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Enhancing pupil engagement and learning through augmented reality-based interactive phonetics education

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Abstract

The traditional learning environment often lacks interactivity, which can impede the learning process for young students, particularly in subjects like phonetics, where engagement is crucial for success. This research explores the development and implementation of an interactive learning project aimed at enhancing the educational experience for school pupils by leveraging augmented reality (AR) technology. By overlaying digitally created content such as computer-generated graphics, videos, text, and sound on top of a physical view, AR provides an immersive and engaging platform for students to interact with real and virtual elements. The proposed System focuses on fostering a better understanding and faster Learning of phonetics among students by incorporating interactive features into their learning environment. This approach seeks to bridge the gap between conventional teaching methods and the need for more engaging educational experiences, particularly for young learners who struggle with traditional phonetics education approaches. To evaluate the effectiveness of the AR-based interactive learning project, a pilot study will be conducted in selected schools, comparing the learning outcomes and engagement levels of students using the AR platform against those in a traditional learning environment. Data will be collected and analysed to assess the impact of the AR intervention on students' learning progress, engagement, and overall satisfaction with the educational process. If successful, implementing this AR-based interactive learning project in schools could revolutionise phonetics education, leading to improved learning outcomes and more engaging student learning experiences. Moreover, this research could serve as a foundation for future studies examining the broader applicability of AR technology in various educational contexts.

Keywords: Interactive learning; Phonetics education; Augmented reality; Knowledge transfer; Pupil engagement

1. Introduction

Augmented reality (AR) proposes a conceptual prototypical for exploring the viewpoint of a new form of Virtual Reality (VR) application called Augmented Reality (AR) technology in the education field (Milgram, 2008). AR sets itself separately from VR by mixing 3D virtual objects into real environments in real time, thus allowing students to communicate with their physical environment and making learning more interesting (Fonseca et al., 2013). An interactive learning project is developed to provide a platform for users to interact more in the learning environment than in the conventional learning environment (Mahdi and Tomico, 2013). AR learning offers interaction such as screen touching, device flipping, device rotating, etc., to let users involved in a new technology learning style (Alessin et al., 2014, Alessin and Voigt, 2011, Billinghust et al., 2015, Billinghust et al., 2017).

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Games are seen as tools used for pleasure; academic research can also be seen as a social tool which can be used to teach children and adults verbal or non-verbal skills. Games as tools of pleasure are used to help relax the mind after a long day of hard work during our leisure time. (Guerra, 2011). They have a way of making us have a winning mentality as we carry out our daily activities. It gives us a sense that we can easily overcome hurdles that come our way daily as we carry out our daily activities. More so, games can be seen as tools for teaching in the classroom to aid the understanding of terms and concepts in a particular subject under study (Modlo *et al.,* 2019).

In today's world, everyone is using smart phones (Milgram and Takemura, 2008). As smart phones are reducing the work of memory, for youngsters and kids it is necessary to get some work for memory to sharpen it as stated by (Redondo et el, 2013). Furthermore, games are used tools for research by a psychologist to test behavioural patterns found among people, which suggests their reactions to things happening around them. John Spilsbury created the first jigsaw puzzle in Britain during the mid-1700s and used a map puzzle to teach world geography. During the 1900s, magazines and newspapers entertained people with word puzzles. Over the last century, puzzles have expanded and taken many forms (Galantey, 2012).

The traditional teaching and learning method has not been an effective way of teaching children. This is because there is limited participation of children in the learning process, and children tend to lose attention quickly. Children also tend to be bored in the classroom and do not like reading, writing and studying. Hence it is necessary or pertinent to develop. The difficulty children encounter in learning through the conventional teaching method is the motivation behind my project: to create and implement an educational augmented reality to teach and help children in Learning. My project aims to design and implement an augmented reality training application for school pupils between the ages of 5-10 (Fonseca et al., 2014, Furh et al., 2011, Folarin, 2014, Galantey et al., 2012)

This project aims to develop an interactive teaching application that will be educative and helpful in the mental development of children by building the Childs mental, cognitive, social and physical skills. This research focuses on designing and implementing an educational mobile device-based application for children; it is a single-player application. The application will provide an augmented reality video and audio player where kids will learn introductory phonetics with their virtual instructor. There is also a section for the quiz to test kids' general knowledge in phonetics, a draw and analysis that will encourage kids to do their homework easily with little or no supervision. This augmented reality application focuses on teaching kids introductory phonetics and testing their skills based on all they have learnt from the augmented reality video player that will contain at least 1 to 5 videos in its library on phonetics. I hope to increase the number. More importantly, a draw and analyse section where the program will explore what children drew in 2 Dimension and then show them an animated 3 Dimension of what they drew (Furh et al., 2011, Folarin, 2014, Galantey et al., 2012).

