

Learn4Fun – An Android based Application

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering.

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APPROVAL

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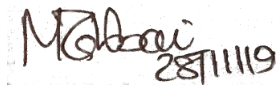
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DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Masud Rabbani, Lecturer, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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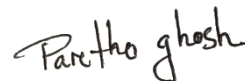
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ABSTRACT

Learn4Fun is an android based application which uses AR (Augmented Reality) to help the children learn things. This whole project aims to focus on children. They do not want to learn or study. Children does not just want to learn, they look for newer things. They are more curious than a teenager or a fully grown human being. But the education level of our country is quite monotonous and boring. This is where our project comes in. We are focusing on the children's curiosity and interest. Learn4Fun helps to make the learning process more easy and interesting. Our application overlays 3D object in real world. It mainly uses the mobiles motion sensors like gyroscope and camera. The user can still see the real world through his/her mobile camera but with the 3D objects and sound. The 3D objects and sound make the whole learning process more interesting. Our application, Learn4Fun uses Unity3d Engine and C# scripts for the integration of AR. Children's will easily be able to operate our app and learn things in a more curious and interesting way.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Augmented reality is still a new concept to people from our country. Ours is a developing country. We are still not very acquainted with new technology. People is also afraid to use these new technology because they do not know how these technologies works. But in recent years people are more interested to use new technology. Hardware components for augmented reality are: a processor, display, sensors and input devices. Modern mobile computing devices like smartphones and tablet computers contain these elements, which often include a camera and Microelectromechanical systems (MEMS) sensors such as an accelerometer, GPS, and solid state compass, making them suitable AR platforms. This makes a proper opportunity for developers to introduce new technology to common people. Children's are more curious to use newer technology. Augmented reality is a cool technology which overlays virtual 3D object into our real world. This makes a nice and easy way to teach the kids without even trying too hard. Children's will always go for something new, something curious, something easier and something interesting. Our application, "Learn4Fun" does this thing interestingly for kids.

1.2 Motivation

Children's do everything but when it is time to study they do not like to learn because it is harder to learn something for kids intentionally. Kids hold on to the smartphone every minute of the day. They are not learning useful things. Every game they play on the smartphone is teaching them less useful things. It is getting harder for parents to get the smartphone from their hands. Parents want their kids to learn something besides playing game on smartphone. Every parent faces these problems on a daily basis. Our application takes this problem into account and turns it into something better. Kids will not just play this application but will also learn something better on the other hand. Everything the kids do on our application will make learn things in a more interesting way. It is always harder

to do something in the same way every day. When the game “Talking Tom” first released, it mesmerized kids with awe and wonder. From this game we can say that children always welcomes something new, something interesting. This is what we exactly want to do. We want to teach the future of our country by doing something new and interesting for them which breaks the monotonous way of teaching. Which is exactly what our apps will do for children.

1.3 Rationale of the Study

We are doing this because we know how childhood can affect a person’s life. Learning is important to do something better in life. Everyone has a different kind of skills which helps them to succeed in life. We are very vulnerable in our childhood both mentally and physically. So learning is very important. Our applications target audience is kids. Our application helps kids learn in a different and unique way. They are learning by seeing which is a hundred time better than hearing. Our application tricks kids into learning. Besides augmented reality will make the learning process seem way more cool and interesting. The app tries to bring the kids imagination to a reality.

1.4 Research Questions

Research questions are what we face from the start of the project to the end of the project. This is a very important steps during the period of our project. Basically this is a questionnaire of what we faced during this period.

1. First question was what is the kind of project we are doing? Is it a project based on research or a development project?
2. Which platform should we choose for our application? Is it windows based or android based?
3. Which IDE (Integrated Development Environment) should we choose? Should we choose Android Studio IDE or Unity3D Engine?
4. Which IDE will better support with our respected computers? Which will be better calibrated to our computer devices?
5. Which programming language should we choose to develop the application? Should we choose Java for Android Studio or C# for Unity3D Engine?

6. Which AR Kit should we choose? Should we choose ARCore or Vuforia Engine?
7. What else do we need for our project? Is it 3D objects? Is it a better webcam?
8. Can we make the 3D objects ourselves or do we need to buy the 3D objects? If we are not able to buy then can we download the free 3D objects?
9. How do we choose the 3D objects and which files will be compatible to our preferred IDE? Is it .obj or .3ds or .max?
10. How do we build the project?

1.5 Expected Outcome

1. Easy and nice user interface.
2. Kids will be able to operate the application easily.
3. Better visual expressions of learning things.
4. When the kids press the words, they will see a 3D object in real-time.
5. Kids will also be able to move on to the next word without going back to the word page.
6. The whole AR experience will help the kids to learn things easily.

1.6 Report Layout

Chapter 1, Introduction; Here we talked about the introduction of our application. Also the motivation and the rationale behind the project with expected outcomes.

Chapter 2, Literature review; Here we discussed about Related works in this field, research summary and the scope of the project and also the problems we faced doing this work.

Chapter 3, Requirement Specifications; Here we talked about the requirement specifications for the application such as requirement analysis and functional needs in this application.

Chapter 4, Design Specification; Here, the necessary frontend and backend designs were developed.

Chapter 5, Implementation and Testing; How we implemented different objects and the testing process of our application.

Chapter 6, Conclusion and Future Scope; We talked about the limitations of our application and the future scope of this application.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Reality is the environment around us. There are two main reality. They are real life reality and the computer generated reality. We already know about the real world reality. So, we do not need to talk about that. The computer generated reality is divided into three parts and they are VR or virtual reality, AR or augmented reality and MR or mixed reality. VR immerses users in a completely digital world. In simple words, a completely digital or 3D world is created for users. AR overlays virtual or 3D objects on the real world environment. Users can see the 3D objects using the camera of their smartphone. They can just see the virtual objects but can not interact with them. Mixed reality is the result of both VR and AR working side by side. Mixed reality does not just overlays 3D objects but also anchors them to the real world. In this reality, users can also interact with the virtual objects. Some might even say that mixed reality is an advanced form of augmented reality. Big companies like Microsoft is working with mixed reality. Augmented reality uses the devices camera and motion sensors to overlay the virtual objects to the real world. The smartphone's gyroscope is very important for this to work. Because the gyroscope continuously keeps calculating the distance, angular velocity, rotation of the objects from the smartphone.

2.2 Related Work

AR, VR and MR are the next big things in the future of our world. AR was first demonstrated in the 1960s, but it was not easy then to work with AR. It required powerful computing energy and a bulky head mounted display (HMDs). The first experiments was conducted in the late 1990s, where geo-referenced content was introduced to AR applications.

