



Smart Educational Game Based On Augmented Reality

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Abstract

Scientists assert our eyes indeed only see a small portion of what is happening around us. Actually it is a scary fact thinking of the human level of acquaintance to surrounding circumstances, and raises the query of what we would be able to see if we could see 100% of everything. The options are boundless, and when it comes to education, imagine how we can improve teaching methods through such technology. Augmented reality can help make classes more interactive and allow learners to focus more on practice instead of just theory. As augmented reality adds virtual objects to the real world, it lets students train skills using physical devices. Our smart educational application can be built on Android, Ios, Mac, Linux, Xbox, PS4, Web, Facebook or Pc. Which is based on augmented reality technology, easy to use and mainly target kids like 3-7 years old learning them alphabets ,words and numbers on two languages (Arabic and English) by an attractive way. it contain image recognition ,text to speech recognition ,some funny games , and some other attractive ideas for kids.

1. Introduction

Education is an avenue of training and learning, especially in schools or colleges to improve knowledge and develop skills. The ultimate purpose of education is to empower an individual to excel in a chosen field of endeavor or career, and to be able to positively impact his/her environment . AR technologies are recently considered powerful tools for improving means of education. Augmented reality (AR) adds digital elements to a live view often by using the camera on a smart phone , wearable glass device or by AR headset like Microsoft hololens or magic leap. AR makes the existing reality more meaningful because it allows to interact with it. AR has a great potential to be used in the classroom because it changes the way students interact with the real

world, enhances student engagement, and makes the learning of their subject content a fun.

1.1 History

1957 → Augmented reality was first achieved, to some extent, by a cinematographer called Morton Heilig. He invented the Sensorama which delivered visuals, sounds, vibration and smell to the viewer. Of course, it wasn't computer controlled but it was the first example of an attempt at adding additional data to an experience.

1968 → a Harvard professor and computer scientist by the name of Ivan Sutherland invented what he called The Sword of Damocles. He invented this first sort of augmented reality device with his student, Bob Sproull.

1974 → by Myron Krueger. The project was called, Videoplace , which combined a projection system and video cameras that produced shadows on the screen.

1990 → a Boeing researcher named Tom Caudell coined the term "Augmented Reality".

1992 → Louis Rosenburg from the USAF Armstrong's Research Lab created the first real operational augmented reality system, Virtual Fixtures. A robotic system places information on top the workers work environment to help with efficiency.

1994 → by Julie Martin .the first theater production to use augmented reality was created "Dancing in Cyberspace".

2003 → the NFL used the popular Skycam, which was used for aerial views of the field to insert the virtual first down marker.

2009 → Esquire magazine, in collaboration with Robert Downey Jr., uses augmented reality in their print media.

Augmented reality has come a long way since its early conception, and the advancements in the past five years have been even more promising. Augmented reality has also infiltrated the gaming world as well.

1.2 Definitions

Education Augmented reality applications can complement a standard curriculum. Text, graphics, video and audio can be superimposed into a student's real time environment. Textbooks, flashcards and other educational reading material, when scanned by an AR device, produce supplementary information to the student rendered in a multimedia format. Students can participate interactively with computer generated simulationsof historical events, exploring and

learning details of each significant area of the event site.

Retail Augmented reality in retail has huge potential to boost sales, while more than 50% of smartphone owners use it when shopping. AR has the potential to revolutionize mobile shopping by bringing products to life in front of you through 3D models that you can size up, examine from all angles, and even place in the environment around you. ZARA, IKEA, and PEZ have developed systems that allow these company's products to be seen in augmented reality.

Entertainment and gaming Augmented reality gaming (AR gaming) is the integration of game visual and audio content with the user's environment in real time. Unlike virtual reality gaming, which often requires a separate room or confined area to create an immersive environment, augmented reality gaming uses the existing environment and creates a playing field within it. While virtual reality games require specialized VR headsets, only some augmented reality systems use them. AR games are typically played on devices like smartphones, tablets and portable gaming systems.