2. Material and methods

- To gather the information through related literatures, via Interviewing methods and observation method
- To develop the System using C#, JDK (Java Development Kit), SDK (Software Development Kit)
- To develop and implement the application using Unity Hub, visual Studio, Scriptwriting, and Vuforia to augmented reality unit.

2.1. System Analysis of the Existing System

Different methods of teaching have existed over the years. The formal and informal teaching and learning methods are examples of teaching and Learning we have. The informal teaching method is the first form of Education every individual receives from childhood. The informal teaching method is delivered orally using a hands-on approach. It teaches morals, cultures and household chores. The formal teaching and learning method uses the conventional method of teaching (teacher to student), books to learn, and online platforms (YouTube and online academics). The teacher-to-student method (conventional method) of Education is an effective learning method but provides a one-way transfer of information. The teacher is the centre of attraction. Students are not fully involved in the learning process and quickly lose attention. How does a kid learn to ride a bicycle? Not by watching the teacher rides a bike but by learning to ride himself (the act of doing).

2.2. The problem with the existing System

The traditional or conventional teaching and learning method has not only been an effective way of teaching children. This is because there is limited participation of children in the learning process, and children tend to lose attention quickly. Children also tend to be bored in the classroom, and they do not like reading, writing and studying.

2.3. The Solution to the Existing System

It is necessary or pertinent to design and implement an augmented reality training application for school pupils aged 5-10 to aid their learning skills and participation in the learning process.

2.3.1. Proposed New System

The Easy Learning for Kids (ELK) is an educational augmented reality application that teaches children phonics and how to draw fun and engagingly. The System provides a friendly user interface for kids. It allows them to learn at their own pace and increase their cognitive skills as they solve day-to-day problems related to their education and learning process. The augmented reality system is educative and entertaining. Unity, Vuforia, and Microsoft Visual Studio will be used as the platform for developing the partial immersion application or augmented reality.

2.4. System Architecture

The application design focuses on illustrations of how the System can be implemented using diagrams.

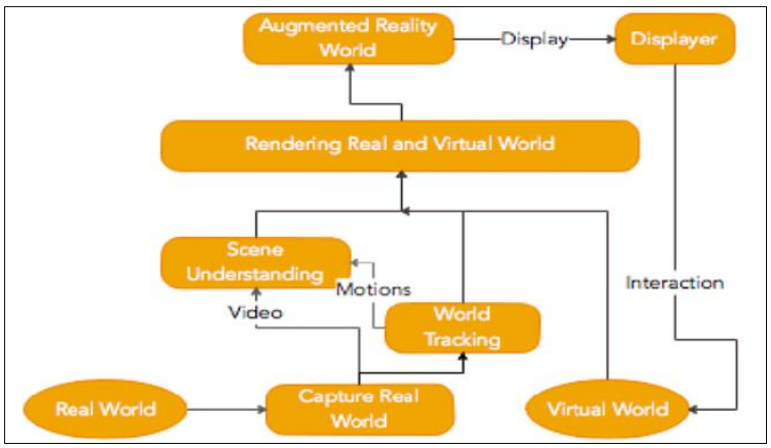

Figure 1 Augmented Reality (AR) System Architecture

2.5. System Feasibility Study

The System is feasible if goals and requirements are satisfied within the constrain of available resources and technology using a particular strategy. Furthermore, to understand the implementation of augmented reality, I have focused on the model of augmented reality easy learning application. (Sun *et al.,* 2013)

