An Interactive Augmented Reality Alphabet 3-Dimensional Pop-up Book

For learning and Recognizing the English Alphabet

By

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ABSTRACT

This document describes the process developing an Augmented Reality (AR) alphabet book mobile application. Using only an android phone camera, the child could view the superimposed virtual alphabet 3 dimensional objects in a fun and interactive manner using the marker-less physical alphabet book as the interaction tool. The reason behind choosing alphabet teaching as the topic of the book is that the Alphabet knowledge is the core knowledge of any language. It is a jump-start for children to start reading and recognizing words and sentences, thus learning the alphabet is extremely important, for many researchers, emphasizing on how early, child's education shapes the child's successful future. Though there are, a great deal of technology based alphabet books; parents still prefer buying the old style physical books or some might use a virtual technology based book application. The problem is that though the physical book possesses many benefits, that our generation and the generations long before us, have experienced, yet from the current generation children's point of view, they may in fact find it dull and boring. For, it is commonly recognized, that the current generation children are surrounded all around by technology and gadgets, that can make them board, easily distracted, and may refuse to willingly use a plain non-technology book to learn, and if using a virtual application, they will lose the benefits offered by a physical book. Knowing this, the use of Augmented Reality should solve such a problem. For Augmented Reality (AR) is considered the best of both worlds, where, real and virtual objects are combined in the real environment, that will allow the use of both technology based application and a traditional physical book, combining the benefits of both and meeting the child and the parent midway. Although AR technology is not new, its possible potential in education is just beginning to be investigated. The main aim of this research is to develop an interactive 3-Dimentional alphabet pop-up book, and using digital storytelling, to help teach children to learn and recognize the alphabets. The objectives of the study are to enhance the interactions of the alphabet book, by creating an android application that contains animated interactive 3-Dimentional models, interactive sounds, songs and music. Furthermore, to investigate the use of digital storytelling (music, sounds), interactions and animation effect in learning engagement, through using the augmented reality technology. The scope of this project and research is very wide, it includes the 3D modeling, texturing, rigging & animation, book design and content decision research, furthermore, Augmented Reality and Android application development. It also includes research on interactivity options to be implemented through user perspective observations. Finally, it was found that the children enjoyed using the application and sang along to the songs provided for phonics learning.

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INTRODUCTION

1 INTRODUCTION & BACKGROUND OF STUDY

It is common that every kid in either pre-kindergartens or kindergartens have a problem to start learning alphabet. Learning and mastering the alphabet knowledge is necessary for kids. Alphabet knowledge is crucial as a jump-start to read and spell (Adams, 1990; Ehri, 1987; 1998). Most of the times, parents will buy few of the alphabet books or any other learning tools in order to make sure their kids get familiar with the alphabet and can recognize them well before starting school. However, children nowadays get bored easily with the traditional plain books according to interview with parents. They want something advanced and different

Augmented reality (AR) is one of the emerging technologies that are widely used in various fields like medicine, advertising, military, travel and education. AR allows users to manipulate and retrieve data within the real world, and allows the user to experience the realness of an idea without endangering consequences.

It also allows the user to grasp and understand some logics, theories and facts that can't be easily seen or used like understanding the human anatomy (muscles, tissues) or the solar system and universe.

However, Augmented reality for education is capable of providing interactive, interesting & fun learning to grab their attention and guarantee the higher possibility of understanding and to enjoying the subject being taught. The reason behind using Augmented Reality to develop the storybook is that AR combines both "real and virtual objects in a real environment" (Yuen, Yaoyuneyong, & Johnson, 2011). Therefore AR is considered to be the best of both worlds (the real & the virtual).

Moreover, Shapiro, 1998 in How to Raise a Child with a High EQ: A Parents' Guide to Emotional Intelligence mentioned, "Many people don't realize the extent to which stories influence our behavior and even shape our culture." Referring to these shows the importance of storytelling is an important part of human culture in both entertainment and education. Traditional storytelling by traditional physical books enables **"multi-sensory"** experiences including speech (narration), vision (seeing the book) and touch (turning pages and pointing)" (Zhou, Cheok, Pan, & Li, 2004)

Digital storytelling with AR integration will still use the traditional physical book to enable the children's "multi-sensory" experience as mentioned earlier. Moreover AR will overlay the 3-D interactive virtual environment on top of the physical world (the storybook) using a technology (in this case mobile device (Android)).

Hence, the application will give the children a total imerssiveness in the story as if they are part of the magical story they are reading. For Augmented, reality is designed to "haze the link between the realities the user experiencing and the substances provided by technology". (Thomas, 2012)

Finally, the aim of this study is to enhance the interactions of traditional books, while still keeping the main advantages of traditional physical books and this can be successfully implemented using AR. The basic idea behind this project is to develop a new interface by applying interesting interactive objects to capture the interest of the nowadays kid. The application will provide a realistic environment using 3-D graphics, sound, music and speech to encourage interaction between the child and the application, giving the child a popup magical experience.

1.1 Problem Statement

The current methods with learning the alphabet can be boring, dull and non-interactive. A new study by Common Sense Media finds mention in the New York Times that "children under 8 are spending more time than ever in front of screens,". Furthermore, Santoso, Fei Yan & Byung Gook (2012) added in their research that the present generation is accompanied by digital technology such as computers, video games, smart phones and mobile devices.

Therefore, nowadays, kids, even infants are native media literate. This scenario leads the kids to have an advanced expectation on the learning activities, which make them less interested to study using the plain traditional alphabet books, and would rather play with their gadgets and with the technology they are surrounded by. While, parents still buy traditional books to help teach their children the alphabet. Hence, the kids feel dull and bored.

1.1.1 Significance of the project

Current methods of learning obviously doesn't match With the advanced technology nowadays, in a research by (Parhizkar, Shin, Lashkari, & Nian, 2011) found that children found that reading in conventional ways is dull and tiresome, where there are so many entertainments out there which is much more interesting than reading. (Parhizkar, Shin, Lashkari, & Nian, 2011) also concluded that teachers have to come out with ideas that would attract children's attention to make the "study more interesting in order to encourage the reading habit". (Parhizkar, Shin, Lashkari, & Nian, 2011)

Figure 1: A little girl playing with an Ipad (Mannino, 2013)

The problems should be tackled as kids nowadays are more advanced and get bored easily if the learning process does not run efficiently. They are exposed to various technology advancement, thus they also might have different expectation on the learning process. Therefore, the common current methods of teaching the alphabet are worrying the parents, because their kids seem uninterested and do not want to learn the alphabet, which is the core basis of learning any language to start reading and writing.

Thus, an interactive digital storytelling alphabet application book should be developed to allow the kids to have fun and engaging learning process. Using augmented reality technology is the best of both worlds combines both virtual and real environment to give a magical mixture that combines both virtual and real environment benefits.

1.2 Objectives of Study

The Study aims are to develop a fun and interactive AR alphabet Storybook for children to learn and recognize the English alphabet:

I. To enhance the interactions of traditional alphabet books by creating an interactive Augmented Reality user interface application on an android mobile for the AR book.
II. To investigate the use of AR digital story in engaging the children to learning alphabet.
III. To conduct a study on the effect of interactive AR animations on learner's engagement.

1.3 The Relevancy of the Project

Augmented reality offer the new form of learning process making it more interactive, and interesting. The project aims to integrate the AR technology as learning tools. For the time being, the project will be developed based on recognizing the English Alphabet and learn how to pronounce them through songs.

Generally, the application will offer the children to read the AR books using the Android tablets or smart phones. With the advancement of AR technology, kids will be able to manipulate and interact with the virtual views of the book; thus making the learning becomes more exciting. If the project is successfully developed, the AR book can be readily used by the kids and the user's perception study will be done accordingly. With the success of the project, the learning process should definitely be more fun, exciting and interesting.

1.4 Scope of Study

The objective of this project is to develop an interactive Augmented Reality based story with the possibility of introducing some game based learning. The game will be designed specifically for children of young age to help benefit from the learning advantages of storytelling mentioned in section 2.2. The scope of this project involves several areas that will be used in development as follows:

I. **Augmented Reality** is the emerging technology and widely used in various fields. One of them is in education field. Publishers and developers are interested to make the learning process becoming interesting in order to attract student or kid's interest to learn. Thus, the project aimed to develop storytelling alphabet book using the Augmented Reality technology.

II. **3-D Design & Animation:** Maya, Blender and other programs will be used to design and animate 3-D characters and props to be used in the AR book.

III. **An Android (Mobile) Applications & Interaction:** Since the Mobile technology is now available and very useful and affordable and not only adults are familiar with the use of such devices you can find 3 years olds carrying their smart phone and playing around with it. Thus, the project aimed to develop AR application on Android tablet instead of using the PC or computer. Since Android operating system is an open source and Google releases the code under the Apache License, it is the most common used operating system for smart phones rather than IOs (apple operating system). With the completion of the project, kids will be able to use the application embedded on their Android tablet while enjoying reading the AR books.

IV. A physical storybook: Adobe Photoshop and InDesign will be used to create the book 2-D graphics (marker images) and the storyline.

1.4.1 Feasibility of the Project within the Scope & Timeframe

In Summary, the target users for the application children with age ranging from three to 6 years old, preschool as well as early primary school. The application allows the child to read and listen to the story using their phone and a physical book, and by using AR, the children will be able to manipulate and interact with the 3-D models to learn and discuss what they have acquired from the book.

The project will be developed on two studying semesters as in eight consecutive months. The first four months will involve the first few phases of the methodology process, which are the planning, Analysis & designing phase (See Section 3.1-3.3). In the second phase of the project (second 4 months) will be focused on developing, Implementation then testing (Section 3.4-3.5). Therefore if the tasks were properly managed and the time was wisely allocated this project should be feasible within the timeframe. (See Gantt chart for first phase Section 3.3)

CHAPTER 2

LITERATURE REVIEW

2 LITERATURE

2.1 Augmented Reality

As mentioned by (Graham, Zook, & Boulton, 2013) Augmented reality (AR) is an animator, direct or indirect, view of a physical, real-world environment whose elements are augmented by computer-generated sensory input such as sound, video, graphics or GPS data.

Therefore, the technology functions by improving the current perception of reality. AR is usually in real-time and in a semantic framework with environmental elements, such as the small news slip on TV while a movie is playing.

With the help of advanced AR, technology nowadays the information about the surrounding real world of the user becomes interactive and artificial information about the environment and objects can be digitally overlaid on the real world.

However, (Yuen, Yaoyuneyong, & Johnson, 2011) argued in their article titled A Survey of Augmented Reality Technologies, Applications and Limitations in the Journal of Educational Technology Development and Exchange; that such definitions that were mentioned earlier are" too simplistic for an evolving and expanding field" , For an AR system :

- Combines real and virtual objects in a real environment. (Krevelen & Poelman, 2010)
- Registers (aligns) real and virtual objects with each other.

And

- Runs interactively, in three dimensions, and in real time.

(Zhou, Duh, & Billinghurst, 2008) Simply define AR as technology "which allows computer generated virtual imagery to exactly overlay physical objects in real time" (p. 193).

Figure 2: Augmented Reality (Dubois, 2011)

The goal of augmented reality (AR) is to add the information and significance to a real object or places. Augmented reality is designed to haze the link between the realities the user experiencing and the substances provided by technology.

Augmented Reality has received good acceptance from the people all around the world despite being relatively new developing technology. Though it is not fully developed, technological giants from all across the globe are constantly investing in research and development for the same (Thomas, 2012).

2.1.1 Augmented Reality VS. Virtual Reality

According to (Weng & Giap, 2008) member of the Faculty of Cognitive Sciences and Human Development, at the University Malaysia Sarawak described the difference between Augmented Reality and Virtual Reality by stating the following: "Unlike Virtual Reality (VR) that aims at replacing the perception of the world with an artificial one. AR has the goal of enhancing a person's perception of the surrounding world. Being partly virtual and real, the new interface technology of AR which is able to display relevant information at the appropriate time and location, offers many potential applications; these include aiding in education, training, repair or maintenance, manufacturing, medicine, battlefield, games and entertainment".

Figure 3: AR ATM Finder Application (Cool App: ATM Finder with Augmented Reality, 2010)

Meanwhile considering the array of the developing technologies, all seeking to modify, Augmented, interface with, or even replace our perceptions of reality, (Milgram & Kishino, 1994) wanted to clarify the difference between real & virtual considering the array of the developing technologies by defining four types of environments.

First is the real environment, which is the environment that everyone lives in. On the opposite end of the scale are virtual worlds (virtual reality), in which all information perceived by the user is computer-generated and completely unrelated to real world locations, objects, or activities. Between these two extremes, exist, at least conceptually, two types of augmented environments: Augmented Reality (AR), which takes the real world and real environments as its framework and inserts computer-generated content. While augmented Virtuality, in which a computer-generated world serves as the backdrop while real-world data are blended in and superimposed. Figure 4 illustrates the Mixed Reality (MR) spectrum, or the Reality-Virtuality (RV) Continuum, proposed by (Milgram & Kishino, 1994) .

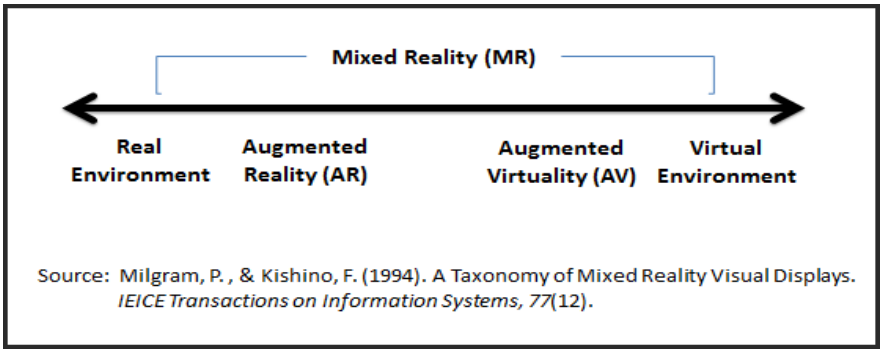


Figure 4: Mixed Reality Spectrum

AR is closer to the real world on one end of the scale with the dominate perception being the real world which is improved by digital data. AV on the other hand is closer to a completely immersive virtual environment involving systems that are mostly computer generated, but would have some real world imagery added. Virtual environments (VE) are environments that are totally simulated by the technology.

Figure 5: Virtual reality games on Kinect (Project Natal: Changing Gaming Virtual Reality, 2010)

As the technologies continue to rapidly advance, it seems possible that the virtual elements and real world elements, sharing space in mixed reality environments will become more and more difficult to tell apart.

2.1.2 Types of Augmented Reality

There are two types of augmented reality: marker-based which uses cameras and visual prompts, and marker-less which use positional data for example a mobile's GPS and compass (Patkar, Singh, & Birje, 2013).

2.1.2.1 Marker Based

This technology uses physical-world symbols as a reference point for computer graphics to be overlaid. Marker-based AR typically uses the camera feature of mobile devices or computer to analyze and capture the markers. Users can observe different view of the real objects with the use of the markers. QR codes are mostly used in the type of AR.

Figure 6 : QR Augmented Reality example

The other more advanced marker based on is including Popcode and GoogleGoggles. The position of the marker may results to different results sometimes. Users can move the markers to view the virtual model of objects in different angle.

Marker based AR is:

- Marker-based AR uses a camera & a visual marker to determine the center orientation and range of its spherical coordinate system.
- Most of the time, the applications using markers are an open source technology.

2.1.2.2 Marker-less

Marker-less AR typically uses the GPS feature of a Smartphone to locate and interact with the surrounding. There are few programs available to create the marker-less AR application, which includes ARIS, aurasma, and Layar. ARIS is an open source Augmented Reality and Interactive Storytelling program.

Using a Flash based browser interface, users can create AR games, tours, and other imaginable interactions for delivery on the iPhone, iPad touch (with camera), and iPad 2 (Dartmouth Collage, 2013) .

Aurasma uses the smartphone's GPS, camera, accelerometer and other features to recognize the surrounding area and display interactive AR content without the need for barcodes (Dartmouth Collage, 2013)

Layar displays digital information called "layers" in the user's field of vision through their mobile device. Layars can be viewed using the Layar App for iPhone and Android based smartphones (Dartmouth Collage, 2013).

Figure 7 : Marker-less AR (SmartAR)

Figure 7 above shows the marker-less AR application developed by Sony called "SmartAR". SmartAR technology uses "object recognition technology" to achieve the markerless functionality (Sony, 2012). It also boasts extremely accurate high-speed tracking, 3-D space recognition and interactivity.

Markerless AR is:

Figure 8 : Markerless Augmented reality Calculator

- Currently one of the best technology for tracking
- It performs active tracking & recognition of real environment on a type of support without using special placed markers.
- Allows more complex augmented reality applications.

2.1.3 Devices used for Augmented Reality

- Desktop

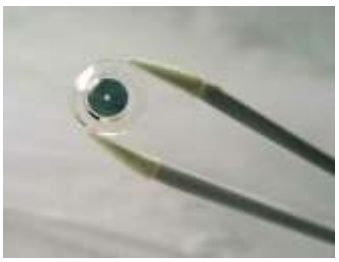
- Head mounted devices

- Mobile Devices

- Eyeglasses

Figure 9 : Google glass

- Contact Lenses



2.1.4 Augmented Reality Applications

Augmented Reality (AR) has been pursued in research because it may

I. Allow for the improvement of users' perceptions, knowledge, and interaction with the real world (Azuma, et al., 2001) .
II. since, AR has the potential to improve productivity in real world tasks (Schmalstieg, 2001) (Krevelen & Poelman, 2010) mentioned that AR is the technology which is capable of creating the "next generation, reality-based interface" and is moving from laboratories around the world into various industries and consumer markets. (Yuen, Yaoyuneyong, & Johnson, 2011)

Nowadays, the application of the augmented reality has been widely used in various fields including aviation, medication, industrial design… etc... However, (Ludwig & Reimann, 2005) offered an organizational scheme, which claims that AR applications fall into three main categories:

I. Presentation and visualization.
II. Industry.
III. Edutainment.

Additionally, Hamilton (2011) mentioned an extensive breakdown and analysis of AR applications within education, as well as within the media and entertainment industry, the gaming industry, the travel and tourism industry, the field of marketing, the expanding field of online social networks, and in everyday life. (Yuen, Yaoyuneyong, & Johnson, 2011)

Finally, it cannot be denied that AR applications have tremendous potential in all fields where rapid information transfer is critical (Krevelen & Poelman, 2010). For this reason, the development of AR in several nonacademic fields will be examined, before specifically addressing the applications of AR in education in section 2.3

2.1.4.1 Medical Applications

According to (Samset, et al., 2008), AR technology will not only be able to enhance medical surgical and clinical procedures by improving cost effectiveness, safety, and efficiency, medical AR systems may also assist in the invention of new surgical procedures (Yuen, Yaoyuneyong, & Johnson, 2011). AR systems have potential to support surgeons with navigation and orientation before, during, and

after surgery. AR systems can use streaming input data to create virtual superimposed images in real-time.

