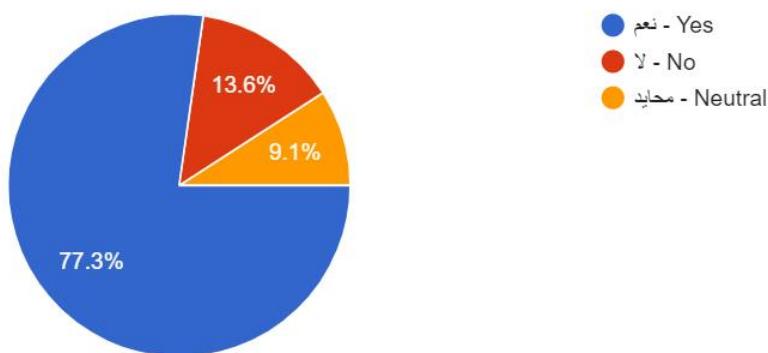




واجهات التطبيق مريحة؟ - من ناحية الألوان و مواقع الاشياء-

- Convenient application interfaces? - In terms of colors and locations of things

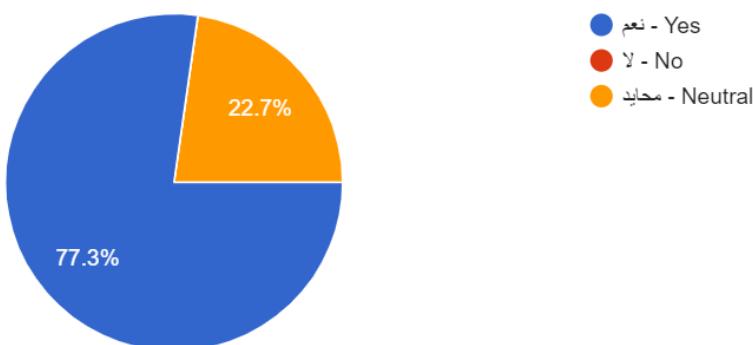
رداً 22



ووجدت في التطبيق جميع الوظائف التي توقعتها منه؟

?Did you find in the application all the functions that you expected from it

رداً 22

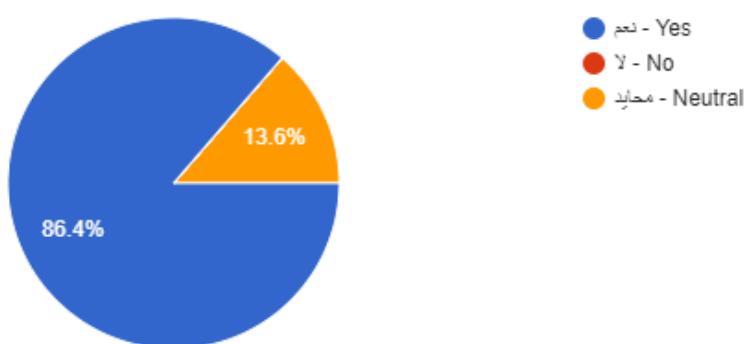




أرعب في تجربة التطبيق بشكل دائم في كل مرة أريد تعلم التشريح؟ أو هل أريد تكرار التجربة مره أخرى؟

I want to try the app permanently every time I want to learn anatomy? Or do I want to
repeat the experience again