Annotation and Visualization AR could be used to annotate objects and environments with public or private information. Applications using public information assume the availability of public databases to draw upon.

For example, a hand-held display could provide information about the contents of library shelves as the user walks around the library. At the European Computer-Industry Research Centre (ECRC), a user can point at parts of an engine model and the AR system displays the name of the part that is being pointed at. Figure 1

shows this, where the user points at the exhaust manifold on an engine model and the label "exhaust manifold" appears.



Figure 1: Engine model part labels appear as user points at them.

Alternately, these annotations might be private notes attached to specific objects. Researchers at Columbia demonstrated this with the notion of attaching windows from a standard user interface

onto specific locations in the world, or attached to specific objects as reminders. Figure 2 shows a window superimposed as a label upon a student. He wears a tracking device, so the computer knows his location. As the student moves around, the label follows his location, providing the AR user with a reminder of what he needs to talk to the student about.



Figure 2: Windows displayed on top of specific real-world objects.

1.3 Technology and Education

The future of the educational system is practically determined by the development of technology. Some educators and experts are against the trends of implementing EdTech tools and apps in every single aspect of the schooling system, mainly because technology is a source of distraction for students. However, proper technology integration guides students towards greater understanding of all concepts covered in class.

The teaching strategies based on educational technology can be described as ethical practices that facilitate the students' learning and boost their capacity, productivity, and performance. Technology integration in education inspires positive changes in teaching methods on an international level.

Learning techniques in general can be divided into seven essential styles that individual prefers to learn using: **Visual, Aural, Verbal, Physical, Logical, Social and Solitary.**

The Game is designed to use some of these styles, mainly Visual, Aural, Verbal and logical.

As well as using the previous techniques, the last to styles can also be achieved in the game depending on the child's preference.

Motivation

Despite of the great importance of education, many kids don't like it. This can be justified by the love of children to play more and the difficulty of learning them in traditional ways. Hence, we will use AR technology to visualize the concepts and materials to kids in an

attractive way that makes them learn faster, easier and without the alienation from it. In addition, we tried to teach kids alphabets, words and numbers on two languages (Arabic and English) by an attractive way .also it contain some stories ,some funny games , and other attractive ideas .

Objectives

Developing an application that simply and creatively visualizes and teaches kids on an attractive way using the Augmented Reality Technologies.

2. Smart Educational Game Architecture using AR

Augmented Reality (AR) is a variation of Virtual Environments (VE), or Virtual Reality as it is more commonly called. VE technologies completely immerse a user inside a synthetic environment. While immersed, the user cannot see the real world around him. In contrast, AR allows the user to see the real world, with virtual objects superimposed upon or composited with the real world. Therefore, AR supplements reality, rather than completely replacing it. Ideally, it would appear to the user that the virtual and real objects coexisted in the same space, in order to make it more meaningful through the ability to interact with it. AR is developed into apps and used on mobile devices to blend digital components into the real world in such a way that they enhance one another, but can also be told apart easily.

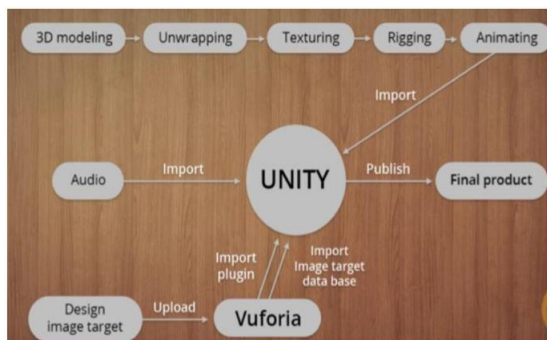


Figure 3: DFD to create entity modules



Figure 4: Augmented Reality

2.1.Types of Augmented Reality

Marker Based AR Some also call it to image recognition, as it requires a special visual object and a camera to scan it. It may be anything, from a printed QR code to special signs. The AR device also calculates the position and orientation of a marker to position the content, in some cases. Thus, a marker initiates digital animations for users to view, and so images in a magazine may turn into 3D models.