1. The Touring Machine was the first mobile outdoor application which was used as a campus outdoor tourguide. Which showed virtual annotations on real university buldings by Feiner S.[1].
2. Apple is working on a project codenamed T288 which will release in 2020. Apple is working on headset which will be capable of running both AR and VR

- technology. Basically the headset will connect to a dedicated box using a high-speed, short-range wireless technology. This box will be powered by Apple's own custom chips. It will also act as the brain of the headset. And it will be super portable[2].
3. Microsoft already launched a product named HoloLens in 2015 which was priced at 3035.52 dollars. The next generation of the HoloLens 2 will also cost more. The price starts at 3500 dollars per device. Preorder is going on now. Users will be able to interact with the virtual objects using the new and improved version of HoloLens [3].
 4. Niantic launched the game Pokémon GO in 2016 which started all the hype about augmented reality. This game brought AR to the mainstream and it also remains the most successful AR game ever made[4]. Niantic partnered with Warner Bros. in late 2017 to bring out another cult title Harry Potter: Wizards Unite which will be released later this year[5].
 5. Safran is a high-tech industrial key player in the propulsion and aerospace equipment, space and defence sectors. Safran has developed a new augmented reality technique to improve servicing of aircraft wiring. Now on offer to airlines, this innovative technique considerably reduces the time planes must be grounded for maintenance [6].
 6. Hyundai Motor Group and WayRay AG has introduced the world's first Holographic Augmented Reality Navigation System at CES 2019. It was equipped on a car named Genesis G80. The biggest advantage of this technology built into the vehicle is that the stereoscopic image is displayed on the actual road and appropriately adjusted in accordance with the specific viewing angle of the driver, thereby delivering accurate driving guidance. The driver can enjoy vivid and precise holographic images without wearing a headset. The direction of movement is kept precise through the vehicle speed in real-time and projecting navigational alerts through the windshield onto the road allows drivers to navigate safely while looking ahead undistracted [7].
 7. Argon4 is an AR web browser. Argon4 is very much similar to a normal web browser that allows multiple pages to be loaded into different tabs but it handles

- the case of multiple AR apps in a special way. It can show augmented reality contents [8].
8. AR GPS Drive/Walk Navigation is a smartphone app that uses smartphone's GPS and camera to implement an augmented reality-powered car navigation system. It is easier and safer than the traditional navigation system for driver. While using this system, the driver do not need to map the path and the road. The driver can watch the realtime camera preview navigation screen to get driving condition without impacting driving safety [9].
 9. 10 Minute School is working on a new AR application. This application will show 3D or virtual objects along with learning videos when the camera sees the image from the text book. This application will use image recognition to recognize a target image and then show the resulting 3D object. The application has not been launched yet. It is still on the work [10].

There has been a lot of development in the field of AR. Although our country does not have many big scale AR projects but we have to remember that it is still a new concept to us. There has been many seminars on VR, AR and MR to inspire people to work with them. People are excited to work with new technologies and invent new, easier way to utilise these newer technologies.

2.3 Research Summary

Our application is all about paving way to the development of AR technology to the mainstream media of our country. We intend to help kids learn things easily and in a new technological way. There are two main ways to use augmented reality in applications. They are being marker which uses a target image to show 3D objects and the other is markerless which does not require a image target to show 3D objects. We used markerless augmented reality in our application. Our application can show virtual objects which will help kids process information a lot faster. They will be able to learn faster. Our application does not use image target as it is a markerless application. Our application uses the users smartphone's camera, processor, display and sensors like accelerometer, gyroscope, GPS and solid state compass. We also used C# scripts for the application. We used Unity3D

Engine to build our app because it is very compatible with the building of AR, VR applications. The user first goes into the lessons section on the app and then chooses English from there, it then takes the user to a different page. There the user presses different key buttons and it takes them to a new page where the user can see and experience 3D virtual objects and sounds to learn the words thoroughly.

2.4 Scope of the Project

Scope of the project means what we are going to cover in this project. They are

1. Importance of augmented reality apps development
2. Using Unity3D Engine
3. Using 3D virtual objects
4. Using C# scripts to use the smartphone's camera

2.5 Challenges

We learnt many challenges while completeing this application. They are

1. Finding better compatible IDE
2. Using Unity3D Engine
3. Building 3D virtual objects
4. Downloading free 3D virtual objects
5. Writing C# scripts
6. Moving the objects
7. Using sounds
8. Using the smartphone's gyroscope
9. Using the smartphone's camera to show the 3D virtual objects

CHAPTER 3

REQUIREMENT SPECIFICATIONS

3.1 Business Process Model

BPM or Business Process Modeling is the mobility of illustrating systems of an industry. This is done in Business Process Management and in Systems Engineering. Business Process Modeling is done to analyze, improve and automate the current or ongoing activity of an industry. Business analysts usually does the work of Business Process Modeling in an industry. Sometimes there is a team instead of a single person who does this job. They are highly sophisticated, educated persons. This modeling is done by retrieving event logs from events. This is retrieved by using a data mining tool named process mining. The merchandising purpose is often to increase activity speed or reduce cycle time; to increase efficiency; or to reduce price, such as labour, materials, scrap, or capital costs. In practice, a management decision to invest in business process modeling is often motivated by the need to document requirements for an information technology project[11]. The word business process model is used in a very similar way by software developers. This model's only purpose is to showcase core facets of including objectives, structures, operational activities and policies. This processing is done by creating a diagram. This diagram is known as Flow diagram or Data Flow Diagram. We are creating this diagram to showcase our applications data flow.

A Data Flow Diagram or DFD showcases which data passes from where. In an application, data passes from multiple sources to multiple branches. Software developers uses this diagram to show the flow of information from one branch to another branch in their application. This diagram's main purpose is to show how the data or information will advance through the application system. It also shows the placement of data, meaning the place where data will store. This diagram does not shows the systems process timing, or how the activities will work throughout the system. Every application is unique this is why everyone's DFD diagram is different.

In Figure 3.1, we can see our applications Data Flow Diagram. It explicitly describes our systems flowing of information.

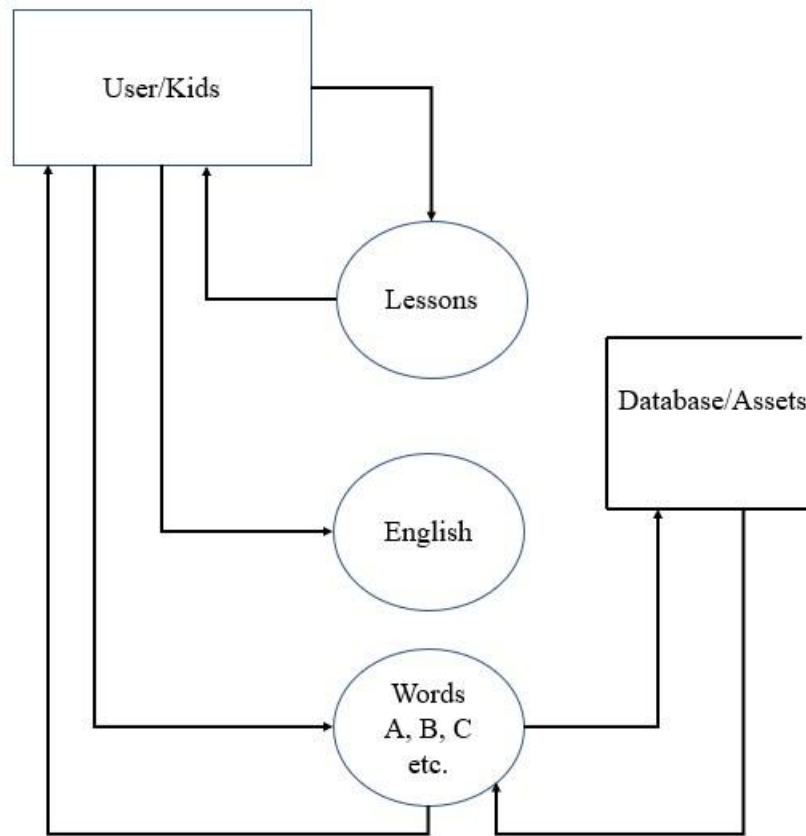


Figure 3.1: Data Flow Diagram of Learn4Fun

The individuals can go through Lessons, English and Words. The Words pulls the database or the assets. In return the Words gives the output or the result back to the users through the smartphone's camera. The 3D virtual objects are in the Database or Assets folder.

3.2 Requirement Analysis

In systems engineering and software engineering, requirements analysis focuses on the tasks that determine the needs or conditions to meet the new or altered product or project, taking account of the possibly conflicting requirements of the various stakeholders, analyzing, documenting, validating and managing software or system requirements.