2.6. Model Showing User's Activities

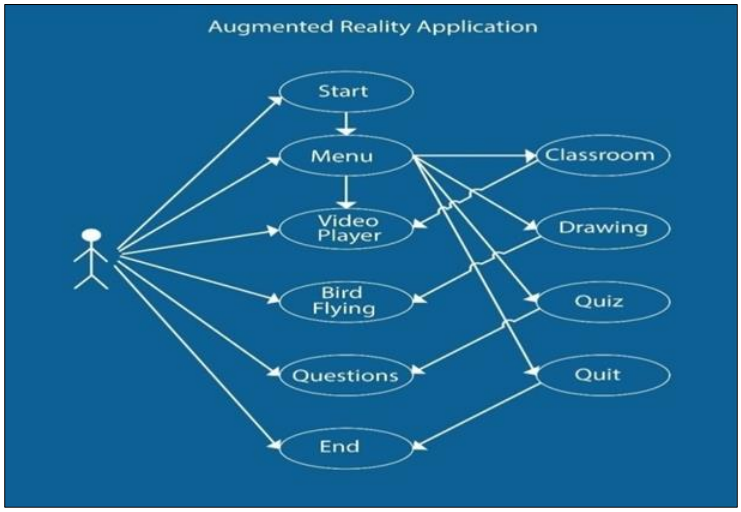

Figure 2 Use case diagram of Augmented Reality Application

The main menu pops up as soon as the user doubles click the mobile application on their Android phone as indicated in the use case diagram; the user can start the System, go to the classroom and start learning phonics, navigate to the quiz section after class completion, learn how to draw as well as quit the game. I identified main use cases for the use case diagram, which may include some sub-use cases.

2.7. System Design

System design is proceeding from an identified set of system requirements to a plan that meets those requirements. Also, designing a system is the process of making a complex plane of the form or structure of something, emphasising features such as its appearance, convenience and efficient functioning. The design phase aims to develop a clear blueprint of the learning application that will satisfy all documentation requirements for the System. This blueprint will provide interface design models that are consistent, user friendly and will provide straightforward transition through the various system functions (Navarro et al, 2012, Guerra et al., 2011, Junwei, 2016)). The overall system design objectives are to provide an efficient, modular design that would reduce the augmented reality system complexity, facilitate change and result in an essay implementation.

2.7.1. Functional Requirements

- A user can be able to take a lesson in phonics
- The Android application will overlay the number of videos as seen as the image target has tracked the replica of the image in its database.
- The Android application will overlay an augmented reality video player the moment the image target is tracked; immediately, a video player will be overplayed from which the user can play, stop, pause, next, previous, mute and unmute and also move back to the main menu.
- The user can take a quiz at any time
- The user will also learn how to draw

2.7.2. Non-Functional Requirements

- The System shall provide a friendly user interface.
- The System shall have a fast rate of operation and response time.
- The System will always be available to users at all times.

System Requirement

Hardware and software are required to run the Easy Learning for Kids system. The system or software requirements are listed and needed to operate the System properly. These are the necessary specifications that most Android devices have to use the software and hardware.

Hardware Requirement

The following are the minimum hardware requirement:

- RAM: 3GB
- Storage: 16 or 32 GB ROM
- Android device

Software Requirement

The following are the software requirements.

- Android Operating System
- Unity Hub
- Android Development Kit
- Java Development Kit
- Visual Studio IDE

2.7.3. Development Environment

The User Interface was created using the Unity platform, while the scripting aspect was done using Microsoft Visual Studio using C# as the programming language of choice.

Microsoft Visual Studio

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

Visual Studio supports 36 different programming languages and allows the code editor and debugger to keep (to varying degrees) nearly any programming language, provided a language-specific service exists. Built-in languages include C, C++, C++/CLI, Visual Basic .NET, C#, F#, JavaScript, TypeScript, XML, XSLT, HTML, and CSS. Support for other languages, such as Python, Ruby, Node.js, and M, is available via plug-ins. Java (and J#) were supported in the past.

C# Programming Language

It is designed as a general-purpose machine language for building applications on the Microsoft platform, and the language depends on .NET Framework to work. C# programming language can be used to create anything but is particularly good at designing and developing games.

- Reasons for Choosing the Language

Most complex tasks in C# are abstracted away, so the programmer doesn't have to worry about them.