According to Dr. Michael Aratow Chief Information Officer for San Mateo Health Services, AR has been used and it has been playing a huge role in the medical field, for nearly ten years. One of the interesting uses for AR in the medical field involves live interactive imaging for assisting physicians, medical students and children. Minimally invasive surgery (MIS) includes procedures where a camera is inserted into the patient's body to help the doctor visualize the procedures he or she is conducting. In one example (Figure 8), this form of surgery is aided with the use of AR imagery of a brain superimposed onto the patient's head, giving the doctor a more tangible visualization. Another example involves being able to visualize a patient's spine in order to more accurately place a spinal tap, or other spinal injection.

Figure 10: Example of AR use in Medicine (ARISER Augmented Reality in Surgery)

These visualizations can also extremely useful tools for educating both students and children about medicine. With the help of augmented reality projections of bones, muscles, nerves and other internal body parts, MED students can practice procedures on mannequins in a somewhat real-world game of "Operation."

Applications can also help teach kids and medical students about anatomy by allowing them to peek under the skin and reveal the inner workings of human bodies

Figure 11 : Student studying the human bone structure (Finley, 2011)

2.1.4.2 Entertainment

Augmented Reality has been in the entertainment business for almost a decade. Augmented reality is implemented in several entertainment fields like cinematography, games and entertaining applications.

2.1.4.2.1 Cinematography

One of the most famous movies since using real-time Augmented & virtual reality is the movie Avatar the movie contains a lot still scenes in the film that features Augmented Reality. For example, the big map in the HQ that shows the Na'vi's (the people from the movie) tree, the stacks of spaceships that use HUD screens to navigate or the plenty of toys in the researcher's lab.

Figure 12 : Scene of the movie Avatar displaying an augmented reality 3-D Map

2.1.4.2.2 Electronic Games

The electronic games industry and the social media industry are both broadening their scope to include AR technologies. Smartphone apps now allow users to fire AR Gatling guns, which appear to hit real-world objects. Smartphone apps and handheld game consoles have released games which let users track and collect virtual fairies (Figure 9) and other mythological creatures which appear in the real-world around them (Lewis, 2005). According to (Raju, 2009) AR games of these sorts are noteworthy for providing stress relief.

Figure 13 : AR game that makes the users collect virtual fairies in real environment (Inbar, 2013)

2.1.4.3 Military

For many years military AR applications involving the Helmet-Mounted Sights (HMS), worn by fighter and helicopter pilots have been used. These helmets allow users to view relevant information such as instructions, maps, and enemy locations. (Yuen, Yaoyuneyong, & Johnson, 2011)

This information can also be displayed on a vehicle screen, or on the windshield of a turret. For the soldiers on the ground, as well as in the air, AR military-grade helmets are still in development, to be equipped with computers, 360-degree cameras, UV and infrared sensors, stereoscopic cameras.

Figure 14: Air force Pilot wearing an HMS (Farmer, 2013)

Wearing AR helmets, soldiers will be able to communicate with a massive "home base" server that collects and renders 3-D information onto the wearers' goggles in real time. Several objects and people will be defined in specific colors to notify soldiers of friendly forces, potential danger spots, impending air raid locations, and other critical data. With the full deployment of AR technology, the aspect of military combat may be completely changed.

2.1.4.4 Advertising and Marketing

Advertising & Marketing is the most dominate field that AR has been used in such a massive way. Where companies normally seeking new ways to involve and interest their potential customers, have implemented a diverse amount of AR applications which present users with virtual objects, apparently sharing their space, which can be discovered and manipulated using natural movements and hand gestures.

For example, the leading-edge automotive campaigns are displaying full-size AR virtual cars in shopping centers and other public areas.

Figure 15: Latest Adidas campaign using the logo as an AR marker

Another example would be smaller products, such as toys, that can be viewed virtually in stores and booths worldwide. Furthermore, the more sophisticated campaigns allow users to use their Smartphones to view, rotate, and resize virtual models of products in their environment, such as furniture, so that they can gain a more accurate impression of how the item would complement their current furnishings and decorating scheme.

2.1.4.5 Travel & Tourism

AR is not necessarily only used in combat to help soldiers but AR is also used to enhance user's experience navigating in the real world. Citizens are already familiar with using onboard GPS systems while driving, and familiar with online search apps to find locations and services. (Figure 14)

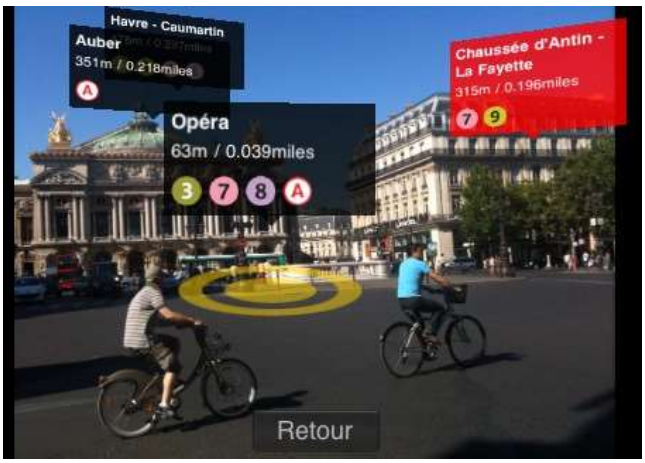


Figure 16: Metro Paris Subway on apple store (First augmented reality app hits the iPhone app store, 2009)

Additionally, nowadays with the growing use of social media, this happens to use data about people's real-time, real-world locations. Furthermore, with the use of AR more comprehensive interfaces showing historical and touristic areas) and business (locations, services) information relevant to the surrounding environment in their real-world location.

Moreover, that is all by simply checking the smart-phone GPS, where recently there are available informatory smart-phone AR applications have been developed to help expand the users' experience by supplying additional data based on their real-world location (Raju, 2009).

2.1.5 Augmented reality in Education

Given all of the developments that were mentioned earlier that demonstrates the functionality of AR, researchers have faith that AR has an immense potential insinuation and vast benefits in the augmented teaching and learning environments

(Billinghurst, 2002; Klopfe & Squire, 2008; Cooperstock, 2001; Shelton & Hedley, 2002) . For example, AR has potential to (Yuen, Yaoyuneyong, & Johnson, 2011)

I. Help teach subjects where students could not feasibly gain real-world first-hand experience (e.g. Astronomy and geography) (Shelton & Hedley, 2002)
II. Engage, stimulate, and motivate students to explore class materials from different angles (Kerawalla, Luckin, Selijefot, & Woolard, 2006);
III. Enhance collaboration between students and instructors and among students (Billinghurst, Augmented Reality in Education. New Horizns for learning, 2002).
IV. Foster student creativity and imagination. (Klopfer & Yoon, 2004)
V. Help students take control of their learning at their own pace. (Hamilton & Olenewa, 2010)
VI. Create a genuine learning environment suitable to various learning styles (Classroom Learning with AR, 2010).

In an article written by (Yuen, Yaoyuneyong, & Johnson, 2011) on Augmented Reality: An overview and five main directions, mentioned that the researchers have explored the use of AR applications within a variety of fields and disciplines, many of which are already directly or indirectly related to education. For example, Sielhorst, Feuerstein, and Navab (2008) have broadly studied the 1990s AR medical display literature.

Moreover, other like Kaufmann and his team have focused their AR research on applications in mathematics and geometry by creating an AR system to facilitate learning between instructors and students (Kaufmann H., 2003; Kaufmann & Dünser, 2007; Kaufmann H. &., 2003).

Additionally, researchers have explored the feasibility of various AR applications for use within the field e-learning systems (Cho, Lee, Soh, Lee, & Yang, 2007; Liarokapis, Petridis, Lister, & White, 2002), architecture (Billinghurst & Henrysson, 2009; Thomas et al., 2001), interior design (Phan & Choo, 2010), and science education ((Kerawalla, Luckin, Selijefot, & Woolard, 2006; Shelton & Hedley, 2002).

In the preceding subsections, some of the most significant educational applications of AR technology will be discussed: AR books, AR games, discovery-based learning, object modeling, and skills training.

2.1.5.1 AR Books

It is very likely that AR books will be the bridge that fills the gap between the digital and physical world. The AR technology has a great potential to offer students 3-D presentations and interactive experiences that are likely to appeal to digital native learners.

For instance, an AR book entitled "*The Future is Wild: The Living Book"* was developed by Meatio in Germany and was launched at the Frankfurt Book Fair in 2011. The book, with 42 integrated AR special features, demonstrates the potential of AR to encourage readers to build a connection to a book (Yuen, Yaoyuneyong, & Johnson, 2011)

Another type of AR book experience is offered by AR pop-up books (Digilog Books), created by Gwangju Institute of Science and Technology (GIST) in South Korea, which can display 3-D characters spring from each page when readers wear a special pair of glasses. The AR system usually functions in real-time with 30 fps and supports about 300 pages without losing real-time performance (Yuen, Yaoyuneyong, & Johnson, 2011).

Figure 17: Child uses an AR popup book developed by Popar (Idealog, 2012)

Most importantly in addition, AR books can be used at the primary level. The Institute for the Promotion of Teaching Science and Technology in Thailand developed a 3-D augmented reality geology textbook, which teaches students about the discovery of the earth's layers, relationships, differences, and functions (Yuen, Yaoyuneyong, & Johnson, 2011).

In addition, Magic Book, an AR interface system, allows AR content to be created for any normal book," bringing the book to life " (Yuen, Yaoyuneyong, & Johnson, 2011) with animated and even interactive models drawn from the text or illustrations already in the book (Billinghurst, 2002).

Moreover, by using a more conventional AR technology, AR books have been released featuring animated images, overlaying and interacting with the pages of the book, and accompanied by music and sound effects (Billinghurst, Kato, & Poupyrev, 2001). Another approach involves AR 'popup' books, in which still or animated 3-D images hover over the pages of the book, often accompanied by sound (Billinghurst, Kato, & Poupyrev, 2001). Meanwhile, the development of the markerless AR tracking is assisting in the creation of more traditional board games, such as Monopoly, in a virtual augmented format.

Currently in our society, where critics of conventional literature have begun to become aware that even video games can be in stores, AR books will open the art of fiction and storytelling to an entirely new interface, demanding greater attention from the 'authors' to a variety of issues, such as the books unity, quality and immersiveness

The main reason why printed learning materials are favorable is to be able to make the systematic study. For example, the textbooks are generally well organized according to level of readers. Textbooks may involve many elements such as concepts, rules, analogies, and imagery so that information may be stored in long-term memory (Kikuo Asai et al, 2005). Augmented Instructions enable us to use a learning style based on printed materials and to access additional information using the concept of AR.

In augmented instructions, markers or tags are added to the text to identify virtual information related to the descriptions in the text, and are detected with an image-processing tool, ARToolkit (Kato, Billinghurst, Poupyrev, Imamoto & Tachibana, 2000). Figure 12 above shows a 3-D graphic image overlaid onto the scene captured by a camera (Kikuo Asai et al, 2005).

However, the potential of AR books to grab the attention of many types of learners, through many paths, is undeniable and very exciting for educators.

2.1.5.2 AR Educational Gaming

Educators often use games to assist student to easily grasp class concepts, but with the help of AR technology, the games that are based in the real world , when augmented it gives the educators' powerful new ways to show connections and relevancy to the topic they are teaching. (Yuen, Yaoyuneyong, & Johnson, 2011)

Games that use marker technology often include a flat game board or map which becomes a 3-D setting when viewed with a mobile device or a webcam. Such games could be easily applied to a vast range of disciplines, such as archaeology, history, geography...etc..

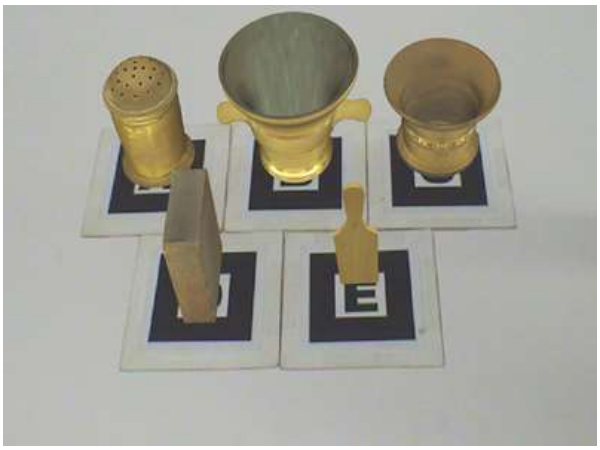


Figure 18 : AR in Education of Archaeology and Cultural Heritage (AREL - Augmented Reality in Education and Learning)

AR games give the educators the opportunity to exploit a new visual and highly interactive form of learning. For example, SimSnails is an interactive visualization and teaching tool that helps the players "learn about, and experiment with, the concepts of natural selection and evolution" (Yuen, Yaoyuneyong, & Johnson, 2011).

2.1.5.3 Discovery-based Learning

AR Applications that convey information about a real-world place open the door of discovery-based learning it provides students with "up to the minute" (Yuen, Yaoyuneyong, & Johnson, 2011) information. Wikitude and similar mobile applications could transform school field trips by replacing paper question sheets with just-in-time information on locations, concepts and sites access activated by learners' smart phones' GPS when they encounter items of interest. Using AR future field trips can turn into virtual "scavenger hunts" (Yuen, Yaoyuneyong, & Johnson, 2011) with specific information on gathered from different locations.

Figure 19: Learning Languages using LearnAR

Another application, LearnAR www.learnar.org, uses AR technology to help students to have a more investigative, interactive and independent learning. LearnAR created a pack of ten curriculum resources and learning activities teachers and students to explore by using a webcam in numerous subjects, such as biology, chemistry, English, math, ...etc. (Yuen, Yaoyuneyong, & Johnson, 2011)

Such AR activities allow independent investigations of scenarios (e.g. Chemical reactions, learning about Sikhism, and exploring 3-D geometric shapes). LearnAR offers flexible learning, (Figure 16) which means it can be used in class by teachers and students or at home by students exploring the subjects independently

2.2 Storytelling in Education

Storytelling is an effective and important educational means for children, as stressed by the most brilliant men in history Albert Einstein & G.K Chesterton.

Figure 20: The Boyhood of Raleigh by Sir John Everett Millais, oil on canvas, 1870 (Wikipedia).

"If you want your children to be intelligent, read them fairy tales. If you want them to be more intelligent, read them more fairy tales. "- Albert Einstein (Albert Einstein Quotes)

"Fairytales don't tell children that dragons exist. Children already know that dragons exist. Fairytales tell children that dragons can be killed '- G.K. Chesterton

In addition, as mentioned by (Atta-Alla, 2012) in his journal that storytelling is a means for sharing and interpreting experience, "Human knowledge is based on stories and the human brain consists of cognitive machinery necessary to understand, remember, and tell stories" (Schank & Abelson, 1995).

The stories are universal in that they can bridge cultural, linguistic, and age-related divisions. Storytelling can be adapted for all ages leaving out impression of age separation.

The stories reflect human thought as humans think in narrative structures and most often remember facts in a story form. Facts usually can be interpreted as a smaller version of a larger story, thus storytelling can supplements analytical thinking. Since, storytelling requires auditory and visual senses from the listener, a person who can learn to organize his/her mental representation of a story and recognize the structure of the language, and express his/her thoughts. (McKeough, et al., 2008)

Books may involve many elements such as storytelling, analogies, and imagery so that information may be stored in long-term memory (Kikuo Asai et al, 2005). Besides, storytelling does encourage students to explore their unique expressiveness and can increase student's ability to communicate thoughts and feelings in proper manner and means. Storytelling can be a nurturing way to remind children that their spoken words are powerful, that listening is crucial and that clear communication between people is necessary. Another benefits of storytelling is it allow students to gain verbal skills and becoming verbally proficient thus directly build their ability of resolving interpersonal conflict (Heather Forest, 2012). Storytelling can also act as an efficient way on passing values and wisdom so that young people who listen to the storytelling can identify the personal values from the imaginative situation, as well as identifying the wise and unwise actions that should be taken for some particular situation (Forest, 2012)

Below is a list of why Storytelling is important in education:

1. **Storytelling is the oldest form of education**	Cultures have always told tales as a way of passing down beliefs, traditions, and history to future generations. The stories are at the core of all that makes us human**. (Hamilton & Weiss, 2007)**
2. **Familiarity**	The oral narrative form is familiar and so represents a useful tool for teaching. It allows the learner to engage with and consider new concepts, ideas and problems.
3. **Reading Motivation**	Listening to stories instills the love of language in children and motivates them to read.
4. **Focus & Investigative**	Stories might be discussing an issue, an artifact or a connection. A story may relate to a specific era or historic events.
5. **Visualize & Perceive**	Stories generate incredibly imaginative responses in the listener. The story delivers and stimulates a series of vivid images in the any person's mind. Moreover, if the storyteller has skill, then the imaginative experience of the listener is polysensual, with all five senses being called into play.
6. **Empathize, Imagine, Interpret and respond**	Response to the story is immediate and occurs as the narrative is being delivered and received. This response is fired by imagination, empathy with characters and situations, interpretation and visualization of the narrative and the analogies, metaphors and allegories within it. The narrative involves characters: whether they are children or adults or even strictly 'human' these provide a point of reference for empathy.
7. **Explore, describe, inquire and question responding to the story**	Through interactions between storyteller and audience in the exchanges that follow a storytelling session and when retelling a narrative, are processes of exploration, description, and inquiry and questioning.
8. **Order, analyze, reflect, compare, connect and make judgments**	Exploration, inquiry and questioning can be further developed into a more detailed analysis. For example, motivation - how and why characters acted and interacted in the way they did; cause and effect and the interconnections between the various elements of the story on a range of scales: both geographic and temporal; literal and metaphoric. And this can be taken further by making comparisons with other stories
9. **Anticipation and problem solving**	Stories abound with playfulness. They can break the rules that apply to everyday experience and perception, and at the same time can conform

	to patterns of inevitability. Either way they present opportunities for listeners to engage with the prediction of outcomes. Trickster tales demonstrate cunning at the service of selfishness or for the sake of the common good. Tales of fools emphasize the nature of wisdom, and riddling tales exercise ideas of logic and choice.
10. **Discern fact from fiction**	Stories deal with facts and fictions. They delight in ambiguity and paradox. Exposure to a diverse range of stories and narrative traditions help listeners to begin to discern truth from lies. Some stories delight in stretching plausibility to the limit; others capture truth with brevity and nostalgia. Even the most fantastical myths contain emotional truths, and can be expressions of metaphorical truths that cannot be directly expressed.
11. **Construct meaning, assimilate and apply understanding**	Developing understanding leads to the listener and the storyteller, constructing meaning from the narrative and with further support; this can be then applied to more familiar situations, contexts and experiences. In this way the meaning of the narrative, however old its source and where and when it is set can be given a contemporary relevance for the individual's hearing, retelling and working with the story here and now.
12. **Accepting, understanding and dealing with change**	Stories deal with change. Change is something that everyone, without exception, has to deal with. The changes to the character may be social or economic, such as the change experienced by Cinderella, or physical, as in Beauty and the Beast, or emotional, as in the awakening of remorse and pity in so many epic heroes.

2.3 Digital Storytelling and Augmented Reality

Storytelling is an effective and important educational means for children. Properly designed digital stories will provide a technology-based learning environment that provides students with more options than what is available in traditional learning.