Requirements analysis is critical to the success or failure of a systems or software project. The requirements should be documented, actionable, measurable, testable, traceable, related to identified business needs or opportunities, and defined to a level of detail sufficient for system design [12]. In application or software development collections of requirement is very important. Also the analysis of these collections of requirement is very crucial part of development. Requirements is divided into two parts. These two parts are Functional Requirements and Non-functional Requirements. A software or an application can perform cartain actions which are known as Functional Requirement. Sometimes an application behaves in a certain way or the application has a pesonality, like how much efficiency, performance issues the application has and many more which is known as Non-functional Requirement.

3.3 Functional Requirement

Functional Requirement defines a function of a system in Software engineering, where a function is described as a specification of behavior between outputs and inputs. Functional requirements may involve calculations, technical details, data manipulation and processing, and other specific functionality that define what a system is supposed to accomplish [13]. Softwares can perform or has some actions that the can perform are related to technical functions of an applications system. In our application's system, there are some necessary requirements. These requirements are like maintaining database. These requirements also go by Functional Requirement. There is some build in functions in the application.

3.4 Non-functional Requirement

There are some requirements that specifies certain criterias in an applications system which could be used in certain times, rather than certain treatments such as how much efficient our application is, user friendliness of our application, execution issue of the software etc. In our application's system, it has many functional requirements such as more efficiency, relevanance, optimizing performance, consumption of memory and smooth operations, load quickly. It also has the acceleration and rotation of the 3D virtual objects which makes the AR experience of our application really nice.

3.5 Use Case

A use case is a possible list of certain actions that can be done in an applications system in Software and Systems Engineering. Use case also defines the relationship between an actor and the processes of an application. It is also known as UML or Unified Modeling Diagram. Users, external systems, humans are known as actors here. Use case is often portraided as the collection of missions or goals of stakeholders in software and systems engineering [14]. Software developers uses use case to better understand the level and the interactions of the application.

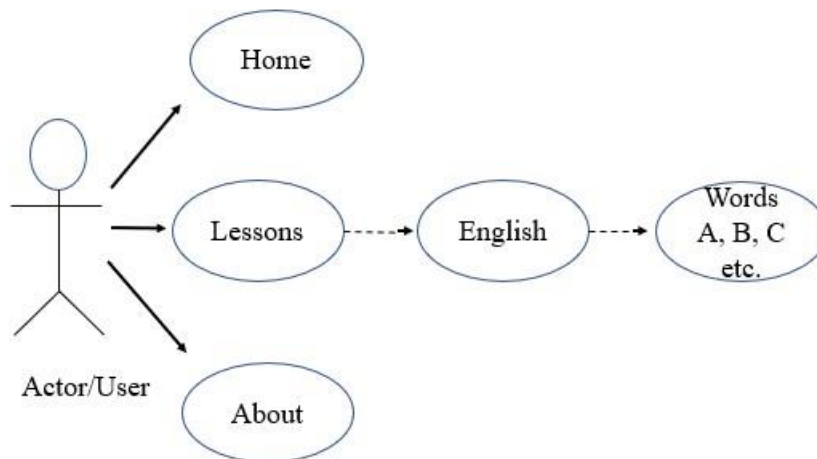


Figure 3.2: Use-case modeling of Learn4Fun.

In figure 3.2 we can see the interaction between the actor and the part of the systems. Home, Lessons, About, English, Words are all part of the systems. And they all are interacting with each other.

3.6 Logical Data Model

There are always a structure of a collection of information. This is called Logical Data Model. They are most typically used in business processes. They seek to capture important

things in an industry. They also show the relationship between these important things. This is a model which showcases certain actions of a certain database. They can also show the structures of information capacity innovation. This is always done mainly for an industry. But the logical data model can also be used in software to show the information structure of Database. For example, the files associated with words. The 3D files are the assets or the database of this application.

3.7 Design Requirements

Design requirements are the functional attributes that enable the team to convert ideas into design features. Our application has such design requirements and they are

1. In our application, we have not used any authentication protocol because it is a public application.
2. Made the application android based because most people of our country uses android powered smartphones
3. We decided to provide simple and easier user interface.
4. We kept the system less complicated
5. We provided as much 3D virtual objects as possible
6. We tried to keep the application more intuitive
7. We provided sounds and animations with the 3D virtual objects

Our target audience is children. We made this application for them. So, we as a team decided to keep it simple and easy so that the kids can easily operate this application.

CHAPTER 4

DESIGN SPECIFICATION

4.1 Front-end Design

Frontend designs resides in an in between world of pixels, world of logic. A frontend designer (who may also go by UI developer, client-side developer, UI engineer, design engineer, frontend architect, designer/developer, prototyper, unicorn, or Bo Jackson) lives in a sort of purgatory between worlds of software developing. A front-end designer just designs the user interface of the application [15]. But it differs from person to person. Sometimes the person who creates the user interface is also the person who creates the whole application. It is suffice to say that a nice, clean and easy user interface is a major part of the creation of the application. Because if the user interface is not beautiful then the customers or the users will not like it. Our application has some nice and easy user interface. Nice and easy user interface is always good for customers to understand. If a software developer makes a nice and easy user interface then he or she will be able to captivate their customers mind and heart. If a customer sees an application which by the way does not have any moderate and nice user interface then the customers will think that the application was made by some amateur and toddler like software engineer. Which is not a great expectation for a software engineer. Software engineers are like magicians. They help people in their daily lives by making their work easier by using technology. They also tend to expect customers to like their works. Who does not want people to like them. But as a beginner, a lot of software engineers tend to not look at the user interface design and just work on the problem they are trying to solve. They do not give much attention to the user interface design because they think they do not need to worry about UI designs. They need to change their attitude and also make the user interface design much more clean and easier for customers to understand.

The front-end design of our application was done as simple as it could be. Because our target audience are kids, we tried to keep the user interface as simple as we could. We did not want to make the front-end design more complicated.

In Figure 4.1, We can see the first scene of our application. Whenever the user starts the application they will see this scene. We tried to keep our application nice, easy and clean to understand for kids as they were the target audience for our application.



Figure 4.1: A Screenshot of the first page of Learn4Fun

When the user starts the app, he or she will see this page first. Individuals will always see this page after they initiate this application. As we talked earlier about the necessities of keeping the user interface easy and clean for target audience to understand. This is an example for that process. This user interface is clean and easier to understand. This scene shows the logo of our application to customers and they will be able to understand the application better.

In Figure 4.2, Individual customers will see this scene of our application and they will know what is going on with the application. Users usually needs not conflicting or complicated user interface to understand the application.