Marker less AR A location-based or position-based augmented reality, that utilizes a GPS, a compass, a gyroscope, and an accelerometer to provide data based on user's location. This data then determines what AR content you find or get in a certain area. With the availability of smartphones this type of AR typically produces maps and directions, nearby businesses info. Applications include events and information, business ads pop-ups, navigation support.

2.2. Features of Augmented Reality

AR can reduce the line between the real world and virtual world, and can provide interactive abilities, less dangerous surgeries & operations, rapid augmentation in tourism, military Training which could be less expensive, 3D views of building and amenities with AR with real time 3D rendering ,adding all the landscaping, animation, color and textures.

The future of Augmented reality will probably be focused on education and video games mostly since it provides a lot of space for creativity. The latest smash hit Pokemon GO is based on augmented reality and it was a huge success for a while.

2.3. Advantages of AR in Education

Augmented reality has huge benefits to mankind. It makes life's activities easy and fun. One of such areas where AR drives massive benefits is in education. There are many ways to use AR in education for better learning process. The integration of AR into lectures and classroom drives unparalleled attention from students. Today, AR app development is booming with focus on augmented reality app development. Here is a list of some of the benefits of AR app development in education:

- *AR in education creates fun and excitement for students. Students become excited to learn. Thus, stirs up their motivation to the learning process. The truth is; AR stimulates better learning process in students. It pushes them into a learning place where they become critical in dissecting new ideas. This increases the imaginative prowess of students in the learning process. At the end, students grow their imaginative and thinking ability.*
- *Increasing in student participation in class. With AR apps, students have access to education and learning models. These models aid better and high level understanding of subjects among students. The more students understand having better grasps of topics, the more their participation. This is the exact result AR apps in education tend to achieve.*
- *The use of AR in education provides interactive lessons to students.*
- *AR gives students the privilege to see, observe, and feel at the same time while learning. Imagine the impacts of contents that interact with student's sights and feelings. Rather than become mere observers, these contents make students part of it.*
- *The use of AR in education brings about enriched ways of telling educational stories. Through augment reality, educational storytelling has become powerful through visual models.*

2.4. Tools used in our project

Augmented reality uses features extraction and pose estimation on the image to detect it and place on it models, animations or doing any kind of actions. We used unity, Vuforia, blender, inkscape, paint 3D and Microsoft visual studio to completely form our application.

2.4.1 Unity



Overview Unity gives users the ability to create games and experiences in both 2D and 3D, and the engine offers a primary scripting API in C#, for both the unity editor in the form of plugins, and games themselves, as well as drag and drop functionality. Prior to C# being the primary programming language used for the engine, it previously supported Boo, which was removed with the release of Unity 5, and a version of JavaScript called Unity Script, which was deprecated in August 2017, after the release of Unity 2017.1, in favour of C#. Within 2D games, Unity allows importation of sprites and an advanced 2D world renderer. For 3D games, Unity allows specification of texture compression, and resolution settings for each platform that the game engine supports. As of 2018, Unity has been used to create approximately half of the new mobile games on the market and 60% of augmented reality and virtual reality content. The unity editor is supported on Windows and Mac OS, with a version of the editor available for the Linux platform, albeit in an experimental stage, while the engine itself currently supports building games for more than 25 different platforms, including mobile, desktop, consoles and virtual reality, including approximately 90% on emerging augmented reality platforms, such as Microsoft HoloLens, and 90% of Samsung Gear VR content. Unity technology is the basis for most virtual reality and augmented reality experiences. Unity Machine Learning Agents is open-source software whereby the Unity platform connects to machine learning programs, including Google's TensorFlow. Using trial and error in Unity Machine Learning Agents, virtual characters use reinforcement learning to build creative strategies in lifelike virtual landscapes. The software is used to develop robots and self-driving cars.