Media have been used with more traditional delivery methods such as lectures, and tutorials to support the essential teaching objectives, such as clarifying and illustrating complex subjects, adapting to the individual learning styles of each student, improving and aiding and the recalling of subjects and topics. (Figure 21)

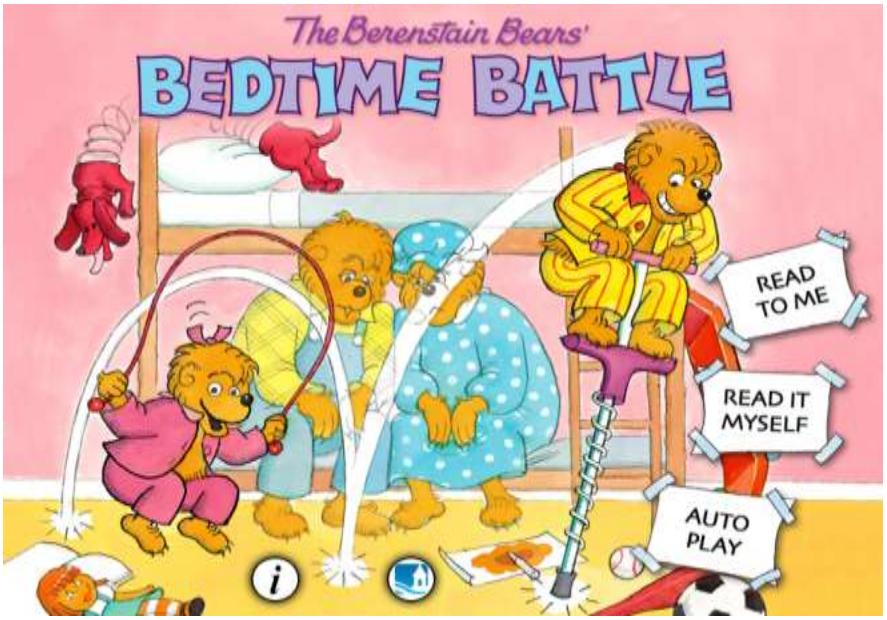


Figure 21 : Digital Storybook titles Bedtime Battle on apple store (KELLY, 2012)

Nowadays, in technology enhanced learning and teaching environments, storytelling is supported by various multimedia tools that are embedded in the learning channel in visual, auditory and kinesthetic formats.

Adding such aids makes a story become more facilitated and digitalized through which it becomes richer in content and application. The action referred as to the delivery of the story is known as “Digital (ly) (Story) Telling”. Digital Storytelling is the modern expression of the ancient art of storytelling.

According to Leslie Rule (2010)

“Digital storytelling is the modern expression of the ancient art of storytelling. Digital stories derive their power by weaving images, music, narrative and voice together, thereby giving deep dimension and vivid color to characters, situations, experiences, and insights.”

In addition to the above, digital storytelling provides rich teachable moments in regards to helping students become media literate. Many different software programs are available that support Digital Storytelling.

2.3.1 Digital Storytelling with Augmented Reality

(Zhou, Cheok, Pan, & Li, 2004) Storytelling is an important part of human culture in both entertainment and education. The traditional storytelling using books enables multi-sensory experiences including speech (narration), vision (seeing the book) and touch (turning pages and pointing).

The aim with AR is to enhance the interactions of traditional books, while still keeping the main advantages of these traditional physical books. With the augmented reality (AR) technology, storytelling becomes more interactive and intuitive in the sense of human computer interaction.

Figure 22: WONDER BOOK: BOOK OF SPELLS AR popup storybook (Bill, 2012)

2.4 Mobile Technology

Mobile technology is defined as the technology that is mobile and portable, which allow variety of tasks to be performed via mobile devices such as PDA, laptops, cellular phone, smart phone or tablet. A standard mobile device has gone from being no more than a simple two-way pager to being a cellular phone, a GPS navigation system, a web browser, and instant messenger system, a video gaming system, and much more. It includes the use of a variety of broadcasted media such as radio wave, microwave, infra-red, GPS and Bluetooth to allow for the transfer of data via voice, text, video, 2-dimensional barcodes and many more (Mobile Technology Association of Michigan, 2013).

In 2012, 87% of world population own mobile devices. In today's generation, mobile devices is a tool that everybody has as it enhances the daily communication the people, and allows some necessary transactions and tasks to be accomplished in less time. Mobile Technology provides various benefits in business (Gebauer & Shaw, 8) and in education (Eschenbrenner & Nah, 2007) due to its mobility, and faster communication.

Today's mobile computing is best used by use of the Internet on Smartphone devices, including the Apple iPhone, Google Nexus One, and RIM BlackBerry (DRESNER ADVISORY SERVICES, LLC; MicroStrategy, 2012)

The adoption rate of smartphones is far outpacing previously observed adoption rates of Internet or desktop-based technologies. The reasons are such mobile devices provide constant connectivity and communication between people and are convenient to carry, extremely powerful, and easy and fun to use (DRESNER ADVISORY SERVICES, LLC; MicroStrategy, 2012).

Hence, the number of people owning a smart phone is far much greater than the number of people owning laptops. Moreover, Mobile technology benefits many parties in today's industry including business, education, health, banking and many others.

2.4.1 Android Operating System

Android is one of the widely used smart phone's platforms. Android is a Linux-based operating system, which designed primarily for touch screen mobile devices such as smart phones and tablet computers (GSA Arena team, 2012).

Android, Inc. was founded in Palo Alto, California in October 2003 by Andy Rubin (co-founder of Danger), Rich Miner (co-founder of Wildfire Communications, Inc.), Nick Sears once VP at T-Mobile, and Chris White (headed design and interface development at WebTV) . On August 17, 2005, Google acquired Android Inc., making it a wholly owned subsidiary of Google. By the end of 2010, Android had become the world's leading smart phone platform, while at the second quarter of 2012, it is announced that Android had a worldwide smart phone market share of 68% and 75% in the third quarter of 2012.

On September 2012, Hugo Barra VP of android products in google announced on google+, that there were 500 million devices activated and 1.3 million activations per day (Barra, 2012) .

Moreover, on July 2012, Android's market share in the United States reached the value of 52% (Fingas, 2012) ; meanwhile, it rose to 90% in the China market (Millward, 2012).

Table 1 : Percentage of Market Share of Top Smartphone Platform (Survey in US) (Fingas, 2012)

Top Smartphone Platforms
3 Month Avg. Ending Jul 2012 vs. 3 Months Avg. Ending Apr. 2012
Total U.S. Smartphone Subscribers Ages 13+
Source: comScore MobiLens

	Share(%) of Smartphone Subscribers		
	Apr-12	Jul-12	Point Change
Total Smartphone Subscribers	100.0%	100.0%	N/A
Google	50.8%	52.2%	1.4
Apple	31.4%	33.4%	2.0
RIM	11.6%	9.5%	-2.1
Microsoft	4.0%	3.6%	-0.4
Symbian	1.3%	0.8%	-0.5

The table above shows the comparison of percentages of the market share of the top smart phone platforms based on survey in the US in 2012. Android is still leading the chart and has just reached a new high of 52.2% for the US smartphone share as of this past July. Furthermore, an internal study by apple reveals eight

reasons why people choose android over iPhone (Sid, 2012) shown in the figure below:

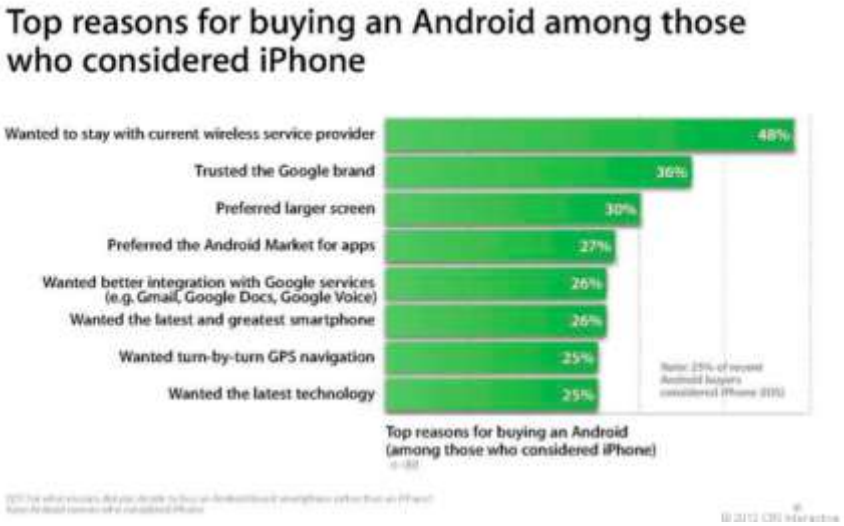


Figure 23 : 8-Reasons why people choose Android (Khatri, 2013)

Moreover, up until today, numerous amounts of Android applications are being developed and published on Google Play or Amazon Appstore for people to download and use. As of June 2012, there were more than 600,000 apps available in the Google Play Store, and the estimated number of applications downloaded from the Play Store exceeded 20 billion (Fingas, 2012)

2.4.2 Mobile Learning

Mobile learning (M Learning) offers a new way to infuse learning into our daily life. Mobile learning uses mobile computing technologies to enhance the learning experience; these technologies can be blended to engage and motivate learners, at anytime and anywhere.

The advantages of m learning over e learning include flexibility, low cost, small size and ease of use (Jones & Jo, 2004). For instance, (Uther, Zipitria, & Singh, 2005) developed adaptive computer-assisted language learning software called Mobile Adaptive CALL (MAC) for mobile devices. MAC is aimed at helping Japanese-English speakers in perceptually distinguishing the non-native alphabet such as the (/r/) and the (/l/) in the English phonemic contrast with a visual aid.

Figure 24: Father and son reading a story through a mobile phone (SÃ¡ndor, 2011)

Furthermore, Mobile game-based learning (MGBL) is quite famous lately and in demand, since many studies have found out that MGBL can improve learning motivation and interest, as well as develop creativity, For instance, an Environmental Detective game was developed by MIT and Microsoft in the Games to-Teach project. It is a handheld PC game where the player plays the role of the scientist to investigate a sudden of health problems stemming from point-source pollution problems (Antonellis, Bouras, & Poulopoulos, 2005) In the immersive learning environment, students experience real feelings and emotions as they do in a real world. Therefore, when mentioning immersive learning it automatically integrates with several new technologies specially Augmented Reality (AR) as mentioned in the earlier sections where AR creates an immersive learning experience.

Several studies have developed AR based learning games to explore how the AR technologies influence learning. For instance, (Daniel, Billinghurst, & Dieter, 2006) developed a handheld AR educational application in which a virtual character teaches users about art history.

This study explored how augmented reality offers benefits of effective and engaging educational application (Daniel, Billinghurst, & Dieter, 2006). Moreover, Faceret al developed a handheld AR game called Savannah, which was designed to encourage children to understand animal behavior. Children played the role of lions in a savannah, navigating the augmented environments with a mobile device.

2.5 Alphabet Learning

The alphabet is simply a collection of letters and the building block of any language. Letter knowledge among kid is one of the best predictors of reading and spelling acquisitions later in schools. This holds true in English, French, Dutch,

Portuguese, etc... (Adams, 1990; Ball & Blachman, 1991; Bruck, Bruck, Genesee, & Caravolas, 1997).

Furthermore, learning the alphabet should begin early in a child's life. However, some children do not learn their alphabet until they start school, which is typically not recommended and may cause the child problems in learning in the future (Mascle, 2005). Hence, the child should master the alphabet learning before preschool age (Donette E Davis, St Aidens Homeschool). Reviews of prospectuses for kindergartners in North America (California Department of Education, 2009) have shown that before children enter school, they should master in the letter recognition letter name, and also can identify the sound of letters correctly (Levin, Shatil-Carmon, & Asif-Rave, 2009).

Moreover, Bradley & Stahl from the University of Georgia also claim that mastering the alphabet knowledge simply means, one is expected to recognize the letter's shape, letter name, letter sound and possess the ability to print letters as well as rapid letter naming.

Resulting of later reading achievement appears to be depending on children's alphabet knowledge and recognition (Lonigan et al., 2000). The knowledge of alphabet names affects children's learning of the letters-sounds (McBride-Chang, 1999; Treiman, Tincoff, Rodriguez, Mousaki, & Francis, 1998). Which indicates that children use the knowledge of letter names to learn their respective sounds (Levin, Shatil-Carmon, & Asif-Rave, 2009).

Figure 25 : A Specimen of typeset fonts and languages, by William Caslon, letter founder; from the 1728 Cyclopedia. (Wikipedia)

In addition, children's knowledge of the correspondences between letters and sounds is both a fundamental and necessary precondition for developments in word recognition (Morris, Bloodgood, Lomax, & Perney, 2003; Storch & Whitehurst, 2002).

Alphabet knowledge is currently viewed as one of the most accurate identifiers of a young child's later risk for reading difficulties. Studies have shown under-developed alphabet knowledge is one of the most" readily- and reliably-identifiable risk factors" (Elbro, Borstrom, &Petersen, 1998; O'Connor&Jenkins, 1999).

Due to, the importance of the alphabet knowledge, thus many state curriculum frameworks (preschool) include the letter name and sound learning for young children (Ohio Department of Education., 2007).

Consequently, there are few numbers of ways on how the alphabet being taught. One of the most common ways is using the alphabet books. Alphabet books have been used for many decades or even centuries to teach the children letter recognition and shape. Fundamentally, an alphabet book contains capitals and lower case forms, keywords, which begin with the specific letters, or the illustrations of keywords. Alphabet books can be engaging especially if the book is using graphics or pop-up images that can attract the child's attention to read the book.

Furthermore, alphabet are also taught using songs to teach the child how to pronounce and to make it easier to memorize and recall. The alphabet songs can assist the children to recognize the sound of every letter in its alphabetical order. Moreover, the children can memorize easier if music is being attached along with the alphabet song so they can sing happily along.

Generally, children learn the alphabet at school. In almost any preschool, the alphabet is being taught in class. Commonly, teachers will show the kids on how to recognize the alphabet, write, and recognize and know few of the common objects that start with the according letter. At school, various mediums would be used by the teacher to teach the kids until they master the alphabet knowledge. The methods of teaching at schools are not reserved for alphabet books currently, teachers use IT (information technology) based mediums, which tend to be more engaging and interesting to teaching the children. Few of the examples of alphabet teaching and learning that uses IT, include the usage of CD-ROM and DVD-ROM. The usage of

CD-ROM and DVD-ROM require the program to be displayed and run using a laptop or desktop.

Baring in mind the current generation children are media and technology literate, the development of electronic books is thriving. Accordingly, most of the e-books are free and available almost everywhere on the internet. Parents now can only open the particular e-book thus help their children to use the book in order to learn alphabet. This way of learning seems to be fun as it offers great graphic together with some animations, plus the background sound. Thus, reading alphabet book is no longer been plain and boring.

In addition, there are many alphabet mobile applications that are available in various operating systems (OS) Android, blackberry, iOS, Symbian as well as Windows Phone. Most of the applications are free to be downloaded and used by the mobile users. The availability of various alphabet mobile applications indirectly helps the parents today has to attract the interest of their kids to learn the alphabet. The alphabet mobile applications teach kids on the letter's shape, letter's sound, and some of them also teach on how to write the letter. Besides, there are paid versions of alphabet mobile applications, which offer more functionality with fun and engaging alphabet games.

2.5.1 Available Alphabet Means of Teaching & Learning

Alphabet books have always been one of the first books that an average child would own. That is simply because most parents want their children to be familiar with the alphabet prior their pre-school entry. Generally, a kid would own two to three alphabet books bought by their parents to assist their learning process.

Generally, an alphabet book provides opportunities for developing conversations and proficiency in the oral language. Moreover it increases the phonemic awareness, teaching phonics, making text connections (activating prior knowledge), predicting (text talk), building vocabulary, extrapolation/ drawing conclusions, sequencing, identifying elements of story structure, recognizing point of view and visualizing setting (time, place and atmosphere), performing dialogue, as well as engaging multiple intelligence through writing, music, art and dance.

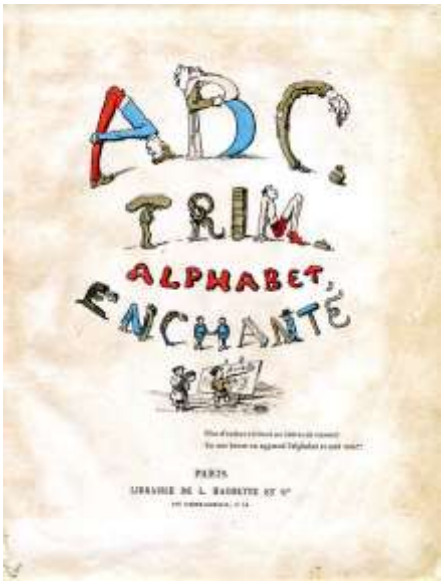


Figure 26 : A French ABC-book printed in 1861(Wikipedia)

Children's literature experts recognize the alphabet book as one of the first book forms written just for children (Huck, Hepler, Hickman, and Kiefer, 2001). It began in the 15th century in England as a hornbook, a wooden paddle with a piece of printed parchment glued on top and then covered by a leaf of horn. The printed parchment would show the letters of the alphabet written in capital case and lower case forms, a syllabary and very often the Lord's Prayer (Gutek, 2000).

In the 16th century, the alphabet was added to a devotional book printed for children's daily use. Due to Puritan influence, in the 17th century, United States and the alphabet continue to appear in religious and instructional books (Huck et al., 2001). In the 19th century, books like Mother Goose's A Apple Pie and Edward Lear's An Edward Lear Alphabet Book added amusement to the religious and instructional focus of the alphabet book (Sutherland, 1997). With the increase of better printing and binding facilities, alphabet books during the latter part of the 19th century became more widely written and published.

Figure 27 : 'Kate Greenaway's Alphabet' was published in 1885 in a miniature edition, and Edward Lear who had an alphabet published in 1871

Today, alphabet books range from simple teaching tools to elaborate works of art (JR.Deacle, 2002). Ehri, Deffner & Wilce (1984) claims that pictures do help children learn letter-sound correspondences and incorporating the letter-shape into the picture can be beneficial. It is proven that pictures play a big role in attracts the kid's interest to learn alphabet. From time to time, the alphabet books had been enhanced and various colors together with the pictures are used in order to attract kid's interest to learn the alphabet. To make some alphabet books more exciting and interactive, pop-ups and moveable parts have been used in addition to colorful illustrations.

With the advanced technology these days, children found that reading in traditional way is dull and boring whereas there are so many entertainments out there which is much more interesting than reading according to an interview of a tuition teacher from Vital Year (Parhizkar et al, 2011). Over the last two decades, there have been a number of efforts to replace or enhance real books with digital equivalents. Progress in e-Ink display technologies has led to the development of electronic books which offering better visual quality for reading. This continues and more advances effort done aimed at enhancing the traditional printed book with electronic features, 11 such as audio books, multimedia CD ROM books, online books, and electronic books readers (Grasset, Duenser, & Billinghurst).