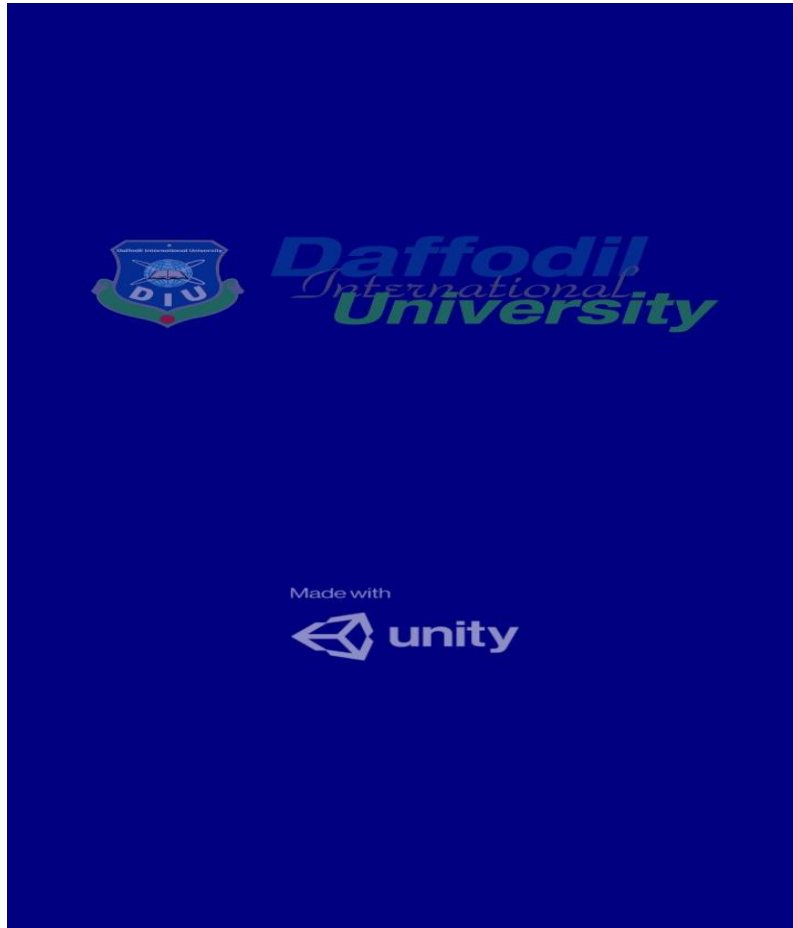


Figure 4.2: A Screenshot of the second page of Learn4Fun

We can see the second page of our application, like figure 4.1 the users will be able to see this page. This page will be shown after figure 4.1. Individual users will see this scene. They will like the user interface design. It is easy, nice and clean. We did not try to make this system complicated to understand.

In Figure 4.3, Customers or users will see the start menu page of our application's system. Here the user can make choices. For example, the user can go see the Lessons option and learn what is going on that specific option. There they can learn the lessons. In Lessons option, the users will be able to learn different topics. This scene also shows the Exercise options and also the about option. In exercise section, kids will be able to exercise what they learnt in the previous Lessons option. And in about section, individual users will learn about the creators of this application.



Figure 4.3: A Screenshot of Options in Learn4Fun

This scene contains the options of our application. The user will see this page after starting the application. From here, the user can go to different pages. Basically, this is the start menu page of the application.

In Figure 4.4, the individual users will be able to go inside the Lessons section. They can see that there are two topics to choose from. They are Bangla and English. Customers will be able to choose the topic as their liking. They can choose bangla and see what is inside that section. They can also do that for the english topic and see for themselves.

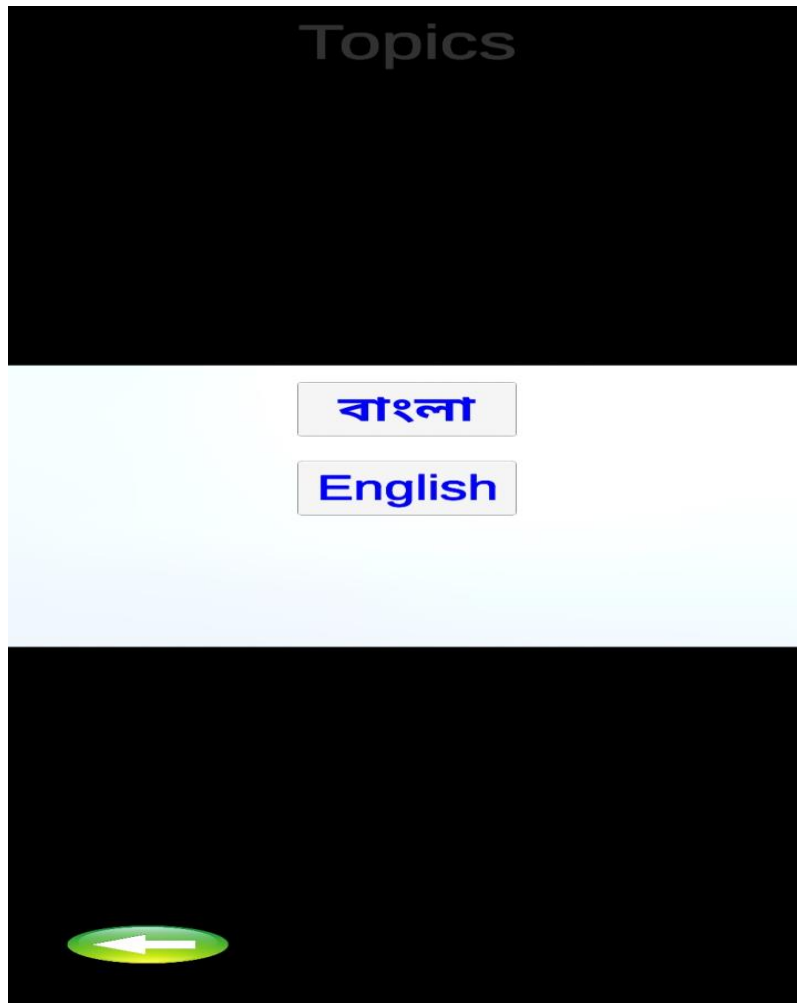


Figure 4.4: A Screenshot of choosing Topic

Here, in figure 4.4 we can see the topic. Users can choose the topic from here. Because our application is a prototype, we did not attach many topics yet. We just added two topics here and they are Bangla and English.

In figure 4.5, the user if they choose option Bangla then they can see the inside of that section. Here the users can see the vowel of Bangla language system. They can see that there are many buttons for them to use.



Figure 4.5: A Screenshot of Bangla words in Learn4Fun

Now here, the users can see the words in Bangla. The users can easily press the words and see the action happen. The individual users can also wish to go back by clicking the back arrow key which is a back button for the user interface. Each buttons here does a specific job. They take the user to a different and specific scene. For example, the first button will take the user to a scene where the audio sounds and 3D virtual models relate to the the buttons that just have been clicked by the individual users of our application.

Here the individual users will be able to see what happens when they click the buttons showed in figure 4.5. In this page they can also listen to the audio that is integrated to this scene and the audio is also playing in a loop so that the users can know what is the scene about. The user can also see 3D virtual objects floating around the environment.