Unity Asset Store is home to a growing library of free and commercial Assets created both by Unity Technologies and also members of the community. A wide variety of Assets is available, covering everything from Textures, Models and animations to whole Project examples, tutorials and Editor extensions. Creators can develop and sell user-generated assets to other game makers via the Unity Asset Store. This includes 3D and 2D assets and environments

2.4.1.1 Unity Windows

Project Window The first window we have in unity engine game is project window. It is one of the important windows in unity, because any assets, scenes, material, game objects, packages, 3D

objects, animation, videos, pictures or scripts you will get them in the project window.

Scene Window We can say that scene window is the interactive window with players to your game you are creating. Your scene will show game characters, camera, lights, and all other types of game objects. Having a scene in the game is a very necessary, but it shouldn't have only one scene as you can make a scene for the beginning of the game and another one for the main menu, also a different scene for each level of your game. You can move between those scenes with programming using C# or state machines.

Hierarchy window It is a window which contains all your game objects in the current scene. We can rename any game object in the by right click on it and choose rename, we can also copy delete duplicate any game object with the same way. From the hierarchy window we can create new game objects like cube, sphere, capsule, cylinder, plane, terrain, audio, effects, light or even an empty game object. And this by clicking on create button on the high left of hierarchy window. There is a concept in the hierarchy window called parent and child, which mean that if you make a game object or more than one a child to another game object which is called parent, now every modify like moving or scaling, you will make on that parent it will happen also on his children. We can make a game object child to another one by pulling the one which I want to be child and through it on the one which will be parent to it.

Inspector Window The inspector window contains components and their properties like materials, scripts ,physics ,UI and so on of each game object on your Hierarchy window. Also it allows you to modify the functionality of each Game Object in your Scene.

2.4.2 Vuforia



VUFORIA is an augmented reality software development kit (SDK) for mobile devices that enables the creation of augmented reality applications. It uses computer vision technology to recognize and track planar images (Image Targets) and simple 3D objects, such as boxes, in real time.

This image registration capability enables developers to position and orient virtual objects, such as 3D models and other media, in relation to real world images when they are viewed through the camera of a mobile device. The virtual object then tracks the position and orientation of the image in real-time so that the viewer's perspective on the object corresponds with the perspective on the Image Target. It thus appears that the virtual object is a part of the real-world scene.

VUFORIA uses three key capabilities to integrate virtual content with the real world as seen through your phone's camera:

- Motion tracking allows the phone to understand and track its position relative to the world.
- Environmental understanding allows the phone to detect the size and location of all type of surfaces: horizontal, vertical and angled surfaces like the ground, a coffee table or walls.
- Light estimation allows the phone to estimate the environment's current lighting conditions.

How does VUFORIA work?

Fundamentally, VUFORIA is doing two things: tracking the position of the mobile device as it moves, and building its own understanding of the real world.

Vuforia's motion tracking technology uses the phone's camera to identify interesting points, called features, and tracks how those points move over time. With a combination of the movement of these points and readings from the phone's inertial sensors, vuforia determines both the position and orientation of the phone as it moves through space. In addition to identifying key points, vuforia can detect flat surfaces, like a table or the floor, and can also estimate the average lighting in the area around it. These capabilities combine to enable vuforia to build its own understanding of the world around it.

→VUFORIA works better when our tracked images has many details on it (more details on each image give VUFORIA more features which make images fast recognizable to VUFORIA)

VUFORIA can work with 6 major's types:

1. Image Targets
2. Model Targets
3. User Defined Targets
4. Cylinder Targets
5. Object Targets
6. VU Marks.

2.4.3 Blender



Blender is a free and open-source 3D computer graphics software toolset used for creating animated films, visual effects, art, 3D printed models, interactive 3D applications and video games. Blender's features include 3D modeling, unwrapping, texturing, raster graphics editing, rigging and skinning, fluid and smoke simulation, particle simulation, soft body simulation, sculpting, animating, match moving, rendering, motion graphics, video editing and compositing..