In Proceedings of CLIR/Kanazawa Institute of Technology Roundtable, Marshall (2005) have shown that users still love the physicality of a real book as it offers many advantages, such as: transportability, flexibility, and robustness. Due to this

factor, thus there are many researches done for another future of books: digitally augmenting and enhancing real books, rather than seeking to replace them entirely. This combines the advantages of physical books with the virtual digital contents added (Grasset et al).

2.5.2 Current Alphabet Learning Approaches

The current alphabet learning approach can be divided into two groups, which consist of non-technology based and technology based. The approaches that are in non-technology based include Alphabet books and alphabet card as a teaching method. The teaching approached by technology based alphabet teaching includes CD-ROM, e-book, DVD and mobile applications. In the sections below, show several examples of current alphabet teaching/learning approaches.

2.5.2.1 Non Information Technology Based Approaches

My little ABC Book is an alphabet book that displays the alphabet together with an object, which are similar to the concept of most alphabet books. For each single letter, they are using one subject that related to that particular letter... The writer for this simple yet interesting book is Bob Staake and the book is published on March 1998 purposely for children age two years and above.

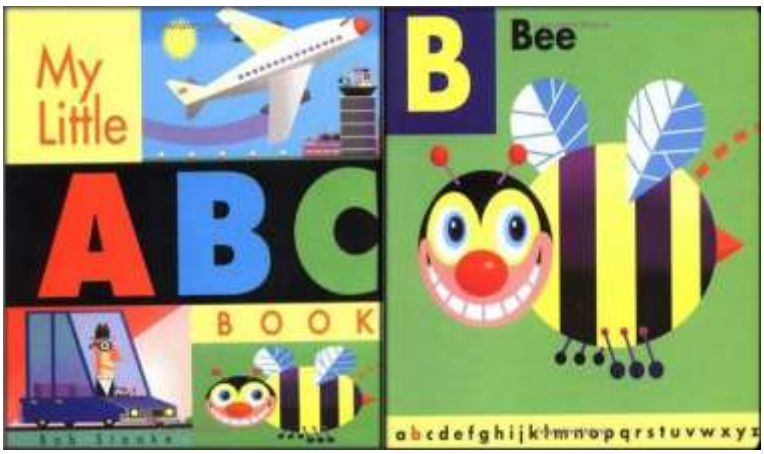


Figure 28 : My Little ABC Book; Alphabet B example

However, reading such book can be boring and plain activity where kids cannot interact. Even, there are astonishing with the use of full color, still kids nowadays would love to spend more times in technological devices compared to the plain book. The book might assist kids on letter recognition, but there is no audio sound for the letter, which cannot help kids with the letter sound. In addition, kids would love it if there were some animations of the object or the letter

Figure 29 : ABC3D Book; Alphabet An example

Another example of Alphabet book is ABC3D book. Essentially, the book only displays each 3-D single letter in each page, which is from A to Z. Interestingly; the book is designed and delivered by French Graphic artist Marion Bataille.

ABC3D is a 2009 Bank Street and claimed as the best children's book of the year. The book is released on October 2008, it offers the reader engaging 3-D letter models where reader can just flip the pages and enjoying how letters morph into each other.

However, this innovation is far advance and it might not really be suitable for little kids, who are just yet to start learning the alphabet. For, they might get confused and might not successfully recognize the letters. Moreover, the book does not provide any word examples of the alphabet, thus the children will not be able to recognize letters and associate them with words.

2.5.2.2 Information Technology Based

In replacing the physical books, CD ROM and DVD were introduced to gain kid's attention and interest to learn alphabet. Figure below shows the example of CD-ROM product, which teaches the alphabet.

I. CD/ DVD

Description

Jump Start advanced preschool from Knowledge Adventure (2006) is computer software, which includes a variety of preschool skills including letter recognition

activities, music, numbers and counting, spatial awareness, colors and patterns, musical styles, languages as well as thinking skills. Moreover, it applies an auto leveling of lessons, thus helping children learn at the pace that suits them. Furthermore, it offers multiple games and lessons, which will give children a never-ending stream of learning options.

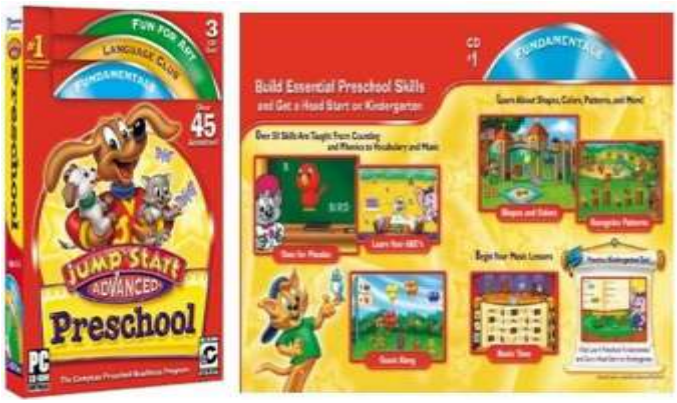


Figure 30 : Jump Start Advanced Preschool

Disadvantages

One of the major drawbacks of the product is that the software has to be installed and run on personal computer or laptop, which is quite inconvenient for children as it is not portable or mobile. Besides, as the program is based virtually; thus it might be great challenges on kid's preference as studies shown that children still love the physicality of books.

Description

Similar to the other alphabet CD-ROMs products, the cd generally includes animated activities, which include running and dancing...etc. Principally, the alphabet program is able to entertain children as well as teach them the basic alphabet learning which includes the alphabet's recognition, the action or object that use that particular alphabet as well as recognize the sound of letter.

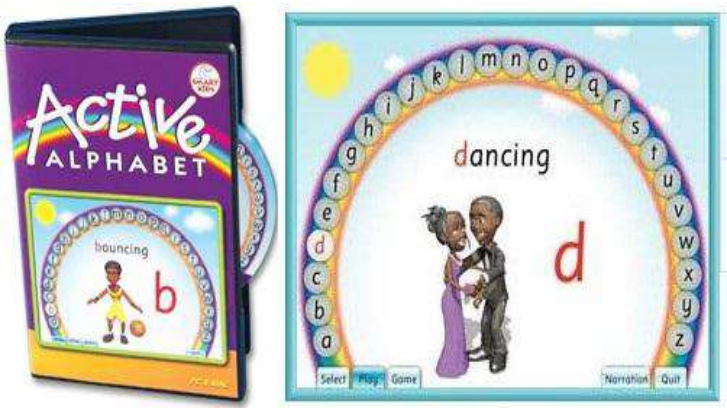


Figure 31 : Active Alphabet

Disadvantages

As the software had to be installed and used on personal computers or notebooks, thus it lacks adequate mobility. Kids nowadays tend to use mobile phones and tablets rather than use the laptops as they offer great mobility, easier to carry; thus, learning process can be anywhere and anytime.

II. E-books

Description

The e-book teaches the alphabet by using the storytelling method together with colorful pictures. Using the storytelling method, the kids able to relate how actually the letters is used in the sentences. In addition, it also teaches how to write a particular letter, for example, in the above image, there is a direction of arrow showing the right way to write letter c.

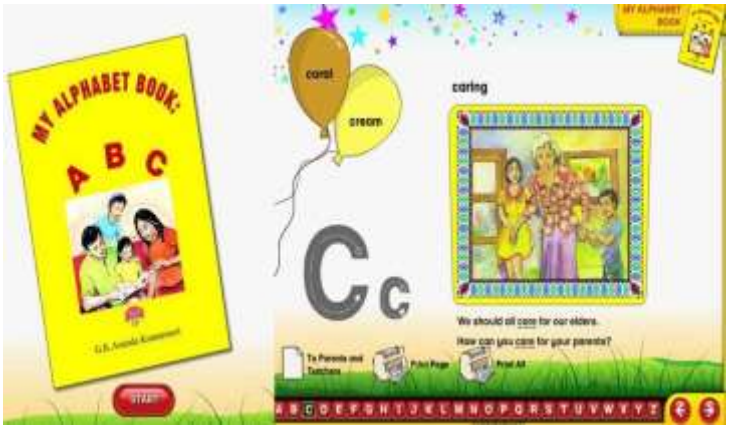


Figure 32 : My Alphabet Book ABC

Disadvantages

The application is plain and boring, for unlike some other ICT-based alphabet approaches used, My Alphabet Book ABC does not use sound aid in teaching the alphabet.

Description

Other emerging products, which are widely developed nowadays, are mobile applications both in Android and iOS platforms.

Kids ABC Letters Lite is an android application that teach alphabet for 2 to 7 years old. There are four modules of the application, which are naming the letters, forming letters, recognizing letters as well as identifying letters in context.

Figure 33 : Kids ABC Letters Lite

The app is interactive and engaging as it offers unique games in teaching the alphabet. Kids will have fun learning the alphabet while playing the games. In addition, the color combinations and designs used for the application are also interesting. The app is free from letter A to H and to use the rest of the levels one needs to pay.

ABC for kids is an android app to learn English alphabet with real sounds and human pronunciation. The apps enable kids to relate the particular alphabet with real life objects. The free version of apps is simple yet interesting.

Figure 34 : ABC for Kids

Description

Another application available on mobile platforms is Alphabet App, which can be run using an iPhone or iPad. Alphabet App helps kids learn alphabet and at the same time improves their vocabulary. The application comes with several basic features, which are “Learn ABC”, “Find the alphabet” game, “Match the alphabet” game as well as rewards. “Learn ABC” features do provide each letter with five corresponding objects or word with the stunning pictures to help kids grow vocabulary.

Figure 35 : Alphabet App IOS

Using the module, kids able to learn five words that start with that letter instead of only one word. “Find the alphabet” game will let the kids find and guess the letter instructed. The module could help kids memorize the letter better. The third module is “Match the alphabet games”. The game requires the child to match the letter with the pictures given; helping their memory to memorize, as well as getting to know the alphabet better. The last module is “rewards” which is based on “Find the alphabet game” as well as “Match the alphabet” game. If the child were able to complete both of the games successfully, they would be rewarded with 90 beautiful stickers. Generally, does not only have beautiful visuals, it also has great sounds and is user friendly.

Finally, even though there are broad advantages offered by the virtual application; however parents still love the physicality of the alphabet books and tend to buy them for their children. Due to this factor, the use of augmented reality can be the bridge between the parents and their children, a common ground where old physical books can be used and overlaid on the real physical books with the predesigned digital.

2.5.3 Available Augmented Reality Alphabet Teaching/ Learning Application

Based on the literature found Augmented Reality Alphabet applications have indeed developed on PC/laptop platform and IOS (IPhone/Ipad) mobile platform.

There are several applications that have been developed which essentially use augmented reality in learning the alphabet such as "I Can Learn My ABCs" application, This a PC based application, where one has to install the program on the computer.

Figure 36 : I can Learn My ABCs interface

"I Can Learn My ABC's" requires a webcam and computer as well as Flashcards (Markers for the program to recognize). The application uses letters of the alphabet, which each surrounded by special black squares, which act as the markers. The application can be a great tool to introduce the kids to letter recognition.

When a letter marker is shown to the webcam, the application will respond by showing both the upper and lower case forms of the particular alphabet, modeling the according sound of the letter, as well as presenting a picture of an object that begins with that letter. However, the application does not overlay the virtual object on top of the real environment, it simply just detects the marker from the real environment and shows according letter merely virtually. The application can be simply downloaded from the Adobe AIR Marketplace and there is a free limited trial

then one has to pay $5. Learning using augmented reality can be interesting and able captivate the child's attention.

Additionally, a reviews on "I Can Learn My ABCs" by users agreed that their children enjoy the application's learning process very much. They added that their children tend to repeatedly play, thus the application is worth buying. Generally, children are able to have fun and learn at the same time. However, one of the major drawbacks of the application is that it uses PC or laptop, which is inconvenient and not very mobile.

At the moment, as mentioned earlier in section 2.9, the usage of mobile technology is booming and many people are expected to own at least one mobile device. Moreover, it has been also agreed that the sophisticated mobile phones or tablets are able to replace the usage of laptop and personal computer. For, it offer high mobility; thus easier to be carried any & everywhere. Mobile applications developed in large numbers and frequently used by mobile users.

One of the alphabet mobile application developed using augmented reality technology is "AR Flashcard" as shown in Figure below:

Figure 37 : AR Flashcard

AR Flashcard was released on March 2012. The application principally runs on iPhone and iPad. AR Flashcards is a new way to interact and make Flashcards more entertaining for toddlers and preschoolers. The application requires the users to print out the AR flashcards, which can be downloaded from the website free. The application also is available on iTunes to be downloaded and requires users to pay

$0.99 once. The application works when the users point the device's camera towards the printed AR flashcards, beautifully rendered 3-D animals will pop up on the screen overlaid on top of the flash card as seen in the figure above.

Looking at some user's review on this application, most of them agreed that it offers fun learning and enables children to learn in new and exciting ways. Some of them also claim that their kids kept repeating the letters and animals names; thus learning a lot from this application.

The major drawback of the AR Flashcards application is that is used only on iPhone and iPad. Even though by the end of 2012 a research firm IDC concluded, that Android had 75% of the market share, compared to just 14.9% for Apple and even less for the rest (Android Community, 2012). It will be a great advantage if the application was developed on the Android platforms, as more numbers of users will use the Android instead of the Apple platform. Additional drawback is the usage of flashcards; flashcards are easier to be carried. However, for the little kids, and they tend to be lost a mess and unaesthetic like a proper book where a book can be used both with and without the application, furthermore, using a book has a lot of benefits as mentioned in the sections earlier (section 2.6.1 & section 2.7).

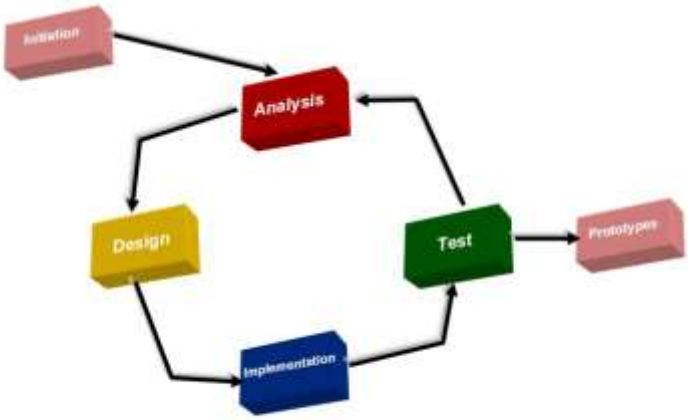
Based on the market research done, there are still no Augmented Reality Alphabet applications for an Android platform available in the marketplace. Thus, developing the application in Android platform can be a great advantage as Android had been widely used as smart phone's platform worldwide.

CHAPTER 3

RESEARCH METHODOLOGY & PROJECT ACTIVITIES

3 METHODOLOGY & PROJECT ACTIVITIES

The Research methodology is Evolutionary Prototype methodology, which is more of a design-based method, which relies on project activities. This was decided after a lot of consideration of all the requirements and the nature of this application development, Evolutionary Prototype methodology was used. The evolutionary approach aims to develop a complete system through a series of prototype iterations.



The current prototype has experienced a sequence of modifications, until the result that will be shown in the coming section *(and more in development since this is the first draft of the dissertation).* The evolutionary prototyping methodology is typically used for most mobile applications, where the applications are always in demand on google play store or ITunes and their rivals are all on the move, updating into new versions fixing current bugs and taking constructive feedback from the user. Typically, using evolutionary development allows comparison to the first draft, second draft, third draft…and then the final version, which will be released, released or updated.

This methodology is exceptionally good for developing this particular project, for which there is no manual or existing system to help with the development. Furthermore this project is prone to changes as the development progresses (evolve) by adding new features and so on.

Four main stages were required in developing the project, listed as follows:

3.1 Planning Phase

During the planning stage, the important project background information was gathered; also, project requirements were defined as in; the project's problem statement (Section 1.1), objectives (Section 1.2), motivation, relevancy (Section 1.3) and scope (development requirements) and were thoroughly understood. This stage is very important to be performed before developing the project. This stage is described in more details, in the first chapter of this document.

Regarding this project, the planning stage depended on understanding the children's alphabet learning process, and how it can be enhanced by implementing augmented reality through digital storytelling. Furthermore, time management should be studied early in this stage regarding to know the feasibility of the project within the given time, which is approximately 6 months.

3.2 Requirement Analysis Phase

Throughout the analysis stage, the requirements that were clearly stated earlier at the planning stage were analyzed with the help of the users (Children/ Parents/ Teachers). Furthermore, in this phase literature of the earlier researches and published papers, journals were studied and researched carefully according to each related scope related to the development of this project, also the previous techniques that can be integrated with the project development, was considered.

In addition, the similar products in the market also acted as a guide or standard on where to start and how to improve the existing product that will help the children in their education.

Moreover, the possible problems the project might encounter were predicted during this stage, like the period given for development, rivals that might be encountered, copyright issues. All were taken in consideration in this stage to develop an early solutions framework that might help solve these kinds of problems, and insure the successful delivery of the project. For example, since it is an original work the product idea and early design stage was copyrighted to ensure the safety of the project. Analyzing the difficulties that the project might encounter was a big aid

that helped to accomplish the objectives of the project. Additionally, all the data and information gathered during the planning stage were used in this phase.

Furthermore, In this phase a basic research on the effective tools to be used and their equivalents, a small comparisons were made, between the AR SDK platforms and development platforms to be used in this project and why (see section 3.5)

3.3 Design Phase

Designing phase is the longest phase throughout the prototype development cycle, during the design stage, the design functions and operations were described in details, including the storyboard, outline, diagrams. Regarding the alphabet, its early design was based on the storyboard designed below specifically for this project. (see section 3.6)

3.4 Implementation Phase

During the implementation phase, each prototype iteration was built, was based on the system analysis and design set earlier. The phase involves developing the AR application using the Vuforia SDK and Unity 3-D. (described in section 3.2)

During the Implementation stage, a working prototype and confirm that all the functionalities of the product successfully work.

3.4.1 Testing

Usability tests were carried out to ensure, whether the system meets the requirements established earlier or not. The frequent testing and iterating of the process, until reaching a satisfactory outcome, ensured that final users can use the product easily with no problems or errors.

In addition, observation and pilot studies were carried out on every prototype milestones. Finally, the feedbacks from the possible users were analyzed and taken into consideration. Furthermore, they were mentioned in the research report for further enhancements and development iterations.

3.5 Tools

The tools that have been used can be categorized into two main categories, software and hardware (Equipments).

3.5.1 Hardware & Equipments

The hardware comprises in using a windows 7 operating system, with an i7 –i5 processor to ensure smooth and fast real time rendering when designing the 3d models, animating then rendering the final layout. Furthermore, the webcam was used for dynamic testing of new features, before building and deploying to the android device for incremental testing (figure 38).

Figure 38 : Screen shot of project using the Vuforia Play mode for dynamic testing in unity 3D

Furthermore, the book is needed to use along the application, for it is the marker-less marker needed to overlay the 3D models upon.

3.5.2 Software, Platforms & SDKs

In the development of this project, a lot of software are used, for it combines several scopes to fulfill the project objectives and requirements.

1- Autodesk Maya

Autodesk Maya is 3D animation software, used to model, texture and animate the 3D objects that will be used in the application.