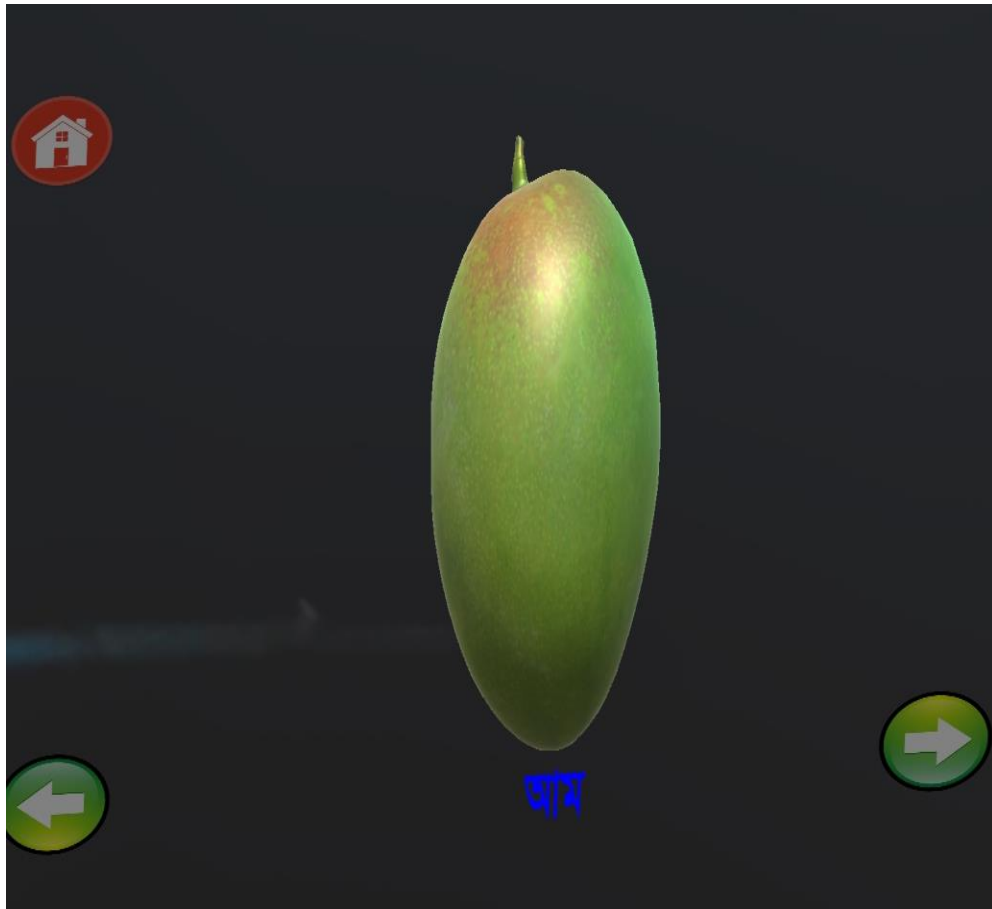


Figure 4.6: A Screenshot of AR Camera in Learn4Fun

In figure 4.6, the users can see the 3D virtual objects floating around the environment. There is also sound happening in the background. The application uses the users smartphone's camera and shows the 3D objects in real time. The application also uses the users smartphone devices gyroscope to float the 3D virtual objects through the users smartphones camera. The user can go to the previous scene from the backward arrow key. They can also go forward by clicking the forward arrow key if they wishes to do so. If the user just want to go to the home page they can just select the home icon floating in the environment.

Here in figure 4.7, the user can see what happens if they click the forward key in the environment from figure 4.5. They can move to the last scene according to the button they clicked in the previous scenes. This is the last scene of figure 4.5.



Figure 4.7: A Screenshot of showing virtual objects through AR Camera

The user can go back using the back button floating around the environment and press the last Bangla word through using the AR camera in the application. They will be directed to a specific scene according to the button they just pressed. As this is the last word of Bangla section, there is no forward arrow key to go forward. The users can only go back and to the home page if they click or presses the buttons respectively.

In figure 4.8, The user can go see the English topics. From here, they can see and choose the English words as their liking. If the choose the word “C”, it will take them to a specific and guided scene which will represent the words they just pressed. They will go through that page and see the results happening.

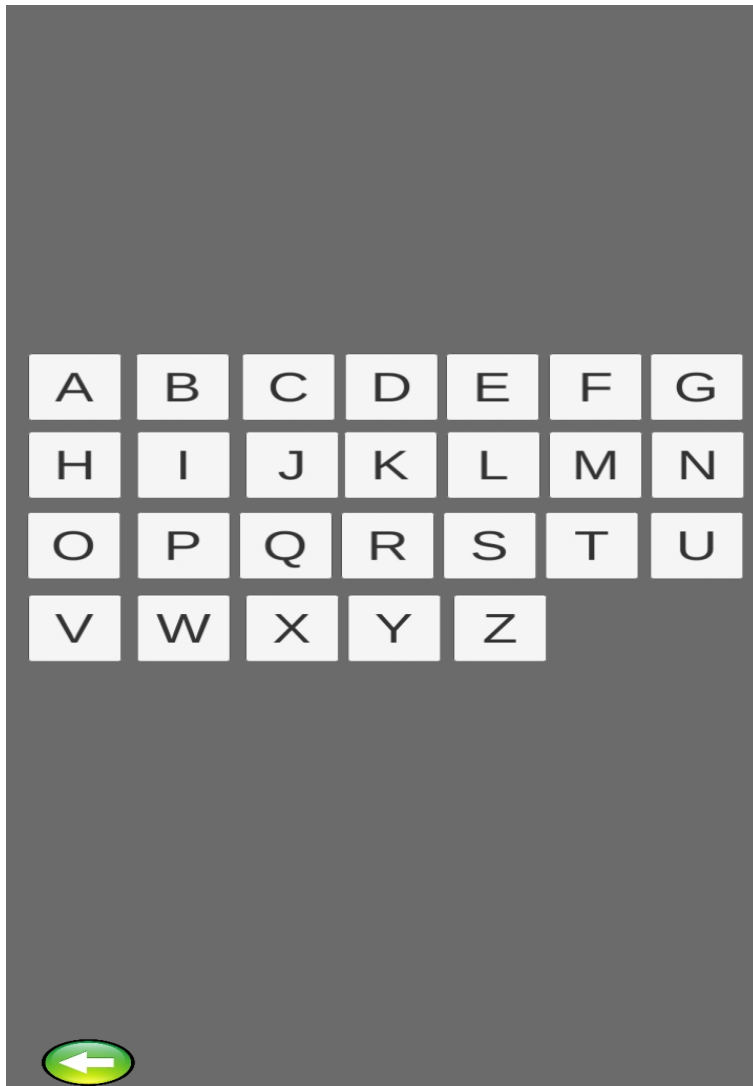


Figure 4.8: A Screenshot of choosing the English topic in AR Camera

Here the users will be able to choose the words or they can press the first button which will take them to a specific scene and they can move forward from there. The user can also go back from here if they wishes to do so. The systems user interface design is easy to understand for kids.

In Figure 4.9, the users will see this scene if they pressed the word “K”. From here, they can go back and forth using the designated arrow keys. They can also choose to go to the home by just pressing the home icon floating around in the environment. They can move forward and see the next scene from this scene without going back to the origin scene.

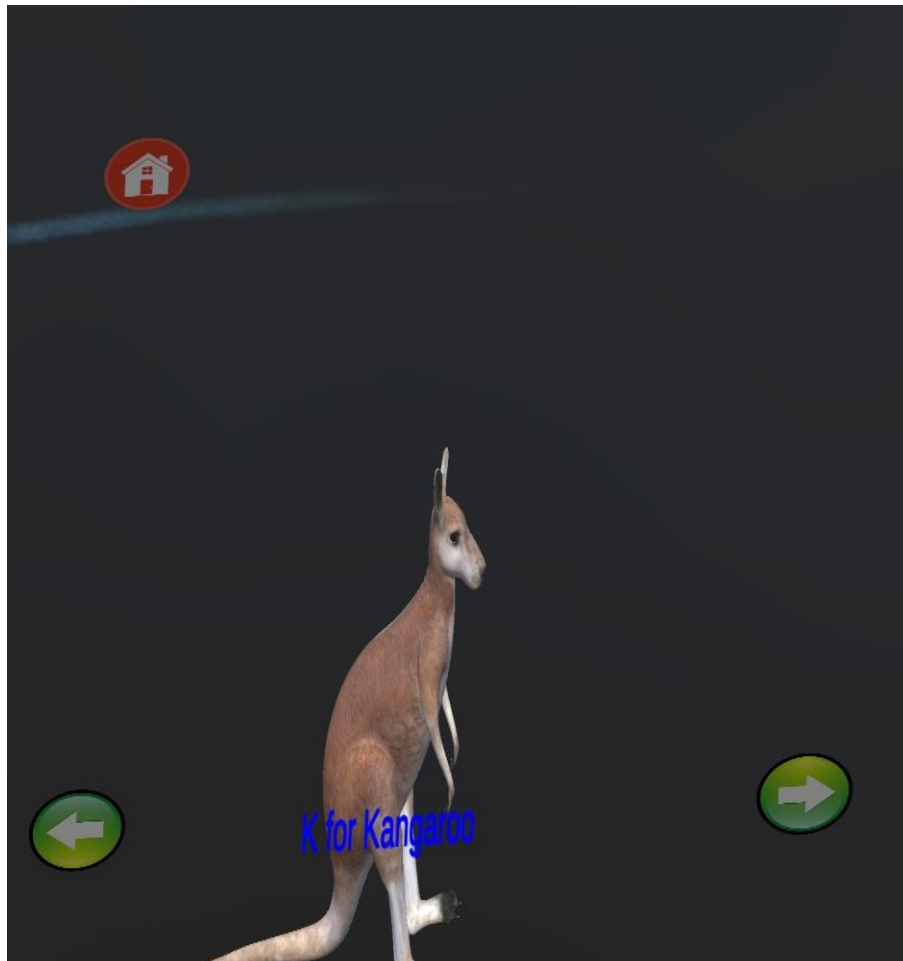


Figure 4.9: A Screenshot of showing virtual objects in English Topic

They can see the kangaroo floating in the environment which relates to K for Kangaroo. There is also the words floating here. They can listen to the songs happening in the background which is in a loop. So, if they misses the first time they can catch the audio again. They have to hurry though, the 3D virtual objects are not just floating around the environment. They are also moving.