رد 22





Appendix D: UAT Interview Form and answers

Questions		
س2/ ما هو اكثـر شيء اعـجبك في التطبيق؟ Q2\ What do you like most about the app?		س1/ ما هي رـدة فعلك اتجاه التطبيق؟ هل تـمنى اضـافة أو تعـديل شيء فيه؟ Q1\ What is your reaction to the application? Do you wish to add or modify something in it?
Answers		
ج2/ اني اقدر اجرـب الاشيـاء كـأنـها حـقيقـة	ج1/ التطبيق حـلو مـره وزـين، اـيه اـتـمنـى انـكـمـ تـضـيفـونـ باـقـيـ أـعـضـاءـ الـجـسـمـ عـشـانـ اـسـتـقـيدـ لـانـ لـماـ اـدـرـسـ بـالـكـتابـ غـيرـ لـماـ اـجـربـ بـتـطـبـيقـكـمـ	تميم الزيد
ج2/ الصـراـحةـ الـوـانـهـ كـيوـتـ وـ صـفـحةـ الـعـضـوـ تـحـسـينـهـاـ مـودـرـنـ مـرـةـ	ج1/ انـممـ عـادـيـ يـعـنيـ تـوقـعـتـ مـنـهـ اـنهـ يـكـونـ فـيـهـ حـرـكـاتـ وـ كـذـاـ لـكـنـ مـقـبـولـ ،ـ التـايـمـرـ بـالـكـويـزـ شـوـيـ طـوـيلـ الـوقـتـ اـحـسـ الـكـلـ بـيـاـخـدـ رـاحـتـهـ ،ـ الـهـيـنـتـ لـوـ اـنـكـمـ حـاطـيـنـ اـشـيـاءـ حـامـسـةـ اـكـثـرـ +ـ حـطـوهـ عـرـبـيـ	رواء العريفي
ج2/ اكـثـرـ شـيـءـ اـعـجـبـنـيـ حـقـ الكـامـيراـ اليـ طـلـعـ اليـ دـاخـلـ الـجـسـمـ وـ أـقـدـمـ اـتـمـشـيـ فـيـهـ اـشـوـفـهـ مـرـهـ اـعـجـبـنـيـ اوـلـ مـرـهـ اـجـربـ شـيـءـ زـيـ كـذـاـ.	ج1/ اـعـجـبـنـيـ التـطـبـيقـ مـرـهـ يـعـنيـ شـيـءـ جـديـدـ وـ فـيـهـ حـرـكـاتـ اـيـشـ الـحـرـكـاتـ؟ـ لـماـ اـنـتـقـلـ بـيـنـ التـطـبـيقـ وـ كـذـاـ،ـ لـاـ مـافـيـهـ شـيـءـ اـبـيـ اـضـيفـ	ميس المـدـالـلـ
ج2/ اكـثـرـ شـيـءـ حـقـ الـARـ اليـ يـطـلـعـ لـيـ جـسـمـ الـاـنـسـانـ قـدـاميـ مـرـهـ اـعـجـبـنـيـ.	ج1/ حـلوـ مـاـ شـاءـ اللـهـ شـوـفـيـ هـوـ حـلوـ بـسـ الـصـراـحةـ بـسـ الـاـلوـانـ مـاـ عـجـبـتـيـ مـاـ حـبـيـتـهـ مـرـةـ.	فاطمة
ج2/ المـعـلـومـاتـ الـلـيـ فـيـهـ حـلـوةـ وـ ظـرـيفـةـ كـانـ فـيـهـ حـاجـاتـ حـلـوةـ بـصـراـحةـ فـيـ الـinforـmationـ الـلـيـ بـتـكـونـ فـاـخـرـ سـلـاـيدـ حـلـوةـ.	ج1/ تـوقـعـتـ اـكـثـرـ مـنـ كـداـ،ـ لـكـنـ مـجـمـلاـ مـشـ وـحـشـ ..ـ الـحـاجـاتـ الـلـيـ عـاـلـيـزـ اـعـدـ عـلـيـهـ هـيـ الـكـويـزـ بـصـراـحةـ يـعـنيـ تـحـسـيـهـ اـتـعـملـ عـلـىـ اـسـتـعـجـالـ وـ الـلـغـةـ لـوـ عـرـبـيـ هـنـكـونـ اـسـهـلـ بـصـراـحةـ.	زياد عبدالحي
ج2/ اكـثـرـ شـيـءـ اـعـجـبـنـيـ الـكـويـزـ فـيـهـ مـسـاعـدـاتـ ذـيـكـ الـيـ فـوـقـ اـحـسـهـ تـحـمـسـ.	ج1/ حـلوـ ،ـ لـكـنـ لـوـ تـضـيفـونـ كـويـزـاتـ اـكـثـرـ.ـ قـصـدـ نـصـيـفـ أـجـهـزةـ جـسـمـ اـكـثـرـ ،ـ وـ لـاـ نـفـسـ الـجـهاـزـ يـكـونـ فـيـهـ اـكـثـرـ مـنـ كـويـزـ؟ـ كـلـهـ مـدـريـ ،ـ مـمـكـنـ تـضـيفـونـ لـكـلـ درـسـ كـويـزـ مـدـريـ الـيـ تـشـوـفـونـهـ بـسـ الـزـيـدـهـ تـكـثـرـونـ مـنـ الـكـويـزـاتـ موـ بـسـ خـمـسـهـ.	شيخة
ج2/ انهـ وـاقـعـيـ وـمـرـنـ يـعـنيـ اـقـدـمـ اـشـوـفـ القـلـبـ مـنـ كـلـ الجـهـاتـ وـاقـرـبـ وـابـعـ يـعـنيـ اـحـسـهـ مـفـيدـ وـكـذـاـ.	ج1/ حـلوـ تـطـبـيقـكـ يـفـيدـ بـمـادـةـ الـعـلـومـ كـثـيرـ،ـ يـمـكـنـ تـضـيفـونـ اـعـضـاءـ اـكـثـرـ اوـ خـيـارـ مـشـارـكـةـ يـصـيرـ زـيـ الـاـخـتـبـارـ وـنـرـسـلـ الـاـجـابـةـ لـلـاـسـتـاذـ.	عبدالله