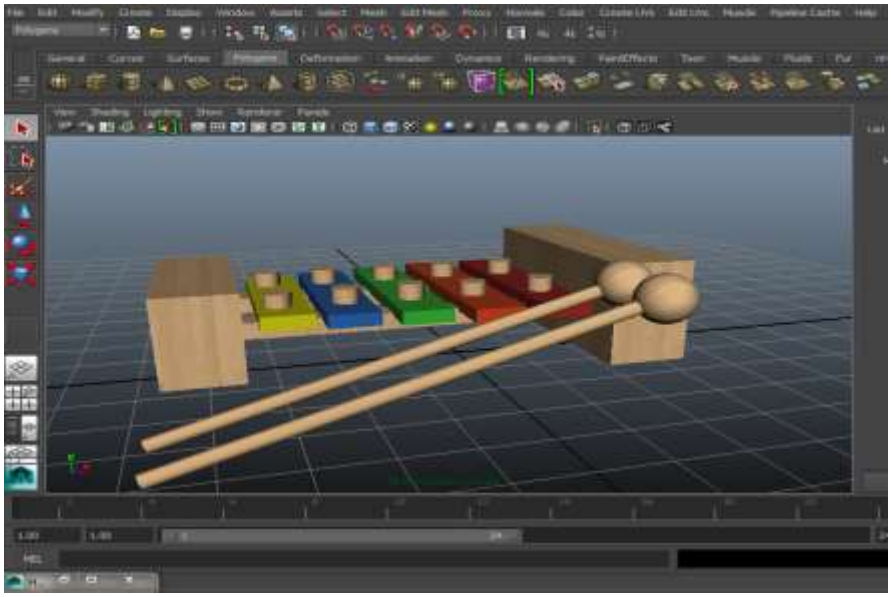


Figure 39: Modeling the Xylophone in Maya, to be used as an alphabet object for the letter X

2- Audicity

It is a free, award-winning open source program for recording and editing sound. This program was used to edit the interaction sounds, alphabet songs, phonic songs.

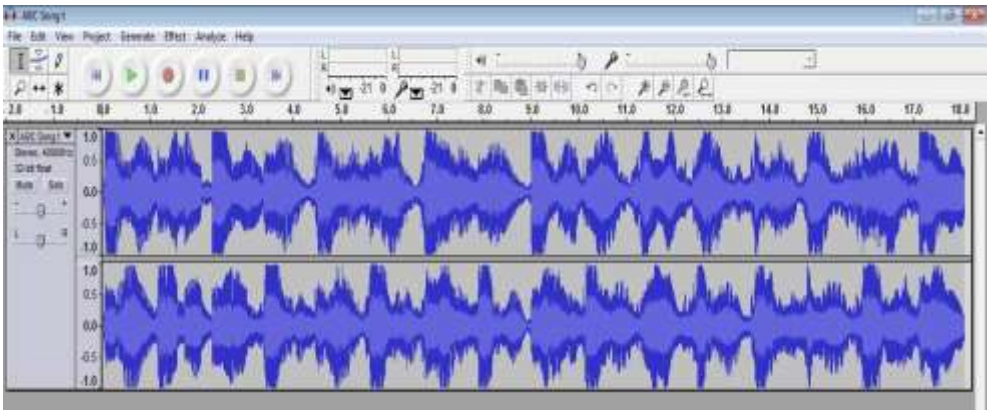


Figure 40: Editing the ABC song on audicity

3- Vuforia SDK

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. More on the documentation please visit this link

:(https://developer.vuforia.com/resources/api/index).

Figure 41:High-level system overview of Vuforia SDK

Figure 42:Image Target class Reference

4- Android SDK

The Android software development kit (SDK) is the development kit to help develop android applications; it includes a comprehensive set of development tools. These include a debugger, libraries, a handset emulator based on QEMU and documentation.

The Android SDK was used to compile and deploy the application, to be used on a mobile phone.

5- Adobe Photoshop

Adobe Photoshop is a graphics-editing program. That was used to edit and create, the logo, buttons for interactions and finally the marker-less marker (the alphabet book)

Figure 43: Designing the Splash screen & Logo

6- Unity 3D Scripting Library

The game engine's scripting is built on Mono 2.6, the open-source implementation of the .NET Framework. Programmers can use Unity Script (a custom language with ECMAScript-inspired syntax, referred to as JavaScript by the software), C#, or Boo (which has a Python-inspired syntax).Starting with the 3.0

release, Unity ships with a customized version of MonoDevelop for debugging scripts.

In this project only C# and JavaScript is used in programming the application.

7- MonoDevelop

MonoDevelop is an open source integrated development primarily targeted for the development of software that uses both the Mono and Microsoft .NET frameworks. MonoDevelop integrates features similar to those of NetBeans and Microsoft Visual Studio, such as automatic code completion, source control, and a graphical user interface (GUI) and Web designer.

MonoDevelop is used in this project to program and use both the vuforia SDK library and unity3D scripting to create a powerful outcome.

For more on scripting for unity please visit this link:
(http://docs.unity3d.com/Documentation/ScriptReference/)

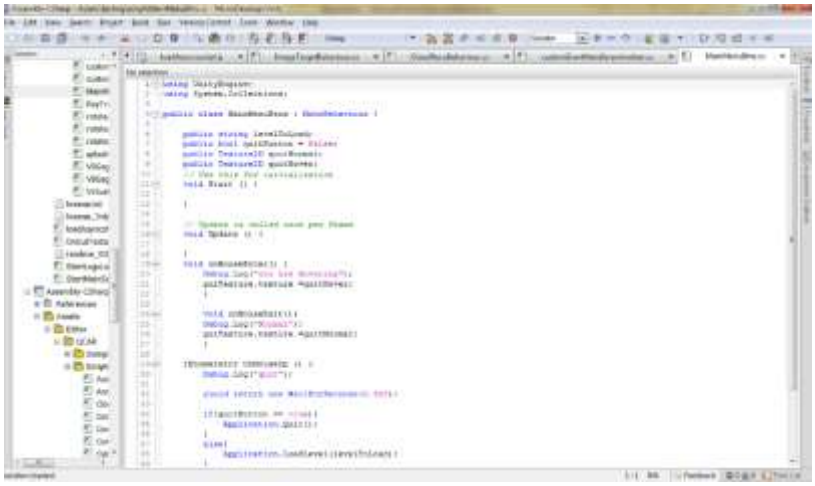


Figure 44 : Screenshot of a script that was written for the main menu gui

8- Unity 3D

Unity is a cross-platform game engine with a built-in IDE developed by Unity Technologies. It is used to develop video games for web plugins, desktop platforms, consoles and mobile devices.

The powerful Unity 3D is used to compile all the above list of software, programs and SDKs, to design the application.

Figure 45 : Project view in unity 3D

3.5.3 AR SDK and Platforms Comparison

Despite the rise of AR applications, there are only a few mature software libraries, which provide well-developed tool kits. Two of them are the **Qualcom** and **String AR SDKs**. The Qualcom AR SDK is named Vuforia(see sub-section above) .The Qualcomm AR SDK (Vuforia) utilizes computer vision technology to tightly align graphics with underlying objects and features support for image targets, frame markers, virtual buttons and simple 3D objects. It is open-source and available for both Android and iOS platforms. The String AR SDK provides less in the aspect of functionality and its extendibility is very limited for free license.

Table 2 : Vuforia vs String AR

	vuforia by Qualcomm	String Augmented Reality
License	Free	Free for limited version
Platform	iOS, Android	iOS, Android (in progress)
Multiple markers	Yes	No
3-rd Party Integration	Yes, Unity3D	Yes, Unity3D

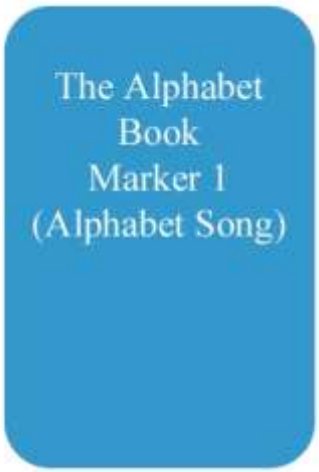
3.5.4 Why Mobile (Android)

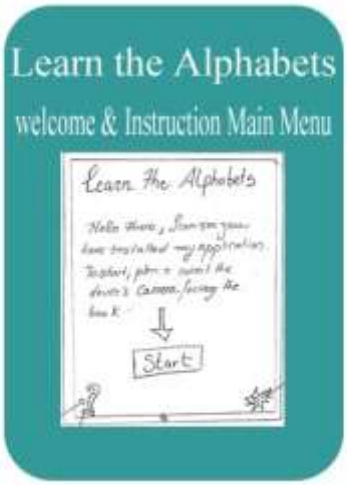
Platform	Advantage	Disadvantage
PC	1. Large display screen 2. Higher computational power*	1. Lack of mobility 2. Need external camera
Mobile	1. High market share 2. High mobility 3. Touch gesture control 4. Built-in camera	1. Smaller display screen 2. Lower computational power
Tablet PC	1. High market share 2. High mobility 3. Touch gesture control 4. Large display screen 5. Built-in camera	1. Lower hardware extendibility

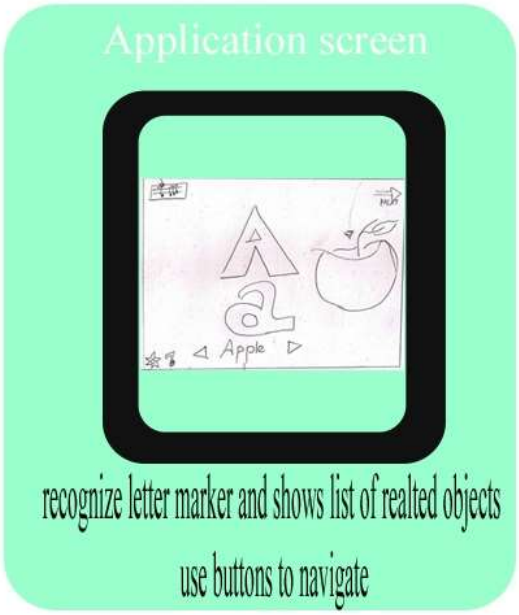
3.6 Project Activities

3.6.1 Initial Storyboard

The initial Storyboard design:







3.6.2 Choosing the Alphabet Objects

In the designing phases, also many decisions were made then altered and/or evolved. For instance the list of objects to teach children the alphabets, this list have change and matured over time, the decisions in designing and choosing the alphabet objects relied on several factors, the complexity of the object with regard to the targeted age. As an example was letter X, letter X has few objects to refer to compared to other

letters and those objects are rather complicated, for example X for X-ray, X for Xanthus hummingbird and X for Xylophone. Defiantly, in this situation the list goes down to X-ray and Xylophone….and ultimately Xylophone was chosen because; it is more appropriate for a 2-5 years old to learn. Furthermore, it was taken in consideration to choose non-similar objects of different names to widen the scope of learning for example, Ball was chosen for letter B, Football was not chosen for letter F, because they are both balls, instead Frog was chosen instead for letter F. While the other criteria and factors judging on choosing the objects the complexity of modeling animation and polygon count.

Below is the list of the Alphabet objects that was referred to from fun and easy lesson plans website for preschool children, the ones highlighted in yellow were the ones considered or used.

Link (http://www.actionalphabet.com/Home.html)

Letter A Objects	Letter B Objects	Letter C Objects	Letter D Objects	Letter E Objects	Letter F Objects
Aardvark	Baboon	Caboose	Dad	Eagle	Face
Ace	Baby	Cactus	Daffodil	Earmuffs	Fairy
Acorn	Baby Bottle	Cake	Daisy	Earphones	Fall
Acrobat	Ball	Camel	Dandelion	Ears	Family
Air	Ballerina	Camera	Dates	Earrings	Fan
Airplane	Balloon	Can	Deer	Earth	Farm
Album	Banana	Candle	Desert	Easel	Feather
Alligator	Banjo	Canoe	Desk	Egg	Feet
Anchor	Barbecue	Cape	Dessert	Egg Beater	Felt
Animals	Baseball	Car	Diamond	Eggplant	Fern
Ankle	Basket	Card	Diaper	Egg Rolls	Fiddle
Ant eater	Basket Ball	Carpet	Dice	Eight	Figs
Ant	Bat	Carrot	Dill	Elbows	Finger
Angel	Bean	Carton	Dill Pickles	Elephant	Fire
Ape	Bear	Cat	Dime	Elevator	Fire Engine
Apple	Bed	Caterpillar	Dinosaur	Elf	Fire Fighter
Apron	Bee	Cereal	Dip	Enchiladas	Fish
Ark	Bell	Celery	Dirt	Engine	Five
Arm	Belt	Chalk	Dish	Envelope	Flag
Armadillo	Berries	Cheese	Dishpan	Eraser	Flamingo
Arrow	Bib	Cherries	Doctor	Eskimo	Flower
Artist	Bicycle	Chess	Dog	Eye	Flute
Astronaut	Bingo	Chessboard	Doll		Fly
Athlete	Biscuits	Chick	Dolphin		Fondue
Autograph	Bird	Child	Domino		Football
Automoblie	Blanket	Children	Donkey		Fork
Avocado	Blocks	Chimpanzee	Donut		Fossils
Axe	Blue	Chocolate	Door		Four
	Blueberries	Chopsticks	Dots		Fox
	Boat	Clock	Dozen		French Fries
	Bone	Clothes	Dress		Frog
	Bonnet	Clothespin	Drum		Fruit
	Book	Cloud	Duck		Fudge
	Boot	Clown	Duckling		Funnel
	Bottle	Coat	Dump truck		
	Bow	Cocoa	Dust		
	Bowl	Comb	Dustpan		
	Box	Confetti	Dynamite		
	Boy	Container			
	Bracelet	Cookies			
	Bread	Corn			
	Broccoli	Corn Chips			
	Broom	Corn Muffins			
	Brush	Cotton			

	Bubbles Bucket Bug Burrito Bus Butterfly Button	Cow Cowboy Cowboy Hat Crab Crackers Crayon Crown Cucumbers Cupcakes			
Letter G Objectts Galoshes Game Garbage Garden Garlic Gate Gift Giraffe Girl Glass Glitter Globe Glove Glue Goal Goat Gold Goldfish Goggles Golf Golf Ball Golf Club Goose Gorilla Gourd Gown Graham Crackers Granola Grapes Grape Juice Grass Grasshopper Green Green Beans Grey Grizzly Bear Guitar Gum Gum balls Gum ball Machine	Letter H Objects Hair Hairbrush Halo Ham Hamburger Hammer Hamster Hands Handkerchief Handle Hanger Harp Hat Hay Head Headband Heart Helicopter Hen Hiccups Hippopotamus Holly Honey Honeydew Hoop Horn Horse Hose Hot Dogs Hour House Hundred	Letter I Objects Ice Ice Cream Ice Cube Ice Cube Tray Ice Skates Icicles Icing Igloo Iguana Ill Inch Inchworm Ink Indian Infant Iris Insect Instrument Iron Ironing Board Island Ivy	Letter J Objectts Jacket Jack-In-The-Box Jack-o-latern Jacks Jaguar Jam Jar Jell-o Jelly Jelly Beans Jelly Fish Jeans Jeep Jester Jet Jewels Jewelry Jigsaw Jigsaw Puzzle Juice Jug Juggle Jump Jump Rope Junk	Letter K Objectts Kabob Kaleidoscope Kangaroo Karate Uniform Kayak Kazoo Kernels Ketchup Kettle Key Keyboard Kid Kit Kite Kitten Kimono King Kitchen Kiwi Knee Knife Koala Kool Aide	Letter L Objects Lace Ladder Ladle Lady Lady Bug Lamb Lamp Lantern Lasagna Leaf Leash Legs Lemon Lemonade Lemonade Stand Leotards Lemur Lentils Leopard Leprechaun Letters Lettuce Lid Light Lion Lime Linguine Lips Lizard Lobster Lock Locket Log Lollipop Lunch Lunch box
Letter M Objects Macaroni Magazine Magnifying Glass Mail Mailbox Magnet Man Map Marble Maraca Marsh Marshmallow Mask Meat Meatballs Melons Milk Mirror Mitt Mushroom Mom Monkey Monster	Letter N Objects Nachos Nail Napkin Neck Necklace Necktie Nectarines Needle Nest Net Newspaper Nickel Night Nightgown Nine Noodles Nose Numbers Nutcracker Nuts	Letter O Objects Oak Oar Oatmeal Ocean Octopus Office Oil Olive Olive Oil Omelettes One Onion Opera Opposites Orange Orange Juice Orca Ornament Ostrich Otter Oval Oven Overalls	Letter P Objects Pail Paintbrush Pajamas Pan Pan Cake Panda Panther Pants Paper Parade Parachute Parrot Peach Peacock Peanut Peanut Butter Pear Pencil Penny Pens Penguin Peppers Pepperoni	Letter Q Objects Q-Tip Quack` Quadruplets Quail Quarter Quartz Queen Question Mark Quiche Quill Quilt	Letter R Objects Rabbit Raccoon Radio Rain Rainbow Rain Coat Raisins Rake Raspberry Rat Rattle Ravioli Rectangle Relish Red Reindeer Rhinoceros Ribbon Rice Rice Pudding Ring Robot Rock

Moon Mop Motorcycle Mountain Mouse Mouth Muffin Music		Owl Ox Oyster	Pet Petunia Piano Pickles Pie Pillow Pineapple Placemat Plants Plate Plum Pocket Pom Poms Popcorn Porcupine Postcard Pot Potato Pretzels Princess Pumpkin Puppet Puppy Puzzle		Rocket Roller Skates Rolls Rolling Pin Rooster Rope Rose Rubber Boots Rug Ruler
Letter S Object Sail Boat Salad Salt Sand Sandals Sand Castle Sandpaper Sandwich Saw Scarf Scissors Sea Sea Shell Sea Shore Sea Weed Seal Seeds Seven Shark Sheep Shirt Shoe Skunk Sled Slippers Snack Snake Snow Soap Sock Soup Spaghetti	Letter T Objects Tacos Table Tambourine Tape Tapioca Pudding Tarts Tea Tea Cup Teapot Teddy Bear Teeth Telephone Television Tennis Tennis Ball Tennis Racket Tent Tie Tiger Tinsel Toast Toes Tomatoes Tortilla Chips Top Top Hats Tooth Tooth Brush Towel Tractor Tray Train Triangle Tricycle Tree Truck T-Shirt Tub Tube Tulip Tuna Turkey Turtle Two	Letter U Objects Ukulele Umbrella Umpire Underwater Underwear Unicorn Uniform Unicycle University Urchin USA Utensils	Letter V Objects Vacuum Valentine Van Vanilla Vase Vegetable Velvet Vest Vet Video Vine Vinegar Violet Violets Violin Visor Volcano Volleyball Volunteer Vulture	Letter W Objects Wafer Waffles Wagon Wall Wallet Walrus Wand Washcloths Watch Water Watercolors Watermelon Wax Web Whale Wheel Whistle White Wig Window Windmill Wings Wizard Wolf Wood World Worm	Letter X Objects X-Ray X-Ray Fish Xylophone Xanthus hummingbird

Spider String Suit Suitcase Sun Sunflowers Sunglasses Sweater					
Letter Y Objects Yacht Yak Yam Yard Yard Stick Yarn Year Yellow Yoga Yogurt Yo-yo	Letter Z Objects Zebra Zero Zig Zag Zither Zinnia Zip Code Zipper Zoo Zucchini				

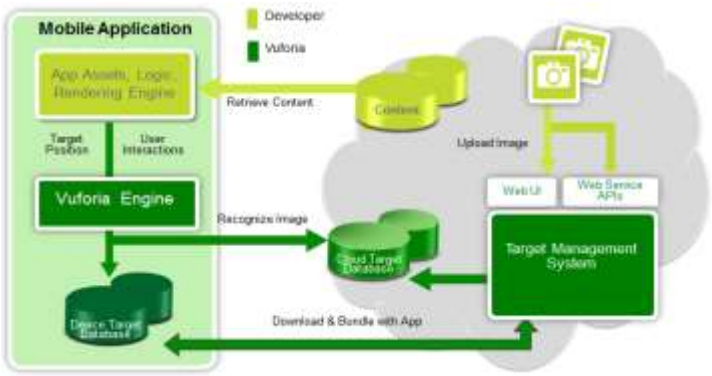
3.6.3 Logo Design

In the design phase, also an original logo was needed to be designed for branding and later on publishing.