In figure 4.10, We can see what happens when the user presses the forward arrow key here. They can see the 3D object. They can also listen the songs. Which will also give them a better understanding of the words they are trying to learn. They can also move back and forth using the backward and forward arrow key. They can also go to the home page from here.



Figure 4.10: A screenshot of Virtual objects floating in the environment

Here, the user pressed the forward arrow key in figure 4.9. That key directed them here to this scene. Where they can see the 3D virtual objects. The users are listening to the songs which is playing in a loop in the background. This song or audio will help the kids to learn better the words. They can go or move forward according to their wishes. They just have to press the key buttons. And the buttons will do their works.

In figure 4.11, We showed what happens when the users chooses the exercise option. There the user can take part into the tests to see what they learned so far in the Lessons menu. There is multiple 3D objects floating in the environment. The users have to choose the right 3D objects among them. If they choose the right objects then they will be directed to a page where they will see that they can go further in the tests or they can simply just go to the home page and withdrew from the test.



Figure 4.11: A Screenshot of Exercise options

Here the users will be able to see multiple objects floating in the environment. They can touch the 3D objects in the smartphone and go to the designated pages. If they choose the right 3D object then they will be directed to a congratulation page. Where they can go further in the tests or they can just simply exit from the test. They can also hear the audio sounds embedded in the scenes which will make them to coordinate the scenes more accurately.

In figure 4.12, The users can see what happens when they presses the right 3D objects from figure 4.11. There is no punishment for choosing the wrong 3D objects either. We did not want to discourage them from making mistakes. Kids learn something by making mistakes. So we should not discourage them when they make mistakes. The kids can also listen to the audio songs in the scene.

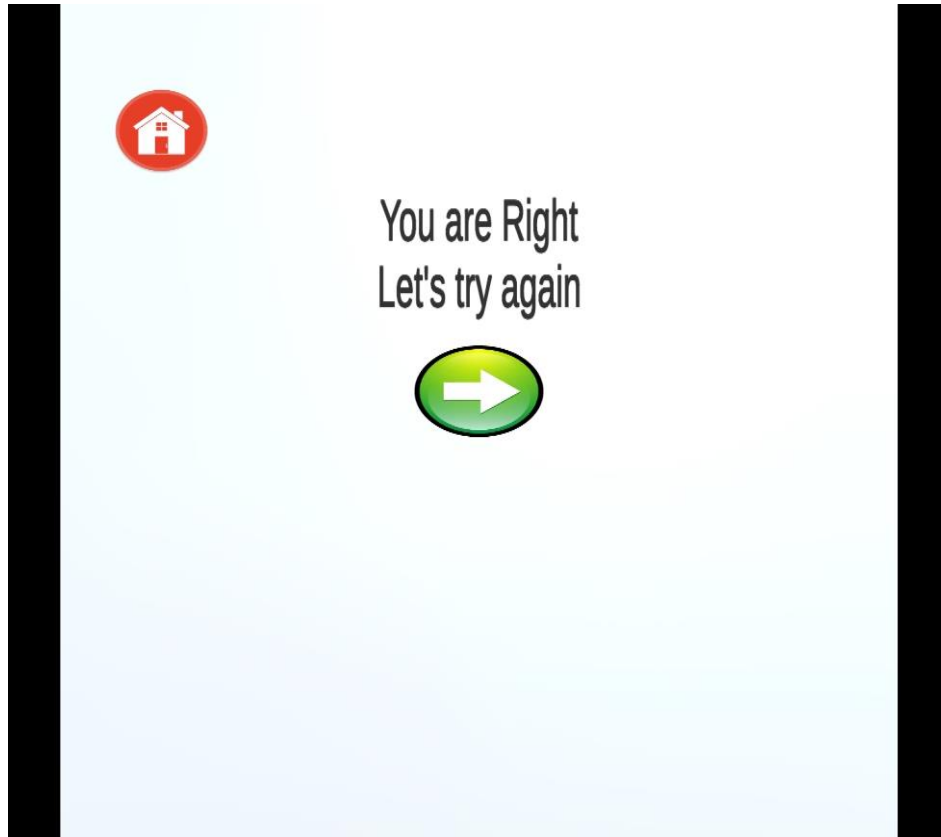


Figure 4.12: A Screenshot of Choosing the right 3D objects

The users will see this prompt if they choose the right 3D objects from figure 4.11. Then the kids can choose to go forth by pressing the forward arrow key or they can just go to the home page. If they simply do not want to do the tests they can just press the home icon. Then they will be able to go to the home page or the start menu of our application. This test helps the kids to hone their learning by making them choose the right 3D objects among other 3D objects. They can also learn from this section of our application.

In figure 4.13, the users can see if they choose the wrong 3D objects from figure 4.11. They will be shown a prompt scene where they can decide to try again or just go to the home page.

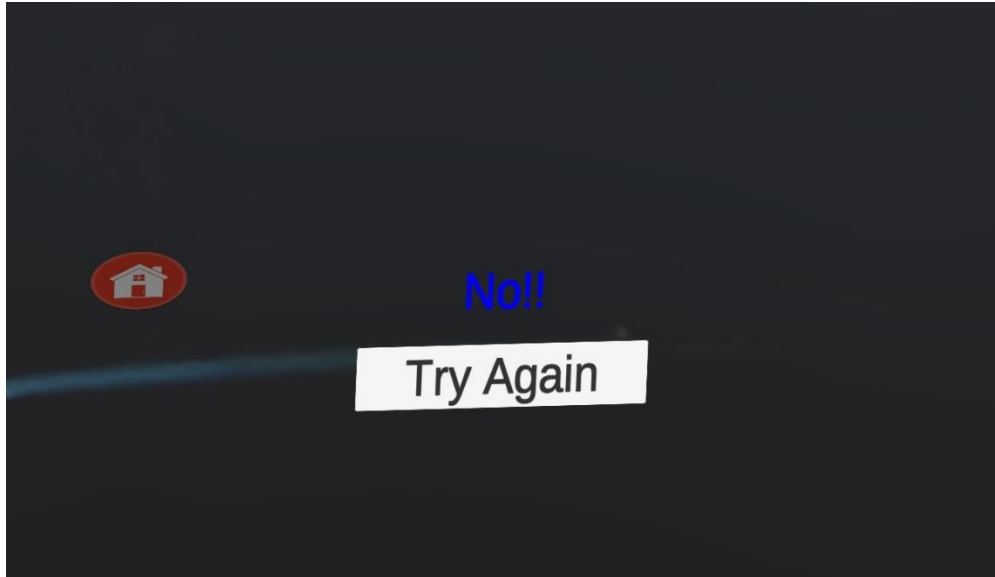


Figure 4.13: A Screenshot of choosing the wrong 3D objects

In figure 4.14, The users can see if they choose all the right 3D objects. If they did then they will be taken to a congratulation page. From here, the kids can try again or just go back to home page as their liking.