Features official releases of Blender for Microsoft Windows, MacOS and Linux. are available in both 32-bit and 64-bit versions. Though it is often distributed without extensive example scenes found in some other programs, the software contains features that are characteristic of high-end 3D software. Among its capabilities are:

- Support for a variety of geometric primitives, including polygon meshes, fast subdivision surface modeling,
- Internal render engine with scanline rendering, indirect lighting, and ambient occlusion that can export in a wide variety of formats.
- Integration with a number of external render engines through plugins.
- animation, constraints, and vertex weighting.

We used blender in our application to make the 3D models that we want to appear in AR like 3D models for Alphabets, numbers, some objects and some animals. Also we made some animation to some animals with the use of blender.

2.4.4 InkScape



Inkscape is a free and open-source vector graphics editor. This software can be used to create or edit vector graphics such as illustrations, diagrams, line arts, charts, logos and complex paintings. Inkscape's primary vector graphics format

is Scalable Vector Graphics (SVG); however, many other formats can be imported and exported.

Inkscape can render primitive vector shapes (e.g. rectangles, ellipses, polygons, arcs, spirals, stars and 3D boxes) and text. These objects may be filled with solid colors, patterns, radial or linear color gradients and their borders may be stroked, both with adjustable transparency.

Usage in our project In order to make a 3D alphabet to import it in unity, we should have to use blender. And to use blender we must have a picture of our alphabet with an extension of scalable vector graphic (.svg) because this extension offers a high quality picture. Inkscape also can remove background of our picture, so we can have our alphabet without any additions that we don't want.

2.4.5 Paint3D

Paint 3D, a refresh of Microsoft paint, is one of several applications introduced with the Windows 10 creators update and one of several 3D modeling and printing applications introduced or improved with the Windows 10 Creators Update, along with View 3D, Windows Mixed Reality, Holograms, and 3D Builder. Developed by Microsoft's Lift London studio, Paint 3D incorporates features of the Microsoft Paint and 3D Builder applications to combine a lightweight hybrid 2D-3D editing experience that allows users to pull in a variety of shapes from the app, their personal computer, and Microsoft's Remix 3D service.

Features Paint 3D's most heavily promoted to features are related to its support for 3D objects. Paint 3D provides 3D stock people, animals, geometric shapes, text, and doodles. Users can rotate objects, adjust the placement of 3D object in all three dimensions, and apply 2D objects as stickers to 3D objects..

Usage in our Project

1. We used paint 3D to design images from scratch and make it childish for kids to use on AR.
 2. We used paint 3D to give our images high rate in vuforia. The higher rate, the more image be augmentable. And that's by adding some stickers which have many features to have a higher rate, so camera can detect this image quickly.
- let's see now the difference which happen in vuforia database before edit with paint 3D and after :

Target Name	Type	Rating
A_Mazeee	Single Image	★★★★★
A_Maze	Single Image	★★★★★

As you see the image with stickers get 4 stars which is more augmentable and higher speed of detection than the original image that got only 3 stars on rating. And also it became more childish for the kids.

2.4.6 Microsoft Visual Studio



Microsoft Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs, as well as websites, web apps, web services and mobile apps. Visual Studio uses Microsoft software development platforms such as Windows API, Windows Forms, Windows Presentation Foundation, Windows Store and Microsoft Silverlight. It can produce both native code and managed code.

Visual Studio includes a code editor supporting IntelliSense (the code completion component) as well as code refactoring. The integrated debugger works both as a source-level debugger and a machine-level debugger. Visual Studio supports 36 different programming languages and allows the code editor and debugger to support (to varying degrees) nearly any programming language.