Figure 46 : The Final Logo Design

3.6.4 Book Design

The book design is very important, because without it the application will not work, below is a simple diagram on how Vuforia sdk works using the image target(Cloud & Database), which in this case the book(database targets).



In this program the image targets are downloaded to be used in the device target database (follow the diagram content marked in green), the cloud target database option is excluded and not used in this application, to provide a non-internet dependent working application.

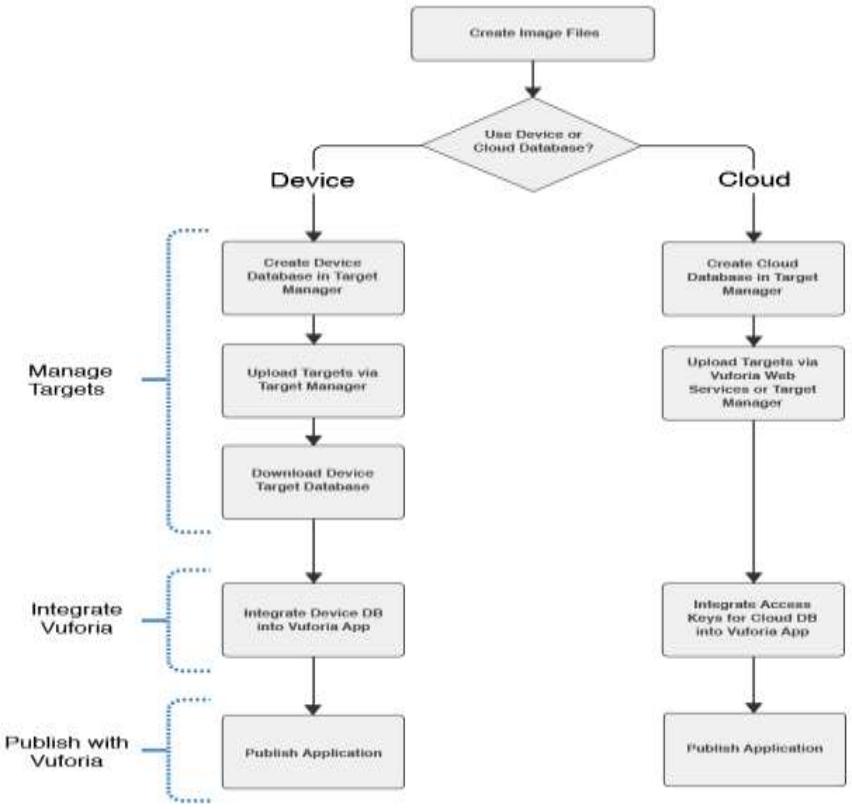


Figure 47 : Vuforia Target markers process flow chart

In the figure 47 above is a flow chart that briefly describes the process used is described in the branch on the left. However, the process description is as follows; the image targets (the book pages) are uploaded to the Target management system, this system manages a target database and gives a rating on how good the image targets are for detection. This rating is very important for poorly designed markers

will work but will drastically affect the application performance, it will be unpredictable. Below is the list of an ideal image target attributes (Vuforia, 2013):

- Rich in detail
- Good contrast; has a proper contrast histogram.
- No repetitive patterns,

High qualities of image targets are necessary, thus the application can successfully acquire target. Due to this demand, the design process should meet the attributes well so that application can work as planned. Designing the book that act as image target for augmented reality application was challenging and time consuming as it had to be designed according to requirements... There are nearly two times the designs were changed due to inability to read the targets or unpredictable results, however, in the report only one of the design phases were shown and discussed.

Previews Book Design:

In this section an small example of the design would be shown, since the alphabets contains twenty six 26 letters it will be very lengthy to describe all, especially when they all have the same concepts applied.

The figure below shows the compilation of the previous design for alphabet part of the book.

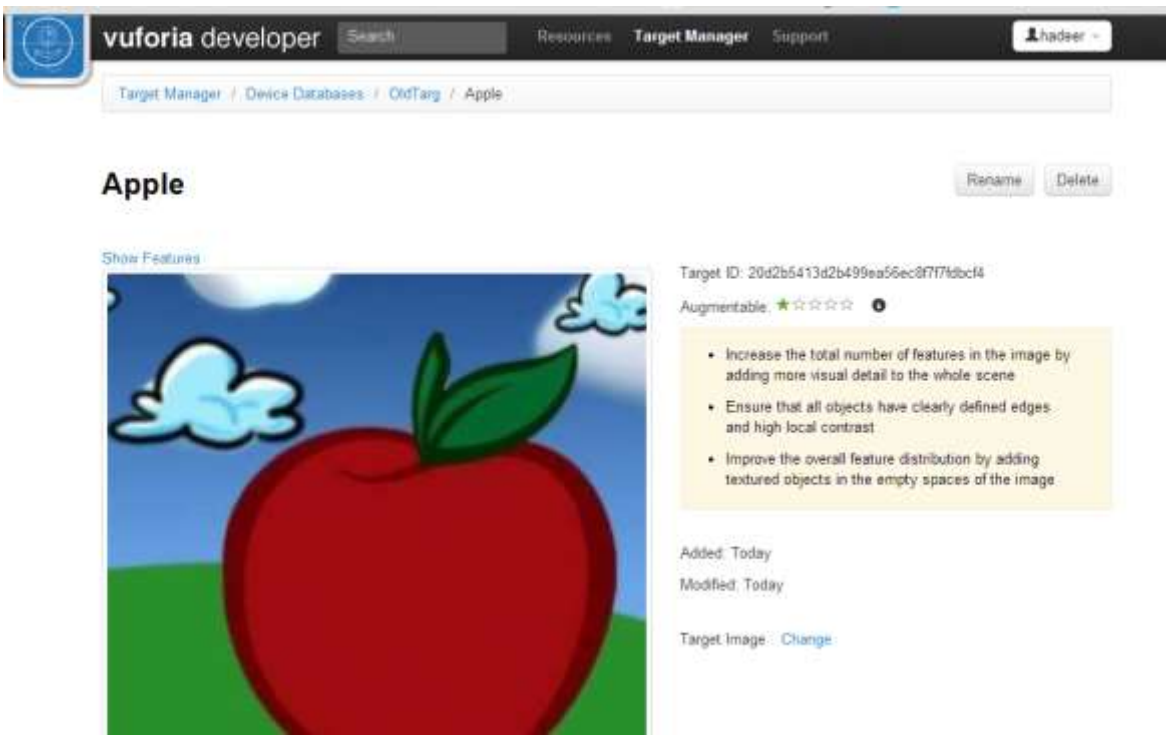


Figure 48 : screenshot of an early book design, the apple page

The figure above is a screenshot of the vuforia developer website, using the Target Manager tool. The image contains an early book design of the first page marker apple, and as can be seen the design augmentability is considered poor because the target manager gave a one star rating, during testing this marker glitches the software and gave unpredictable results.

Final Design:

Figure 49 : Screenshot of the final book design, the apple page

The final design is sticking to a simple yet efficient design, the histogram of each layer using photoshop was edited to have a proper contrast graph also, clear edges where made and non repeatiive patterns were used, most of the markers in the final design contains more than 3 stars, hence, efficient flow in performance.

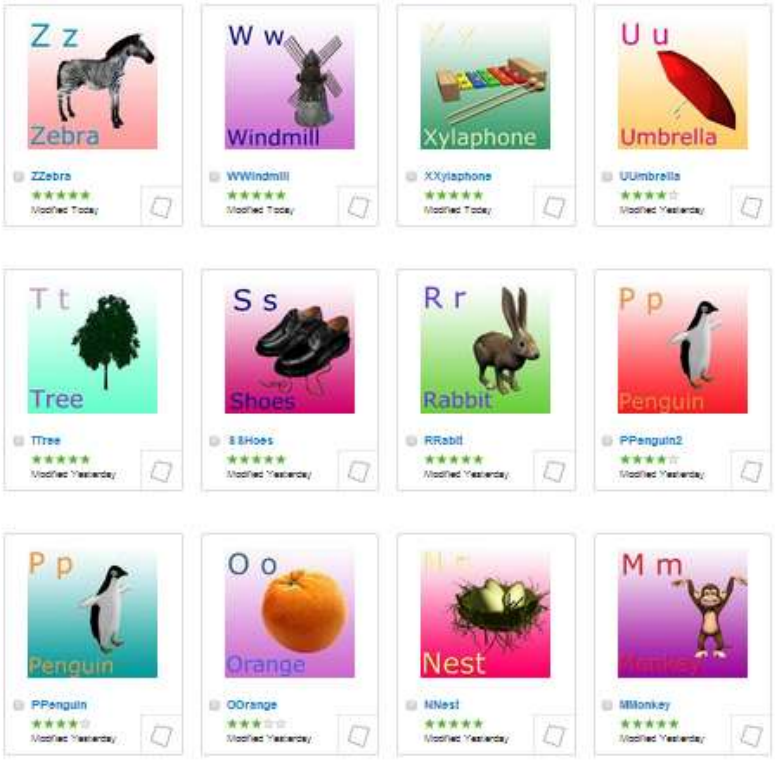


Figure 50 : Screenshot of the target manager database

A rating of three (3) stars or higher insures the augmentability of the targets. It is very advisable to use markers rating higher than two (2) stars, because from experience and testing throughout development all markers below three stars, had issues and made the program behave in an unpredictable way, higher than 3 stars, worked exceptionally fine (the higher the stars the faster they are detected).

3.6.5 3D Modeling, Rigging & Animation

3D Modeling

As the 3D models are the Pop-up art of the book, the augmentation main idea, of bringing objects to life, therefore, it is very important, for the application core revolves around the 3D dimensional world and interacting with it. The application contains more than 35, 3D models, 26 of which are used for the alphabet page and the rest are for the digital storytelling (the songs). For 3D models creation, Autodesk Maya and Blender software were used. As an example, the figure below is a shark model, that was modeled and skinned in Maya to be used in the application, skinning is very important to give a model a realistic mesh connection to prepare for smooth animation.

Figure 51 : A Shark render view from Maya

3D Rigging

3D rigging in another word is skeletal animation. 3D rigging is a technique in computer animation in which a character is represented in two parts: a surface representation used to draw the character (called skin or mesh) and a hierarchical set of interconnected bones (called the skeleton or rig) used to animate (pose and key frame) the mesh.

Below is the rigging of the shark model presented in image 51, bones are made to control the model for animation.

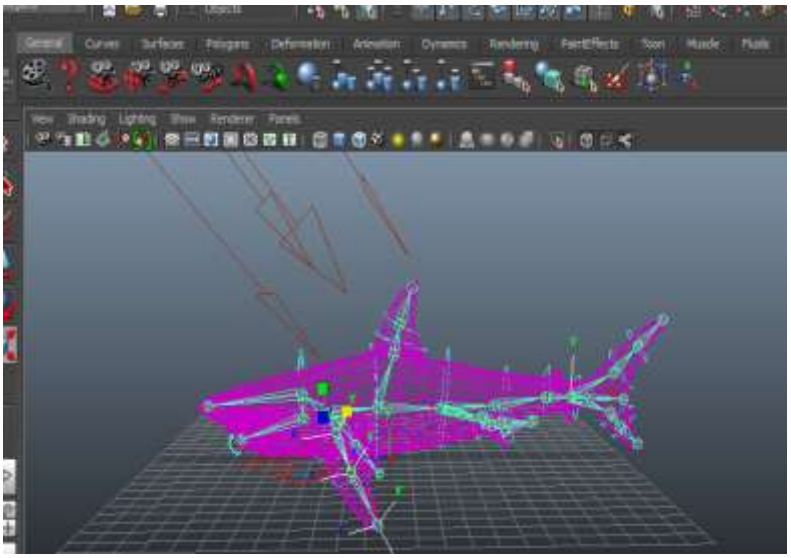


Figure 52: Shark Rigging Controls in Maya to prepare for animation

3D Animation

After the modeling and the rigging phases comes the 3D animation phase, the 3D animation can be made in 3d part software, where the models were created, then exported as animation clips and used in unity, or it can be directly created in unity after importing the 3D model in unity environment. For this project, some of the models were animated in Maya, due to the model complexity and unity's limited

animation tools, other simple models, such as the 3D model for a ball was animated in unity due to its simplicity.

Generally, in this project the animation graph editor tool in Maya & Unity 3D was used to edit the animation flow to ensure a proper and smooth animations, unquestionably, after having set the animation key frames.

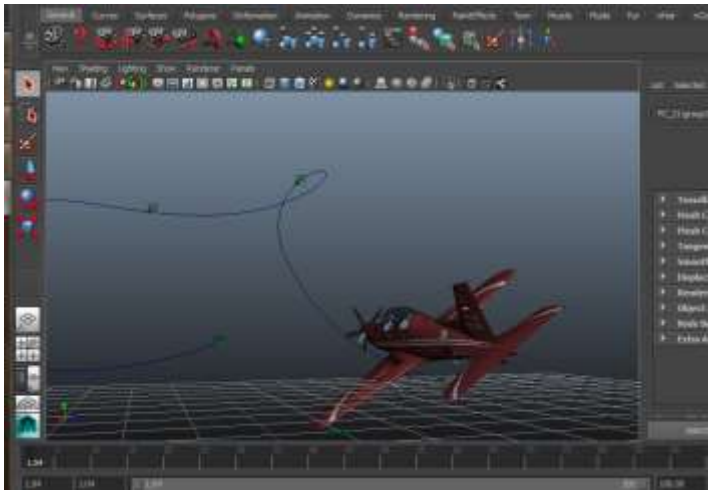


Figure 53 : Jet-plane with the animation Path

In the figure above the jet plane model used for the letter J, animated using an animation path. As for the figure below, the kettle vapor animation is made using the fluid simulator.

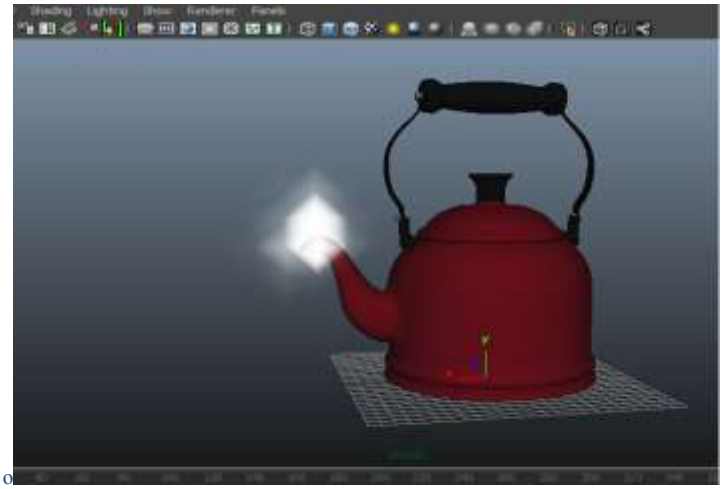


Figure 54 : Smoke animation coming out of the Kettle

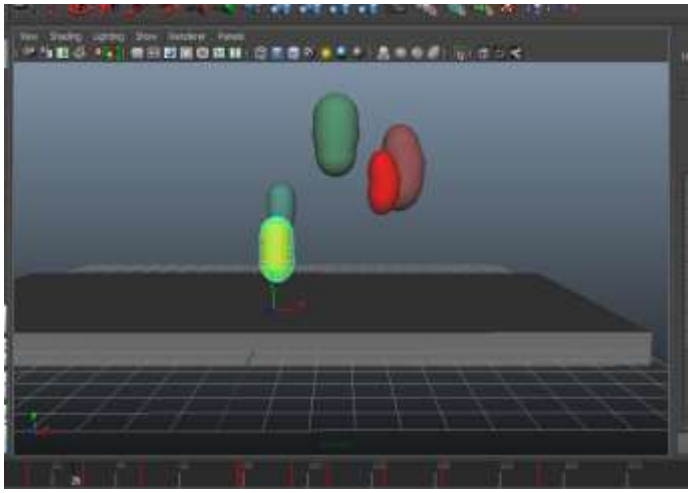


Figure 55 : Jelly beans jumping animation

In the figure above for the Jelly beans jumping animation scene, shows the animation key frames, the key frames, the animations are set to 25 frames per second.

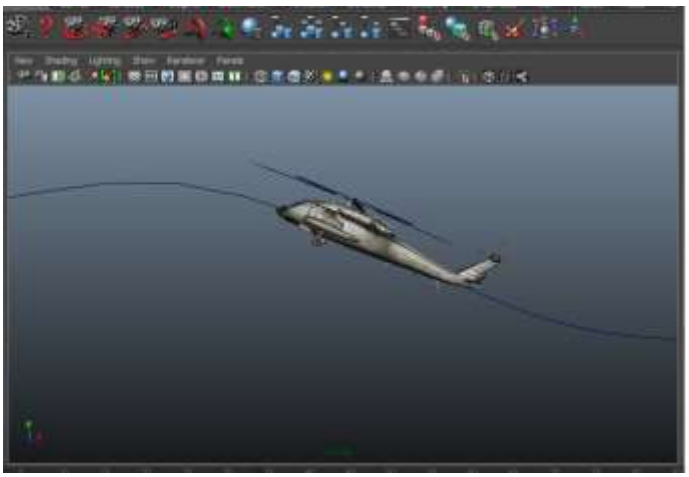


Figure 56 : Helicopter Animation and its animation path in Maya

3.6.6 The Sound and Song of Storytelling

The sounds of alphabet and objects were recorded, to be implemented in the alphabet book application using Audacity software. The sounds were then edited to match and suit the child's learning preference (higher pitch of female voice sounds like a little girl). As for the song of storytelling, old alphabet songs were used.