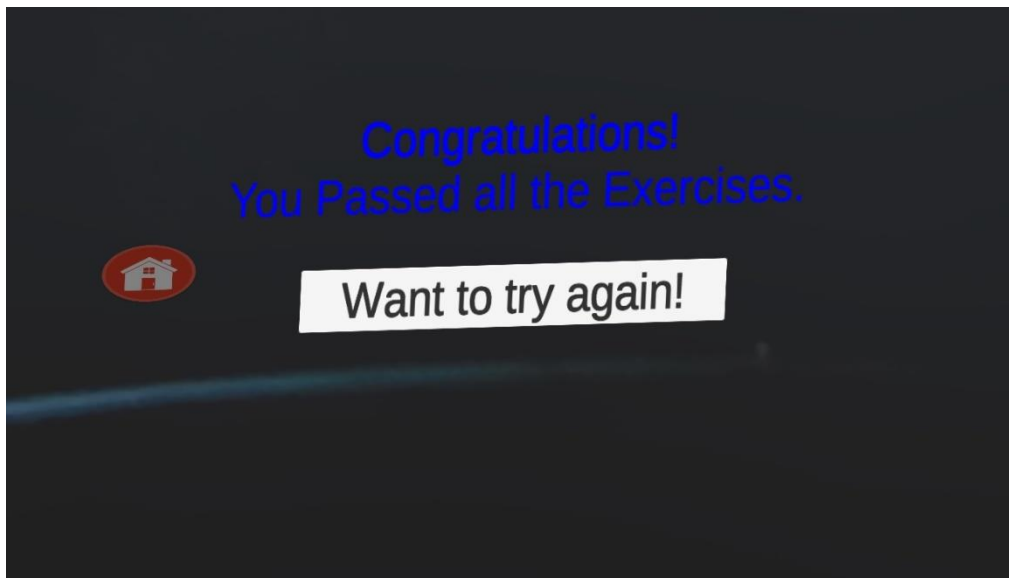


Figure 4.14: A Screenshot of choosing all the right 3D objects

In figure 4.15, We can see the about page of our application. It contains the creators name and their e-mail accounts. To go back from this page users can also press the backward arrow key. This button will take them straight to the home page of our application.



Figure 4.15: A Screenshot of the About page

4.2 Back-end Design

CMS (content management system) or back office — is the part of the app that remains hidden to users (but not to the admin or developers). They are also known as the backend of a software. The back-end makes its entrance into the app in order to give life to the front-end. This is where the real magic happens. The contents of the application, the server or how the buttons will work everything happens here. The developer uses the back-end structure to give life to the frontend design. The most important part of a software building is the backend. Security, structure, CMS are very important to software building. Server, database, application are the three main parts of backend. We did not use any database in here. By database we just added the assets we have in our application. When the user presses the words, the action just pulls the associated files from the asset folder and brings it up in the environment through the camera. We also did not use any registration or authentication panel in our application. Because our application is a public app, meaning

every kids can use this app without any authentication procedure. Our app is only meant for educational purposes.

4.3 Implementation Requirement

We implemented many different components in our work. We also used attributes and some tools to complete the building of this application. This application is very easily accessible. The completion of this app was possible using these tools.

Implementation of our project needed the following things:

4.3.1 Unity3D Engine

Unity3D Engine is a very crucial IDE to develop our application. We could also use Android Studio but it requires much more coding and modules. Unity3D is best used to develop VR, AR applications. That is why, we decided to use this IDE to develop our application. Unity is a cross-platform game engine developed by Unity Technologies, first announced and released in June 2005 at Apple Inc.'s Worldwide Developers Conference as a Mac OS X-exclusive game engine. As of 2018, the engine had been extended to support more than 25 platforms. The engine can be used to create three-dimensional, two-dimensional, virtual reality, and augmented reality games, as well as simulations and other experiences [16].

4.3.2 Android Build Support

We used Unity game engine but it does not come with Android Build Support. To build and run for Android, we had to install the Unity Android Build Support platform module. You also need to install the Android Software Development Kit (SDK) and the Native Development Kit (NDK) to build and run any code on your Android device. By default, Unity installs a Java Development Kit based on OpenJDK [17]. Once the environment is setup then we can proceed with building the application for Android platform.

4.3.3 3D Virtual Objects

We used Unity game engine to build our application. 3D virtual objects were needed to make the augmented reality experience more alive. Without the 3D models, the application did not seem very cool and intuitive.

4.3.4 Interaction Design and UX

Design of the interaction with the users and the products. This is known as Interaction Design. Mainly when people talk about ID or interaction design, they mean software products which are either apps or websites. Interaction designs main purpose is to create designs which will help the users achieve their goals or objectives. There is a huge overlap between interaction design and UX design. After all, UX design is about shaping the experience of using a product, and most part of that experience involves some interaction between the user and the product. But UX design is more than interaction design: it also involves user research (finding out who the users are in the first place), creating user personas (why, and under what conditions, would they use the product), performing user testing and usability testing, etc [19].

We tried to keep our application nice easy and simple which will help the users or individuals use the application nicely. We also refrained from using too much color because the main purpose of this application is to provide help to kids to learn things easily. We did that because ultimately our target audience is children. We are sure that children will love the way our application looks and works. We worked on our application and hoped that kids will love this software.

CHAPTER 5

IMPLEMENTATION AND TESTING

5.1 Implementation of Front-end Design

Users will always be attracted to nicer and beautiful designs. So. It is always a great challenge for the software developers to develop a great frontend design. It is very challenging work to maintain the same display around different android size display. Sometimes an application does not work on an older Android device. When building the application, we set the display size to free aspect ratio so that it fits the screen size it is on. But sometimes it was not working as it should have been. We had to be very careful and fixed the display sizes, also the buttons were floating around the screen which is too distracting for the user. We built the application four times and then it was working properly. The front-end design was as we wanted, less complicated.

5.2 Implementation of C# Script

C# is a general-purpose, multi-paradigm programming language encompassing strong typing, lexically scoped, imperative, declarative, functional, generic, object-oriented (class-based), and component-oriented programming disciplines. It was developed around 2000 by Microsoft as part of its .NET initiative, and later approved as an international standard by Ecma (ECMA-334) and ISO (ISO/IEC 23270:2018). Mono is the name of the free and open-source project to develop a compiler and runtime for the language. Visual Studio can also be used to compile C# programming scripts. C# is one of the programming languages designed for the Common Language Infrastructure (CLI) [20]. In order to use the devices webcam or the smartphone's camera we had to write a C# script. We used Visual Studio to write down the script.

In figure A1 of the appendix section, we showcased the screenshot of C# scripts.

5.3 Implementation of 3D Objects

For visual expression, we needed 3D virtual objects. But 3D objects are very pricey. Then we went ahead and tried to create 3D objects. It was taking us a lot of time and pressure so, we stopped doing it. We were looking for free 3D virtual objects on the internet. We found few sites and we downloaded our required 3D objects [18]. But we were not still able to use the 3D objects. We later found out that Unity only supports .obj, .3ds, .fbx kind of 3D objects. Then we searched for the required file formats and found some. We integrated the 3D virtual objects into the application. The problem with free 3D objects is that they do not have any animations associated with them. So, we had to build the application without associating animations to the 3D virtual objects.