We started coding using Microsoft visual studio 2017 community version and it's a free license version It's a platform used for making programs using any programming language Used for its organized and easy way of writing codes. The used programming language in our project is C# because it's one of the only two programming languages that is supported in unity C# depends on OOP so everything is split into different classes and has the principles of OOP.

2.5 Database in Vuforia Engine

Cards are image targets that Vuforia Engine can detect and track. The engine detects and tracks the features that are naturally found in the image itself by comparing these natural features against a known target resource database. Once the Image target is detected, Vuforia Engine tracks the image as long as it is at least partially in the camera's field of view. Database, which is our cards, were

made by paint and paint 3d tools to create fun images that attract kids to play with it so we did the following:

- Creating a license key for the application.
- Uploading images in Vuforia Engine.
- Making sure that images get high rate which ensure that AR will track images efficiently.
- Downloading database and activating it.

2.6 Game Description

Main Menu

On opening the application the main menu appears in a form of a map as shown in figure 4 choosing one of three tracks to start leads to several numbers of levels. The three tracks are Arabic, English and numbers.

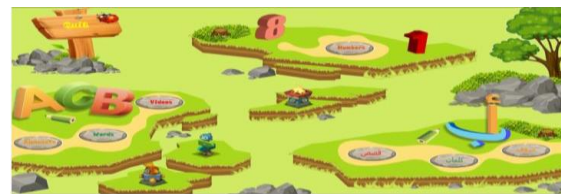


Figure 4 : Main Menu Scene

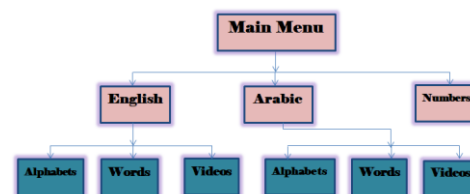


Figure 5 : Game Flow

Arabic alphabets level This level targets to teach kids the Arabic alphabets in a magical way to support kids' learning content skills through imaginative and intriguing play. This level is made in a way that attracts the kids' attention by images, colours, augmented models and sounds. It is the first level in the Arabic track.



Figure6: 3D model with Augmented Reality

The animated 3D model has a c# script to change its scale and position, in a way to make the kids interact with the augmented models.

Arabic Words level At that level the child will learn in a fun, interactive way similar to a puzzle and interact with augmented world by arranging the letters flash cards to get the right word and make the 3D model appear. It is the second level in the Arabic track to make the child learn how to spell and form the words of them.

AR camera tracks the flash cards that have c# script attached to it to check if its arrangement makes the right word of the animal.

English Alphabets level :It is the first level in the English track. The goal of this level is to teach the children the English alphabetic letters in some sort of a fun game involving the presence of an AR maze ,because children at this age loves to play a game that have some kind of a mission. The mission in this game is to lead the ball inside the maze to the object in its exit.

At the same moment the camera tracks the card, the 3D objects all appear and the ball spawns in the entrance of the maze. The child starts tilting the card in a way so that the ball starts moving within the 3D maze walls .

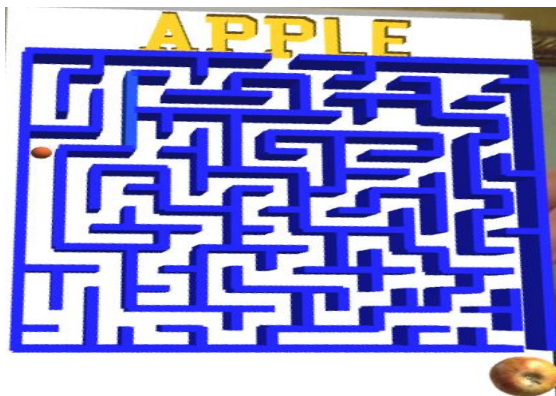


Figure 7: Maze game with Augmented Reality

The maze level contains three sublevels corresponding to the first three letters of the English Alphabets. the scene of the maze level contains: AR camera, image target ,the 3D maze, the sphere which is the ball that moves inside the maze, a floor, a spawn point , a collider , the 3D word and a 3D object.