Figure 57 : Process of editing sounds in Audicity

3.6.7 Development in Unity 3D

Once all the augmented elements were prepared, the development of the application is commenced in Unity 3D and Vuforia extension. The development process using vuforia for augmentation comprises on replacing the unity 3D main camera, with the Vuforia AR prefab camera and making it the main camera in the scene. As for the alphabet image target, one had to drag the 3D models on to the targets and parent them to the target; thus, when the app runs and the camera is pointed to the image target, the 3D models will pop up. In order to include the audio sound source, GUI, animation and interaction, one had to prepare, C# and JavaScript scripts so it will be integrated successfully in the model.

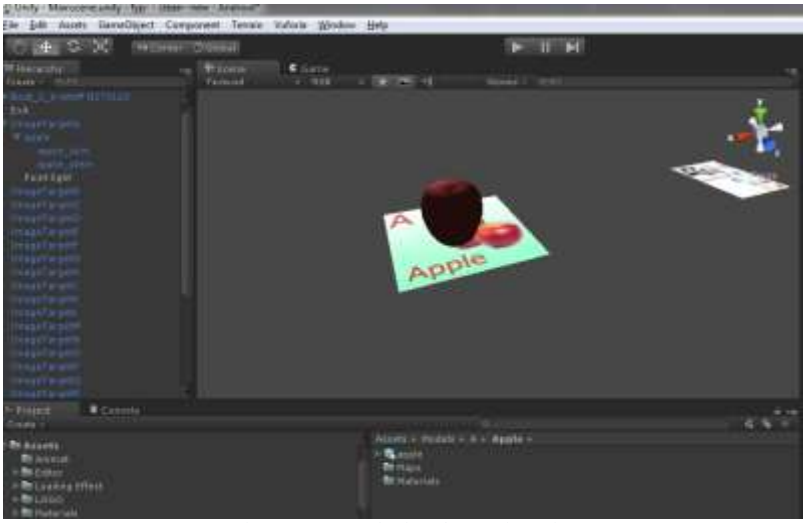


Figure 58 : Developing the app in Unity

3.7 System Architecture

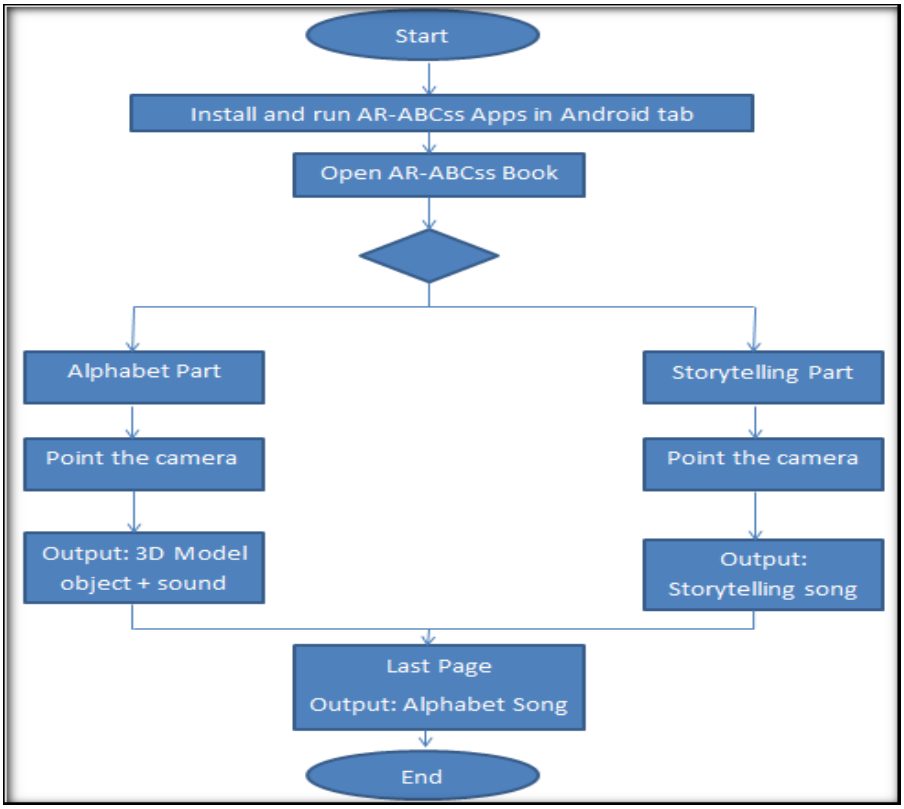


Figure 59 : System Architecture of the prototype

In order to run the prototype, the users should use any Android tablet or smart phones (with version 3.5 and up). There are two elements that are necessary for the program to successfully run, which are the application on the phone with a camera as well as the alphabet markers for the book.

Below are the installation procedures:

I. Deploy the program from unity 3-D on to the android device and it will automatically install the program apk on the device.
II. Open and run the program on the device.
III. Navigate through the main menu and click the logo to start
IV. Place the design markers and point the camera to one of the pictures.

The system consists of two parts, which are alphabet part as well as storytelling part. Each page represent each letter at which left side will be the alphabet and the right side will be the storytelling part. Figure 47 shows the brief flowchart of the system architecture.

3.8 Functionalities & Important Codes

3.8.1 Applying Animations

Interacting with the 3D world that contains 3D models was quite tedious and tricky. After a lot of trials to apply the animations created, when appearing on the mobile camera view, the following code concept finally worked. The main problem that was discovered that the vuforia sdk script ImageTarget Behavior renders its child the gameobject and hence the script controls on the gameobject itself is lost upon being called by the ImageTarget (The Parent).

The solution was to create a custom handler script attached to the ImageTarget not the child (the gameobject), that calls and plays the animation attached to its child.

```
1.  public class customEventHandlerBeachBall2 : MonoBehaviour,
2.  ITrackableEventHandler
3.  {
4.  public string animationClip;
5.  public static bool trackLost = false;
6.  private TrackableBehaviour mTrackableBehaviour;
7.  private GameObject beachball;
8.  public string gameobj;
9.  void Start()
10. {
11. beachball = transform.FindChild(gameobj).gameObject;
12. mTrackableBehaviour = GetComponent<TrackableBehaviour>();
13. if (mTrackableBehaviour)
14. {
15. mTrackableBehaviour.RegisterTrackableEventHandler(this);
16. }
17. OnTrackingLost();
18. }
19. public void OnTrackableStateChanged(
20. TrackableBehaviour.Status previousStatus,
21. TrackableBehaviour.Status newStatus)
22. {
23. if (newStatus == TrackableBehaviour.Status.DETECTED ||
24. newStatus == TrackableBehaviour.Status.TRACKED)
25. {
26. OnTrackingFound();
27. }
28. else
29. {
30. OnTrackingLost();
31. }
32. }
33. private void OnTrackingFound()
34. {
35. Renderer[] rendererComponents = GetComponentsInChildren<Renderer>();
36. Collider[] colliderComponents = GetComponentsInChildren<Collider>();
37. // Enable rendering:
38. foreach (Renderer component in rendererComponents)
39. {
40. component.enabled = true;
41. }
42. // Enable colliders:
43. foreach (Collider component in colliderComponents)
44. {
45. component.enabled = true;
46. }
47. Debug.Log("Trackable " + mTrackableBehaviour.TrackableName + " found");
48. // Play animation
49. beachball.animation.Play(animationClip);
```

```
50.  // Play sound
51.  audio.Play();
52.  trackLost = false;
53.  }
54.  private void OnTrackingLost()
55.  {
56.  Renderer[] rendererComponents = GetComponentsInChildren<Renderer>();
57.  Collider[] colliderComponents = GetComponentsInChildren<Collider>();
58.  // Disable rendering:
59.  foreach (Renderer component in rendererComponents)
60.  {
61.  component.enabled = false;
62.  }
63.  // Disable colliders:
64.  foreach (Collider component in colliderComponents)
65.  {
66.  component.enabled = false;
67.  }
68.  //Debug.Log("Trackable " + mTrackableBehaviour.TrackableName + " lost");
69.  // Stop animation
70.  beachball.animation.Stop();
71.  // Stop sound
72.  audio.Stop();
73.  trackLost = true;
74.  }
75.  }
```

The summary of this class is when the tracable event handler, tracks a marker, (the marker is seen) then it will animate the animation attached to the gameobject which is the child of the ImageTarget(marker) that was found, and when the tracking is lost it will stop the animation. The solution comprises mainly in lines 4-5-6-49-70.

Such classes are used several times on several objects, because as mentioned earlier this project contains more than 35 3-Dimentional models; it was programmed specially to do so, so it would save memory and gives better performance. This is done by making the Gameobject string used for referring to the string public and the animation string public to also refer to the animation clip attached to the gameobject. Doing so will automatically make a space in the unity interface so one can key in the name of the gameobject desired and the animation clip. (this is circled in the picture below)

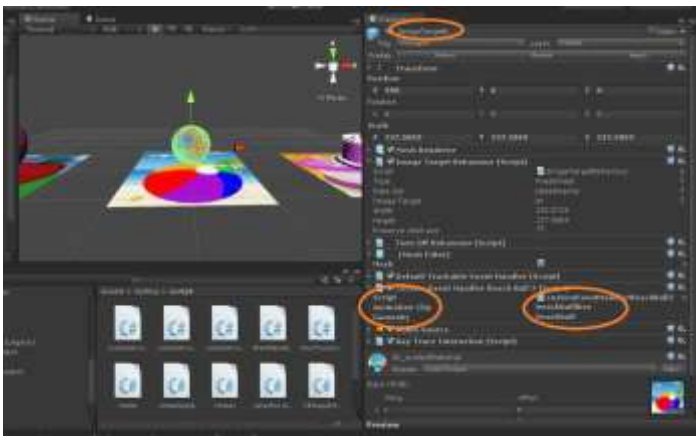


Figure 60 : Unity interface, showing the public declaration usage in the script above

3.8.2 Applying Interactions

One of the most significant scripts to mention is applying interaction with the 3D world script class (RayTraceInteraction). This class was written after many trials in pursuit in applying interactions with the 3D object whether playing and animation clip or interacting dynamically the interaction call was unsuccessful until this class was developed. Little did one know, that the interaction with the 3D world is very complicated, early trials of interactions, was by sampling checking if the 3D model was clicked/touched, if there is any event, but the debugger always mentioned that the model meshes was lost upon rendering. In an effort to solve such problem, one has come to know the existence of the raytrace function. The concept behind this function is upon clicking/touching a ray of light is emitted, and if this ray collides with a 3D model, a reflection/ or refraction will occur, hence resulting an event, after the event one can use the function to interact with this particular 3D model.

This class script should be attached to the image target and the 3D model that is intended for interaction should contain a mesh collider component added to the model shown in the image below:

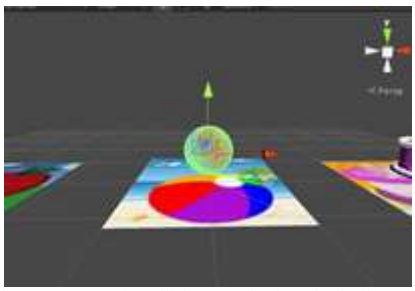


Figure 61 : mesh collider attached to the ball model

```
1.  using UnityEngine;
2.  using System.Collections;
3.  public class RayTraceInteraction : MonoBehaviour {
4.  private Ray ray;
5.  private RaycastHit hit;
6.  private GameObject gameOBj;
7.  public string GameObjectS;
8.  public string animationClip;
9.  // Update is called once per frame
10. void Update() {
11.
12. if(Input.GetMouseButtonDown(0)){
13. ray=Camera.main.ScreenPointToRay(Input.mousePosition);
14. if(Physics.Raycast(ray,out hit)){
15. if(hit.transform.name==GameObjectS){
16. gameOBj=hit.transform.gameObject;
17. hit.transform.collider.enabled=false;
18. Debug.Log("itssss workinggg");
19. StartCoroutine(Anim());
20. }
21. }
22. }
23. }
24. IEnumerator Anim(){
25. Debug.Log("itssss workinggg");
26. gameOBj.animation.Play(animationClip);
```

```
27.  yield return new WaitForSeconds(5);
28.  hit.transform.collider.enabled=true;
29.  }
30.  }
```

3.9 Challenges Encountered

In general as mentioned, earlier the methodology used is evolutionary prototype methodology, each iteration would produce a working prototype. Consequently, problems and challenges have occurred.

3.9.1 Program Installation, Compilation & Learning Curve

One of the earliest problems was dealing with the enormous amount of programs, sdks and environment variables to install. For example, the android sdk installation and it's computability with the unity 3D version.

Other Issues was learning the unity3D environment, and its scripting library, also learning the Vuforia sdk and use it with the unity-scripting library all combined in unity, which took a lot of time.

3.9.2 Interaction & Animation

There was a small problem encountered, when trying to fulfill the interaction and animation objectives. For the animation the models, where designed and animated in Maya and when imported to unity3D and rendered using the main unity camera, it worked as expected, but when integrating with the augmented reality camera, it did not work unless one presses play in the unity development environment, the solution to this problem is described in the functionality sub-section below. Regarding the interactivity, the basic interactivity by rotating and zooming in and out towards the object, has worked exceptionally well, but when trying to touch the pad of the phone, it does not read the action and play the command attached to it. The solution to this problem is also described in the functionality subsection below.

3.9.3 Time constrain

A project with this magnitude needs more time, for now it contains over 40 3D models, which needed to be modeled and animated, not to mention the Book design, song editing, GUI and interaction scripting. Fortunately, the prototype has met all requirements, due to proper time management and constant work.

3.10 Method of User Perception Survey and Observation Study

As the prototype of AR-Alphabees objectives were fulfilled, a user perception survey was conducted and observation study among potential users. The study is

conducted in order to get the perception and responses of the users regarding the usability, fun and commerciality of AR-Alphabees. Usability is a crucial factor to be assessed in order to recognize either the educational application or software will facilitate the acquisition of knowledge. ISO 9241-11 defines usability as the extent at which product can be used by specific users in order to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use. The potential users involved 80 in the study are among parents with little kids, teenage boys and girls and pre-school teachers as well as kids of 3 to 6 years old.

3.10.1 User Perception Survey

User perception study was conducted among parents of the small kids and pre-school teachers. Before they fill up the survey form, they had tested AR-Alphabees. There are four questions had been asked to the users which regarding the usability of the AR-Alphabet product. Each question is scaled from 1 to 5 where 1 is for least agree and 5 are for most agree. The lists of questions asked are as below:

	1	2	3	4	5
I think the product can assist student learn alphabets.					
I think the product is easy to be used.					
I think the product is fun and engaging.					
I think kids would love to use this product.					
I think I would buy the product.					

In addition, comments column also prepared to enable users to drop some comments or any other suggestions to be added and implemented on the application.

3.8.2 Observation & Pilot Study

Observation study is conducted while observing kids play the AR-Alphabees application. The purpose of the observation study is to view and analyze the responses from kids. The responses was used to assess usability and fun of AR-Alphabees application. There are several approaches to measure usability and fun; one is to observe what happens during interaction, observing and noting evidence of usability or fun shown during study, and to ask the users for their own assessments of usability and fun of the interaction (MacFarlane, Sim & Horton).

3.10.2 Key Milestones

Table 3: Final year project part-1 Key Milestones

No.		1	2	3	4	5	6	7		8	9	10	11	12	13	14
1	Selection of Project Topic								Mid-semester break							
2	Preliminary Research Work															
3	Submission of Extended Proposal															
4	Proposal Defense															
5	Project work continues															
6	Submission of Interim Draft Report							s								
7	Submission of Interim Report															

Table 4: Final Year Project Part 2 Key Milestones

No.		1	2	3	4	5	6	7		8	9	10	11	12	13	14	15
1	Project Work Continues								Mid-Semester Break								
2	Submission of Progress Report																
3	Project Work Continues																
4	Pre-SEDEX																
5	Submission of Draft Report																
6	Submission of Dissertation (soft bound)																
7	Submission of Technical Paper																
8	Oral Presentation																
9	Submission of Project Dissertation (Hard Bound)																

3.10.3 Gantt Chart

Table 5: Final year project part two Gantt chart

No. 1	Task	1	2	3	4	5	6	7	Mid-Semester Break	8	9	10	11	12	13	14	15
1	Project Work Continues																
1.1	Developing the Project																
1.2	Preparing Progress Report																
2	Submission of Progress Report																
3	Project Work Continues																
3.1	Development																
3.2	Testing & maintenance																
3.3	Preparing for Pre-SEDEX & Draft Report																
3	Pre-SEDEX																
4	Submission of Draft Report																
5	Submission of Dissertation (soft bound)																
6	Submission of Technical Paper																
7	Oral Presentation																
14	Submission of Project Dissertation (Hard Bound)																

CHAPTER 4

RESULTS & DISCUSSION

4 RESULTS & DISCUSSION

4.1 Prototype

A prototype was developed, where an application installed on an Android device. The application controls the device's camera and when pointed on the target images from the book it displays the according 3-D model tailored to be triggered by this specific target image.

Figure 62 : Application on an android device menu

Figure 63 : The Application GUI

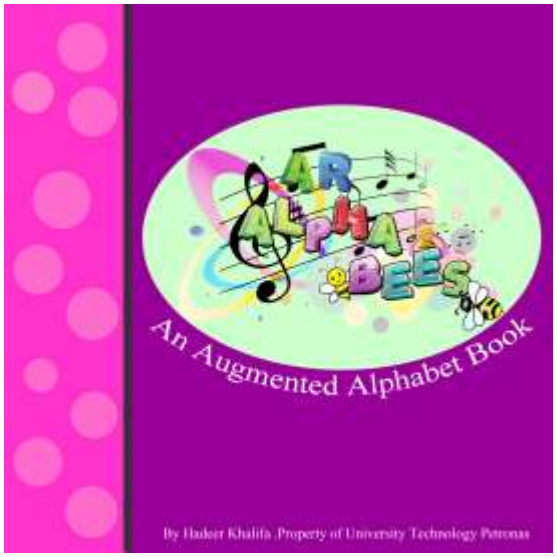


Figure 64 : The Book Cover

The book design aim is to be simple, elegant and efficient, vibrate colors and pictures are used to suite the child's preference.

Figure 65 : N n, Nest marker page 1 & N for nutshell song marker page 2

The Figure above shows the pages inside AR Alphabees book at which each page contains each letter and the particular letter's storytelling. At the left side of the book, show the letter of alphabet "N" in capital and small letters together with object's image and object's word. The object inside the book will act as image target or (marker1). The right side of the book contains the digital storytelling part (songs) of the alphabet and will act as image target (marker 2).

When the user points the camera to the image target (marker 1), the 3D model, will pop up and the sound of "N for Nest" will be heard, and it will also start animating. Furthermore, when the kid points the camera to the image target (marker 2), they will hear a song (digital story) as shown in right side of figure 65.

Below are some pictures of the developed prototype:

Figure 66 : Letter Z for Zebra

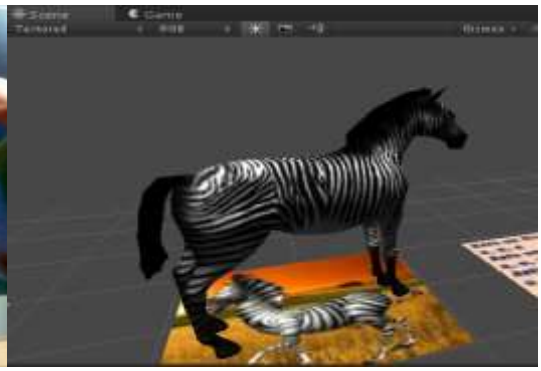


Figure 67 : zebra imported from Maya to unity 3-D

In the figure above, a Zebra was modeled and textured using 3-D Maya and imported in Unity3D to attach the rotation script to make it rotate slowly clock wise with respect to time, other models have a different set of animations other than rotation and they are not all scripted (see section 3.6.5).