Figure 5.1: A Screenshot of a 3D object

In figure 5.1, we can see the 3D model of a turtle. This is collected from various websites that lets developers download 3D models for free. This does not have any copyright issue. Only downsides of these 3D models are that they does not have any animations and that they barely look alive. But building an entire 3D model from scratch is not easy. It takes time to build an entire 3D model.

5.4 Implementation of Sounds

We added sounds to the application along with the 3D models. Without sounds, the kids were not liking the application. So, we added sounds. But it is not easy to add sounds in Unity. So for every page we had to manually add AudioSource and drag the audio clip and drop it on the AudioClip field.

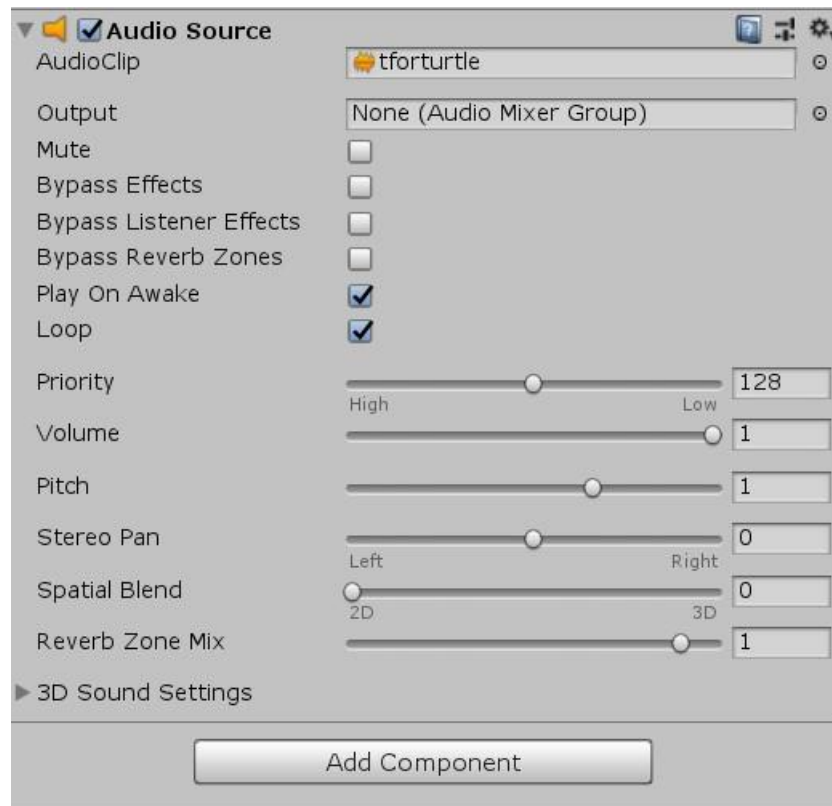


Figure 5.2: A Screenshot of AudioSource in Unity Game Engine

In figure 5.2, we can see the required field for implementing sounds. But for that we had to first import the sounds in the assets folder from outside of Unity.

5.5 Testing

Testing is an important part of building a software or application. Testing is required by every application. Just by building this application, the developers can not ensure the reliability of that application. Every app has many bugs. The developers can find out about those bugs by testing that app. Every big company has a tester. To test the application, we had to build the app. Then we tested the application on different android device.

5.6 Testing Implementation

We tested our application in different mobile platforms specifically on different android versions. We wanted to see if our application works on different android versions because not everyone in our country uses the same android versions on their smartphones. That is why we performed this test. We were pretty successful. Table5.1, shows the result of this performed test.

Table 5.1: Test case for project on Learn4Fun

Test Case	Test Input	Expected Outcome	Actual Output	Result	Tested on
1. Install Application	Tested on Android Versions— 1. Kitkat (4.4 - 4.4.4) 2. Lollipop (5.0 – 5.1.1) 3. Marshmallow (6.0 – 6.0.1) 4. Nougat (7.0 – 7.1.2) 5. Oreo (8.0 – 8.1) 6. Pie 9.0	Successfully installed on all these versions.	Installation Successful.	Passed	31/10/2019
2. Is the AR working	Show AR camera with 3D virtual objects.	Show 3D models through the camera.	Showing 3D models.	Passed	31/10/2019

5.7 Test Results and Reports

Test results is very important to know if the application is working or not. We tested our app on 4 different Android devices and it worked successfully. This app did not installed on android version lower than android JellyBean. We also used a few kids to test the application on their hands as they are our target audience. Then we went ahead and showed it to 6 kids in nursery level and they enjoyed the application. They mostly liked the 3D models in the application. They liked the simple UI designs. Kids enjoyed our application and they learned new things. Learning newer things is a hobby for kids. Kids likes to learn newer things as much as they want. Even the smartphone's camera worked perfectly with the application.

CHAPTER 6

CONCLUSION AND FUTURE SCOPE

6.1 Conclusion

We tested the software for several times and found no bugs present there. Then we tested through kids to see if they like the experience. They liked the app, mostly the 3D models. There are not many apps in play store that has AR and very few from our country. It is still a new idea. But using augmented reality we hope to modernize the learning process of children.

Our country is developing day by day. People are getting acquainted with newer technologies day by day. Thanks to the Government, there are seminars on newer technologies. People goes to attend at these seminars, they learn new things, they get inspired by these seminars. Our application is still at its early ages and we hope to keep developing it in the future.

6.2 Limitations of Our Application

Like every other application out there, our app has some limitations too. We will try to fix these limitations in the future.

The main limitations are,

1. Our app does not have any authentication protocol
2. Our app is not a marker based AR
3. The user can not create a profile
4. Does not have in-depth exercises to test the learning
5. Does not have more topics in topics sections

6.3 Scope for Further Development

We want to marketize this application in future. We want to keep developing this app. We also want to add some features in the future. They are

1. Add user profile
2. Add authentication protocol
3. Make this app for every platform (iOS)
4. Add more topics like Science, Mathematics
5. Add drawing input
6. Add more exercises
7. Add custom made 3D models with animations

We know that our application is not perfect. But we want to keep working on this app in future. We want to break the boring and monotonous learning education system in our country. It is high time that we take opportunities of these newer technologies and use it in our daily life to solve problems.

APPENDIX

Figure A1:

C# Script

```
Assembly-CSharp | AppleScript.cs | WCam.cs | SwitchScreens.cs | WCam | Update()
3 using UnityEngine;
4
5 public class WCam : MonoBehaviour
6 {
7     public GameObject WcamP1; //Webcameraplane
8     // Start is called before the first frame update
9     void Start()
10    {
11        if(Application.isMobilePlatform)
12        {
13            //check if we are on a mobile platform
14            GameObject cameraParent = new GameObject("camParent"); //then we are creating a cameraParent obj
15            cameraParent.transform.position = this.transform.position; //then we are going to set that camera's transform to this camera's transform
16            this.transform.parent = cameraParent.transform; //set the actual parent relation between this camera and the cameraParent
17            cameraParent.transform.Rotate(Vector3.right, 90); //then we are going to rotate the cameraParent
18        }
19
20        Input.gyro.enabled = true; //enable the gyroscope on the device
21
22        WebCamTexture webCameraTexture = new WebCamTexture();
23        WcamP1.GetComponent<MeshRenderer>().material.mainTexture = webCameraTexture;
24        webCameraTexture.Play(); //create a new webcamtexture, then take that webcamtexture and apply it to the plane that we created and play it.
25
26
27
28
29    }
30
31    // Update is called once per frame
32    void Update()
33    {
34        // Quaternion represent rotations in unity3d
35        Quaternion cameraRotation = new Quaternion(Input.gyro.attitude.x, Input.gyro.attitude.y, -Input.gyro.attitude.z, -Input.gyro.attitude.w); /
36        this.transform.localRotation = cameraRotation;
37
38    }
39
40    --
```

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Plagiarism Report

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