The maze tracker which is the image target was first uploaded on <https://developer.vuforia.com> to check its rating, get its database as an image target and its license. 3D maze was created by creating set of cubic objects, having ice material, to cover the lines of the maze it is a child of the image target. The ball is a sphere object created having ice material, to make the ball move fast, and add to it a rigid body component to give it gravity to let fall into the scene. Spawn point which is the point

at which the ball falls into the scene. A C# script is attached to the sphere object to make it fall on the floor not through it and it also makes the ball spawn at the same starting point when it falls of the maze plane. Both the spawn point and the ball objects should have the same coordinates so that the level works properly. Floor is a plane created having a white material so that the ball fall on it .It is a child of the image target. Collider is used so that when the ball hits it and the exit of the maze it opens another scene giving him a choice whether to solve the following maze or to return to the main menu. The 3D object, 3D word and the 3D maze all appear when the AR camera tracks the maze card s As in figure 7 .

English Words level The second level in the English track .This level targets the child's ability of learning through listening and typing. That target is achieved by encouraging the child to interact with the game by typing the written word on the screen and listening to its pronunciation. Using friendly images aims to give the child a familiar feeling while playing this level.

All of the objects in this level scenes are connected together to perform the target of the level by a c# script.

On this level we used text to speech tool by using a code that detects the typed word in the input field and downloading its pronunciation from the following link <http://api.voicerss.org/> and Saving it in an audio file to play it in the scene, so to have the level work properly the device on which the game is running should be connected to the Wi-Fi. The used accent is an English accent.

Arabic and English Videos level This level is focused on stories in Arabic and English that have moral lessons to teach the kids how to behave morally in different situations, also is focused on delightful colours, songs and characters to raise attention of the kids.

AR camera opens and tracks the cards that attached to the videos which have a c# script by default that controls the playing of the video.

Arabic and English Numbers level This level targets to teach kids the Arabic and English numbers and counting in an interactive way with augmented models to make the learning enjoyable. AR camera opens, and when the child tracks the cards of numbers by the camera, a 3D model of the Arabic and English numbers and a 3D model of some objects with that number will appear play as shown in figure 8.



Figure 8: AR Numbers on play mode

The 3D models have a # script that makes it rotate by a 360 degree as well as changing its scale and position in a way to make the kids interact with the augmented models.

3. The testing Experiment on children

Introduction This chapter discusses the results of the project, the impact and benefits of this game on the kids. The main purpose of the project is to teach some basics of the Arabic language, English language and numbers to kids of age 3:6. That purpose is shown in an experiment that was performed on the children.

Overview An Experiment was performed in a group of 11 children ensure that the game achieved its target, which is to teach the children some basics in language and numbers. One of the main purposes of the experiment is to test whether the children focus on the game or get distracted easily. As well as comparing between the impacts of smart educational games on the children learning performance, and the traditional ways of learning which doesn't involve using smart devices or technology.

Experiment procedure In order to make sure that the game fulfills its purpose, an experiment was performed on children to test the game. The experiment idea was to make the children try both the traditional way of learning with ordinary educational games like; cards and books,

and this game, while observing the children reaction towards these two ways.

This Experiment took place in Knowledge universe academy (KUA) in 6th October city, Giza. The participating children has an age of 2 : 10 years old.

□ The children were divided into groups of two or three. Each group had a tablet, a mobile or a laptop and a supervisor. The experiment started by testing this game on them. The game had a

significant impact on the children that they were drawn to it completely that they refused to try the traditional educational games.

Observation The children first reaction towards the game when the 3D Model popped on the screen, while trying the first level in the Arabic track, that they called it MAGIC. They were instantly attracted to the game.