  - It's also a statically typed language, so the code is checked before it is turned into an application
  - It is more consistent than C++ programming language.

Unity Hub

Unity Hub is a cross-platform game engine that can be used by both experienced game programmers and beginners to create games and other kinds of applications, such as augmented reality using Vuforia, AR Core, AR Kit or AR Foundation in creating plugging.

2.8. System algorithm (flowchart)

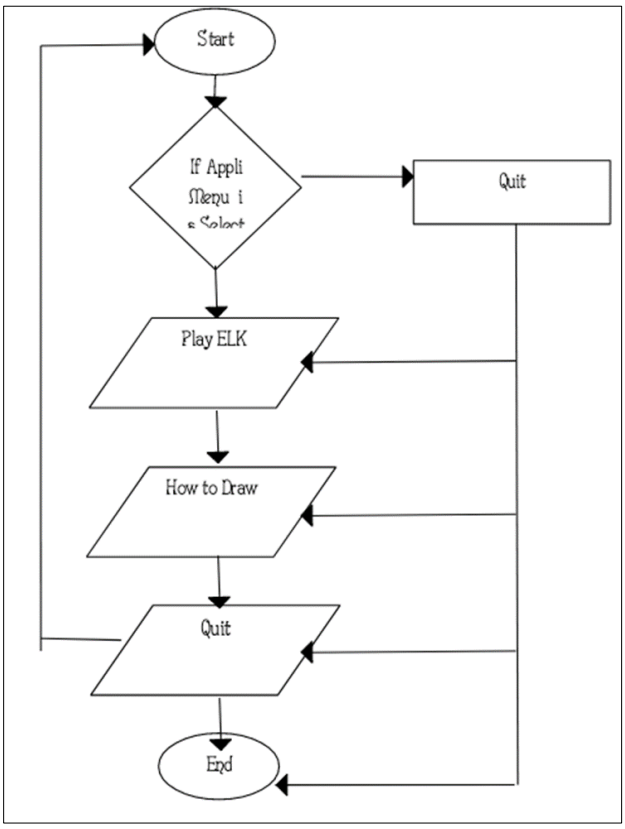

Figure 3 Augmented Reality Application Flow Chart

3. Results and discussion

This section comprehensively describes and critically evaluates all the essential functions and features that can be incorporated into the augmented reality system to facilitate easy Learning for children aged 5-10. These features include phonetic sound learning and a quiz section designed to assess a child's abilities by asking a few questions and awarding marks upon quiz completion.

3.1. Test Run

This testing is done and carried out by executing the program on the Android device system; Vuforia is used for designing and configuring the Augmented Reality Development system. The purpose of these test run is as follows

- To check if there are any bugs in the System.
- To check the effectiveness and efficient operations of the System.
- To check and make sure that the System meets its objectives and the user requirements.

3.2. System Development

System development defines, tests, and implements a new software application or program. It could include the internal development of a customised System, creating a database system, if any, or acquiring third-party developed software. Written standards and procedures must guide all information systems processing functions. The organisation's management must define and implement measures and adopt an appropriate system development life cycle methodology governing developing, acquiring, implementing, and maintaining computerised information systems and related technology (Junwei, 2016).

3.3. System Implementation

System implementation is putting a planned system into action. It is also the carrying out, execution or practice of a plan, a method, or any design for doing something. In an information technology context, implementation encompasses all the processes involved in getting new software or hardware operating properly in its environment, including installation, configuration, running, testing and making necessary change (Roxes *et al.,* 2012).

Table 1 Program Modules

Module	Function
Quiz	Display the quiz questions for the Child to answer and have his score.
Play ELK	It targets the specific image on the drawing path or book specified.
How to draw	Teachers show a child how to draw a specific image to make the drawing easy for the pupils.

3.4. Interface Forms

Figure 4 Easy Learn for Kids (ELK) User interface

The user interface gives the user the room to select an option, such as Quiz, Play ELK, or How to draw; for the next step to be taken after all action is taken, then quit.