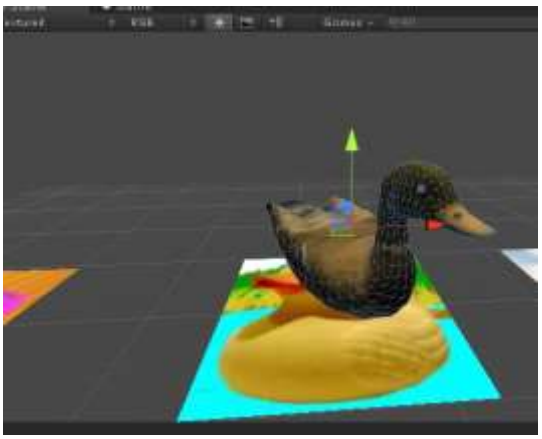


Figure 68 : Duck model for letter D, imported form Maya after modeling and textured

The Figures below, apply the same concept of the letter z, were one has developed letter A, D, P, V, R & J

Figure 69 : Penguin Model For alphabet P

Figure 70 : Violin model for letter V

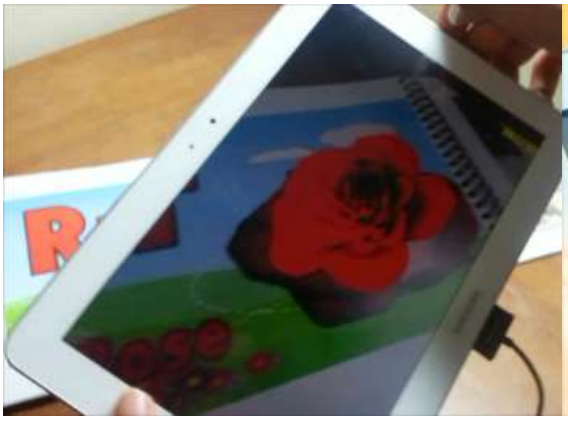


Figure 71 : Rose model for alphabet R

Figure 72 : Jet Plan for the alphabet J

4.2 Pilot Study

In NRIC August 2013 competition/ exhibition the author did a small pilot study, where the current prototype was presented in the exhibition and many people tried it, moms and their children, teenage boys and girls.

Figure 73 : high school girls trying out the application

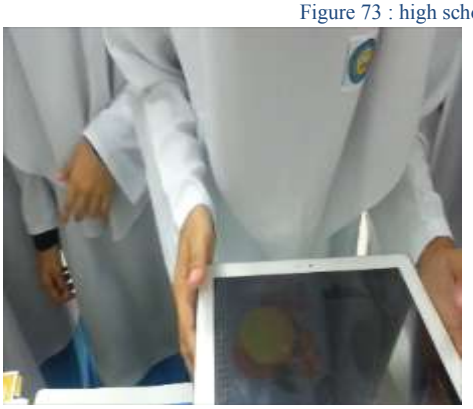


Figure 74 : A girl trying the alphabet O

Figure 75 : One of the users leaning to see the, where the 3-D model comes from

Note: The pictures of the children testing were lost due to an error of the device used to tape it.

4.3 Discussion

During the first pilot study, the application was not yet interactive. The pilot study went as follows; the author demo, on how to use the application in front of the high school/ Middle school/ parents & children and Judges at the exhibition. Fortunately,

the project **won a Silver medal for Novelty and Innovation**. Nevertheless, as the demo ran people started to gather and surround the demo to see the application nearer. Based on one's observation, as well as the videos recorded and taken during the study of user's reactions and comments, all users not only children were fascinated by augmented reality. Where a virtual object seems existent in real life and they tend to put their hand, towards the camera to check whether it is a trick or not, because many did not believe that it runs in real time. Generally, the parents, high school students and other people who tested the application liked it and said that their little ones (brother, sisters or children) would love using such an application.

Figure 76 : high school students testing the application and trying to test the camera to see if it is in real time

All people that tested the prototype application were surprised at first to see the 3-D models pop-up on the tab's screen over the book. Some of them praises it was a beautiful application as they were able to see 360 degrees of the 3-D objects, and some even mentioned that it's "magic".

I. Others tried to hit the book where they thought the 3-D Model are there.
II. Users, especially children also tapped the screen waiting for interaction, but I explained that it would be one's focus on the next stage of development. However, by this incident it confirms the next step of making the application interactive.
III. Users were excited to try each alphabet in order to see the 3-D Models and listen to the associated digital songs (digital stories).
IV. Some of the children sang along when the song started playing.
V. One of the children would not leave with his mother so he could stay and try the rest of the alphabet.

In summary, the pilot study for this little prototype was successful and helped to know and prioritize the features that will be developed in the next phase of the project, which were the interaction and realistic animation.

4.4 Another Pilot Study

Another pilot study was made after adding the interactions and animation, learned from the previous pilot study. In the pictures below, you can see one of the children who tried this application, she looks quite happy and interested, she also started singing along and tapping the screen, fortunately, this time there was actions after such interaction.

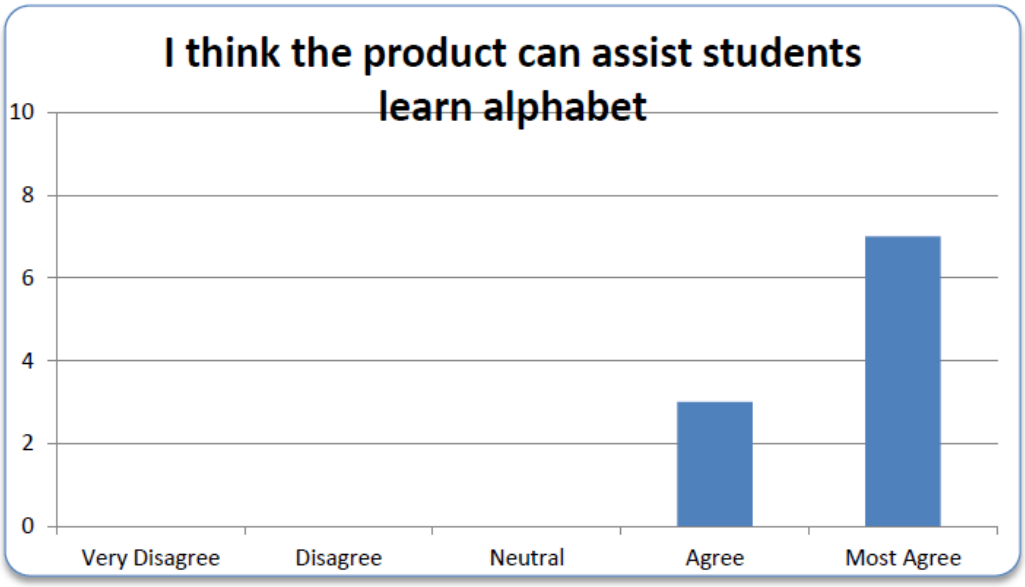
Figure 77 : 3 years old girl, trying the application

4.5 User Testing Results

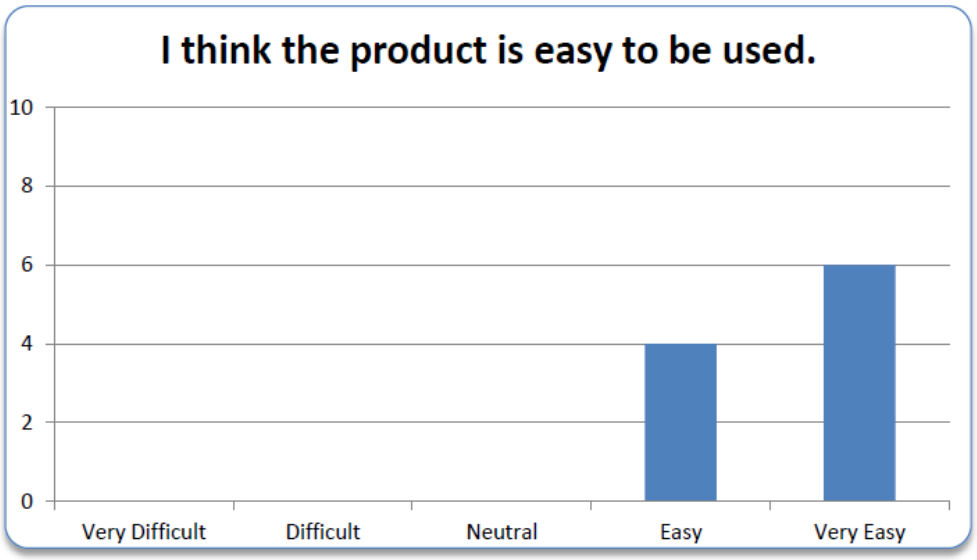
User Testing Study are divided into two which user perception study that involved pre-school teachers and parents with small kids as well as observation study which involved the pre-school children of age 3 to 6 years old. The result helps to support the developed application for further improvement and alteration to the application.

4.5.1 4.3.1 User Perception Survey

In the user perception survey, five questions asked to users. The survey involved 10 respondents. Each question is scaled from 1 to 5 at which 1 is the least agree and 5 is for the most agree.



The figure above, shows the graph conducted for the first question. The users were asked on their perception either the product can assist students learn alphabets. Results have shown that majority 7 of the respondents rated with scale 5 and 3 parents/teachers rated scale 4. This shows that all of the respondents agree that the product can assist students on alphabet learning.



The figure above shows the graph on respondent's rate on the easiness to use the product. Results have shown that majority 6 of the respondents rated scale 5 while another 4 of them rated scale 4. This shows that most of the respondents agree that the product is easy to be used.

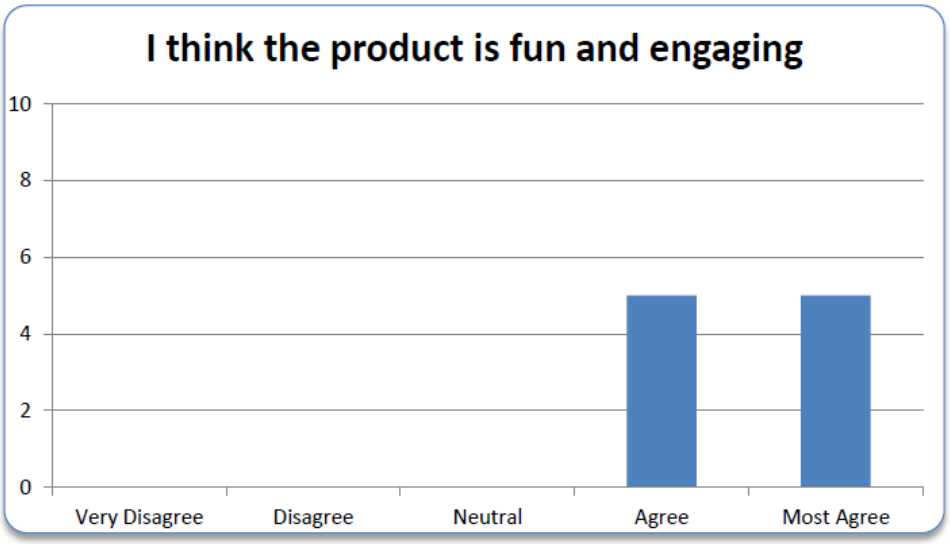


Figure above shows the graph on respondent's rate on either the product is fun and engaging. The graph shows that five of the respondents rate with scale five and the remaining rate with scale 4. The result shows that all of the respondents agree and most agree that the product is fun and engaging.

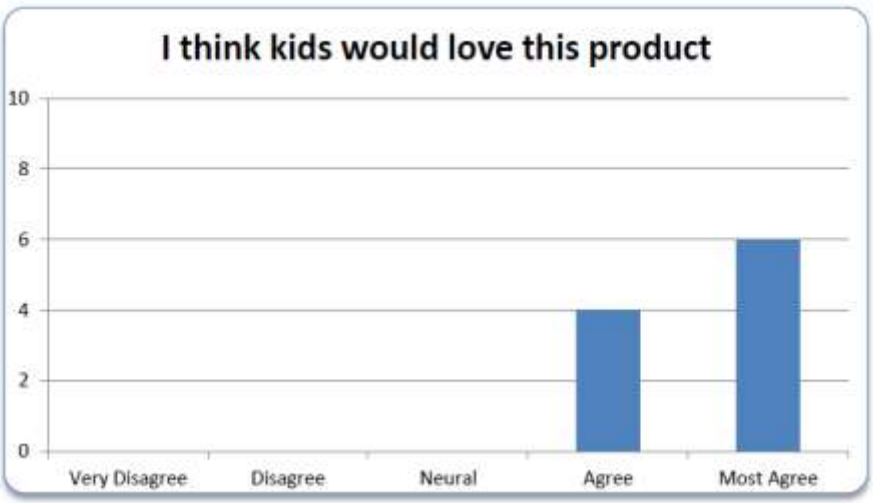


Figure above, shows the graph on four question asked which parent's perception on either kids would love to use this product. The graph shows that majority 6 of the respondents rated with scale 5 which means they are most agree that kids would love the product while the remaining 4 rated with scale 4.

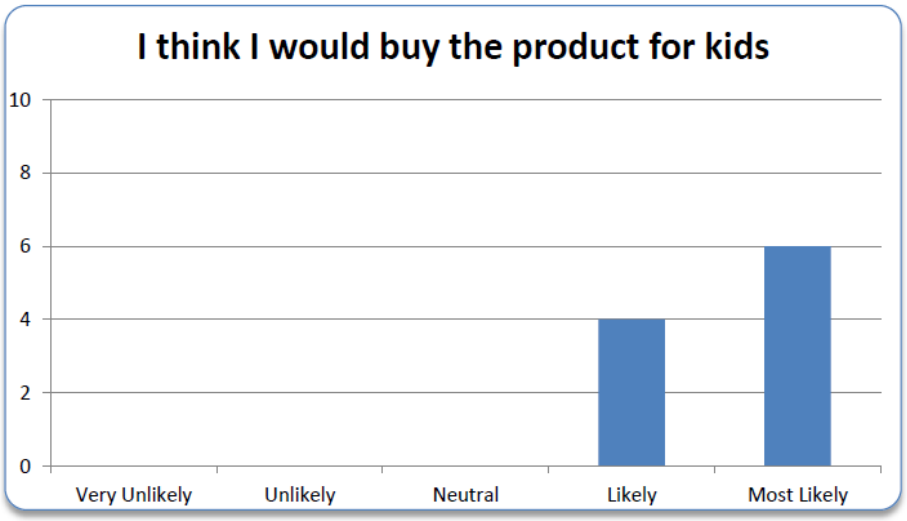


Figure above shows the graph on last question asked which are either the respondents would buy the product for their kids if the product available on market. The graph shows that majority 6 of the respondents rated scale 5, which is most likely that they would purchase the product for kids, and the remaining 4-rated scale 4, which is likely to purchase.

Overall survey result, which based on the five questions, asked shown positive feedback from the parents and teachers as all of the questions were rated at scale 4 and 5. Some of the positive comments drop by the teachers and parents are:

- "Good Idea! Kids would love to use the product!"
- "Is it available in the market?"
- "My baby sister will defiantly love it"
- "My sons/daughter will definitely love them."
- "It helps kids learn alphabet in fun way."
- "You should make it available at Google Play Store; I will download them for my kids."

CHAPTER 5

CONCLUSION & FUTURE WORK AND CONTINUATION

It has long been recognized that the rapidly changing nature of modern information technologies is dramatically altering the situation of both teachers and learners. Dede (2008) points out that, as our information technologies transform, educators continually develop new methods of teaching and learning.

However, along with these changes, the characteristics of learners continuously evolve, as do the sets of skills and the areas of expertise and knowledge valued by society (Dede, 2008). The affordability of mobile devices and other hardware capable of processing and displaying information at rapid speeds has made the widespread use of AR.

Furthermore, industry experts have predicted that the evolution of handheld devices, capable of delivering AR content and experiences will continue to escalate (Dede, 2008). As the tools facilitating AR continue to evolve, research and development of the applications of AR in education continue as well.

However, Augmented Reality has already demonstrated the potential to bring sweeping improvements in several areas; and it specifically had a positive impact on education. For one thing, the combination of AR simulations and training exercises, combined with tangible feedback interfaces, has been shown to improve individuals' performance in learning a variety of physical skills (Saenz, 2010), from delicate surgical operations for the operation and maintenance of tanks.

While the process of creating AR educational materials for high-level tasks, such as surgery, relies on the skilled combined effort of multiple specialists, as each 'lesson' is created, encoded, and made available, it becomes a permanent and perpetual re-usable resource.

According to Dede (2008), immersion of this sort, possible through AR educational activities, can be critical in supplying modern learners with an up-to-date, 21St Century education, which prepares them for the challenges, and activities they will face in our current, rapidly changing and technology-enhanced world. For example, modern learners need to learn to solve problems as part of interactive and distributed teams, in preparation for facing challenges in their future careers, which

actually are too big to be solved, or perhaps even theorized, by individuals acting alone.

According to Dede (2008), all these skills can be effectively learned by users participating in interactive and immersive AR and VR educational activities. For one, through learning to adopt virtual personas, while participating in virtual tasks, problems, and games, learners can disassociate themselves from negative self-conceptions and blocks that might otherwise delay their learning (Steinkuehler, & Williams, 2006). Dede (2008) points out that immersive experiences, especially those in which users act out shifts in identity, can help learners achieve greater awareness of multiple perspectives.

For the present, while movements towards increased and improved distance education, both through real-world, AR, and VR interfaces are ongoing and apparently moving along, the incredible rapidity of technological change and development is an upsurge that educators have been adapting to. While the world is undoubtedly changing, and so humans adapts to the worlds new ways.

5 FUTURE FOR EXPANSION

It is planned that in the near future the list below will be accomplished to enter the Disrupt in January 2014 competition:

1- Make a simple game to stress on learning the alphabets
2- Add more Alphabet Objects to each letter.
3- Add more songs and digital storytelling.
4- Publish in IOS

Finally, the project is meant to implement augmented reality and digital storytelling using mobile technology in order to teach the children the alphabet. The augmented reality technology will enhance the regular physical learning method will be used, so that the children of the current generation can both have fun and be engaged in the learning process. The small pilot study conducted have given positive feedbacks, thus proving that learning the alphabet through digital stories using augmented reality is able to enhance the current static book learning experience into fun and interactive learning.

Moreover, mobile augmented reality has a unique interface where users can work simultaneously with both physical and virtual worlds. Logically, it will grab the student's attention; create an interesting and motivating environment.

In conclusion, the project could be able to motivate and engage the children to learn the alphabet using augmented reality framework technology.

In the near future works, the project will be enhanced and improved to make the application more interesting by adding games. In addition, aesthetics of the book and the user friendliness is added to consideration. Moreover, the possibility of developed on iOS application serious consideration.

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