As an observation on their reaction while going through all the levels, most of them have bigger reaction and attachment to the levels that have 3D objects popping on the screen.

□ Two of the children participating in the experiment were Italians of ages 4 and 5 years; they didn't speak neither English nor Arabic. However they have shown significant reaction towards the game as well and were very impressed with it, that they didn't want to quit it.

□ Although the game targets children from age 3:6 years, older kids involved in the experiment and had fun with it as well, which was unexpected since they already know these basics, which is taught in the game. This group of age 7: 10 years was more curious to know how the game work, especially the levels with augmented reality, since it is not magic. This part attracted them the most and made them and willing to go through all the levels.

□ We noticed that the number of the kids willing to participate kept increasing during the experiment.

□ The children didn't take long time to understand how the game works. Soon after watching the supervisor testing it for them, they managed to play it on their own.

Results This table describes the experiment and the effect on kids before and after dealing with the AR game.

As shown in the below table the overall performance of the children learning skills were improved after using the smart game.

	Before playing the smart game (playing with ordinary games)	After playing the smart game
The age of the kids	Age of 3 -6	Age of 2-10
The number of the kids	6 kids joined.	12 kids joined.
The concentration	Low concentration, they were uncontrollable.	High level of concentration.
The enjoyment and entertainment	A medium level of enjoyment.	Much more enjoyment.
Time playing the game	Half an hour.	Almost two hours.
Fast and quantum of learning	Much more time and effort from the instructor to teach.	They learned faster and showed improved performance.
Dealing with the game	Before playing they did not know how to deal with it.	It took them one time of testing to know exactly how to deal with it.

□ The experiment lasted for almost two hours and in the beginning of the session we showed the kids how to play the game and to use it with the colorful cards that contains the pictures of the letters and animals ,and to go through all levels of the game ,and by the end of the experiment the kids managed to play the game by themselves and deal with it easily using different cards and pictures and go from one level to the other in a simple way .

□ The variety of the ideas in the game and the levels made the game very exciting and entertaining that they were impressed by it.

Conclusion The experiment showed the success of the game in attracting the children, and fulfilled its main target by getting the children full concentration without getting bored or distracted. The variety of tools used in the game was designed to perform different learning styles. But most of the children have shown great reaction towards the levels which uses visual learning technique. This indicates that at their age they use their visual learning ability more than the other techniques. To sum up, the smart educational game had a great impact on the children learning performance.

4. Future plane

This section introduces some methods to develop the game, the methods are

- Increasing our database to include different types of words to provide the knowledge of the kids.
- Adding levels that use machine learning with AR to detect objects and give information of it.
- Using speech to text tool with AR to make kids interact with the game by voice.

- Adding Watson IBM packages to make more variety of the used tools.
- Compressing the memory size of the game.
- Trying to make the game involved in the governmental schools and special schools as the technology has a great impact on education.
- Developing the game to have more subject and methods of the education in schools in a fun way to support the creativity of students.
- Uploading the game in the play store.

5. Conclusion

In conclusion, this paper introduced AR educational game that gives a different approach to learning, how students are taught and one step ahead to technology as AR in education field is rapidly growing in popularity because it brings elements of the virtual world, into our real world, thus enhancing the things we see, hear, and feel. The quote by Clay P. Bedford (n.d) is one to think about when considering the use of educational games, “You can teach a student a lesson for a day but if you can teach him to learn by creating curiosity, he will continue the learning process as long as he lives” (n.p).

The paper also described the game’s used tools which are Unity, Vuforia, blender, paint3d and visual studio, database which is the cards, 3d models, levels’ objective and the testing of it on children as the results showed the success of the game in attracting the children and getting their concentration.

To sum up, educational games need to be got interested and introduced in the classrooms because it lets children from all different learning abilities learn from a different point of view and provides learning skills.

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