ج 2/ زي ما قلت لك ذاك حق الفلاتر ، اي الـ AR هو أكثر شيء اعجبي.	ج 1/ ممتاز خصوصاً ذاك الي يطلع لي الى داخل الجسم مررره حلو زي فلاتر السناب لا مافيه شيء ابี้ اغیره.	سلمى
ج 2/ سهولة وتبسيط التعليم للمستخدم بصور وواقع معزز.	ج 1/ احسه كوييس ، وأشاره لبداية مستقبل مليء بالتقنية وتسهيل الحياة . تدعيم اللغات ، اضافة فيديوهات عن شرح وظيفة هذا العضو مع بعض صفاتة.	محمد
ج 2/ احلى شيء الي اقدر اشوف فيه صديقاتي الموجود باول ما ادخل التطبيق وashوف كم جمعوا نقاط وكذا.	ج 1/ حلو ، ودي اضيف اني اقدر اتواصل مع الناس الثانية كيف تتوصلون؟ يعني زي مثلا تعليقات الناس بالانسقراام ولا كذا يكون فيه زي تواصل ، مثلا اقول انا خلصت هذا الجهاز وتراه مره سهل وممتع او مثلا يغششون إجابات الكوبيز.	سارة العنقرى
ج 2/ لطيف و سريع رغم انه يعتمد على سرعة النت لكن مازال حلو يعني.	ج 1/ التطبيق كوييس عموما يعني بما انه اول اصدار ، بالنسبة للتعديلات ف الكوبيز شوية تحتاج كدا حركات غير كدا حلو.	عمر آدم
ج 2/ اكثر شيء اعجبي الزر الي يغير ألوان التطبيق مررره حبيته	ج 1/ سهل و واضح ما اقدر احسوس فيه كل شيء قدامي يعني سهل ما اضيع فيه ، لا ممتاز	سارة الخنيني
ج 2/ اعجبني ان اعضاء الانسان نقدر نشووفها بوضوح وبجوده عاليه واقدر واصغر اكابر وادخل داخل مررره حلو.	اج 1/كثر شيء اعجبني بتطبيق انه مفید وما في زيه كثير اول مره اشوف تطبيق مفید وممتع بنفس الوقت ، لا حلو.	رنا
ج 2/ اعجبني الى اقدر اشوف جسم الانسان الـ AR .	ج 1/ الصراحة كان التطبيق جميل و مميز و أيدكم على فكرتم الرهيبه ، ابى التطبيق يكون عربي.	الياس
ج 2/ الوانه حلوة و الـ nav bar ظريف.	ج 1/ اضافة خاصية انك لما تحط الـ AR على جسم واحد يطلع المجسم عليه بدل ما يكون في الهواء و يكون في تنافس في التطبيق يعني بدل ما هو تعليمي فقط.	محمد
ج 2/ حلو و سريع.	ج 1/ لو انه بالعربي هيكون احسن و الكوبيز لو وقته اقل هيكون حماس شوية.	أحمد
ج 2/ اكتر شيء اعجبني انه فيه احد يقرأ الكلام وانا اقرج على الشكل بس لو انه يكون بالعربي علشان نفهم يعني.	ج 1/ زين ما عليه حلو ، ايه ان يكون فيه عربي يعني اغير اللغة للعربي .	روان
ج 2/ مريح للعين و المهم بيديج بتاعتة ظريفة إلى حد ما.	ج 1/ حلو حبيته يحتاج شوية تعديلات على الاداء لانه يدخل الي الجهاز سخن لكن عموما حلو احس لو اشتغلتوا عليه اكتر و حطيتوا فيتشرز اكتر هيبي احسن.	عبد الرحمن آدم



طارق العريني	ج 1/ عادي مهوب ذاك الزود يعني لكن بما انه اول تطبيق وكذا يعني فيعتبر حلو.	ج 2/ فكرته حلوة و التصميم بعد اعجبني الصراحة.
عبدالملك	ج 1/ تطبيق جيد ورائع. يمكن اضافة خيار انا اكتب الاسئلة واختبر نفسي فيها لما انتهي من الدراسة.	ج 2/ الواقعية.
العنود التميمي	ج 1/ الدارك مود يخوف لما اسوی لوق اوت لكن غير كذا مرة كيوت و آه لما قلت AR فكرت اني بحط الكاميرا على اخوي و بعدين هو يطلع لي امكان الاعضاء عليه يعني ما توقعته يكون كذا .. بس عادي يعني يمكن ف الاصدارات الاخرى يعني بما انه ما كان عندكم وقت.	ج 2/ الوانه لطيفة مريحة كذا و تعطيك انطباع انك منتب داخل عشان تدرس.
سارة العمر	ج 1/ حلو التطبيق وممتع مره، ماعندي شي اضيفه كل شي زين.	ج 2/ كأنه حقيقي بالصدق ، يارب اصير طبيبة واستخدم التطبيق كثير.