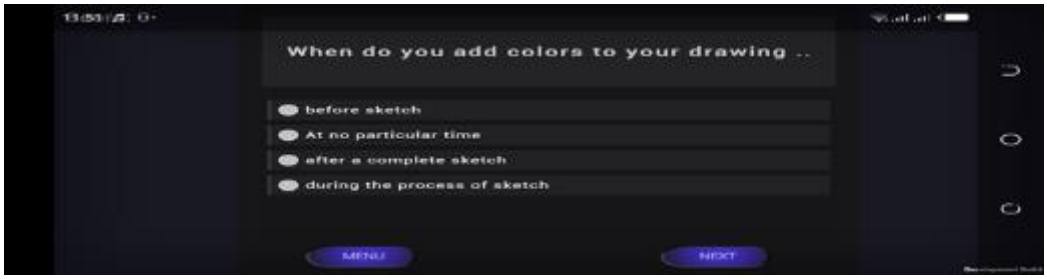

Figure 5 Quiz Question

This interface pops out a quiz question to a child, allowing him to make the right choice, and it will be scored after selecting from his selection of questions.

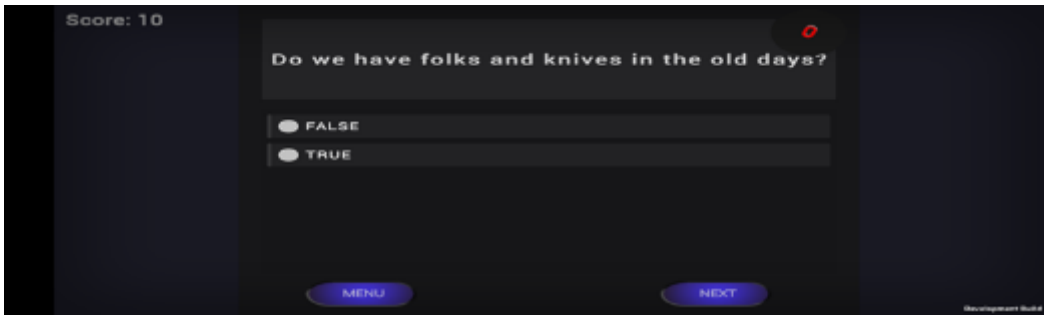

Figure 6 Quiz Question Interface

Figure 7 Interface of the Right Answer

After the quiz question selection and the choice made by the kid, if it is correct this interface will pop out for the kids to see his score.

Figure 8 Interface of the Wrong Answer

Figure 9 Final Score after the Quiz

This interface pops out at the end of the quiz question and answer, showing the Child his final score

Figure 10 Phonetic Lesson Interface

This is the interface that teaches the Child phonetics, where the device camera has scanned the book since the System is an image target, and it recognises only one book

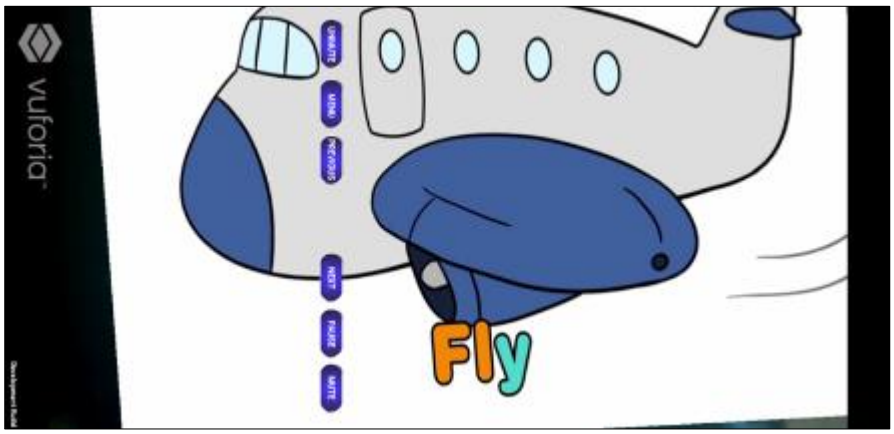

Figure 11 Another Interface on Phonetics Lesson

This interface shows and teaches the Child phonetics on the word FLY and expands the Child's knowledge of the phrase FLY by giving him a sentence with the word FLY as shown below.

Figure 12 Phonetics Elaborating the Word Fly For the Kids

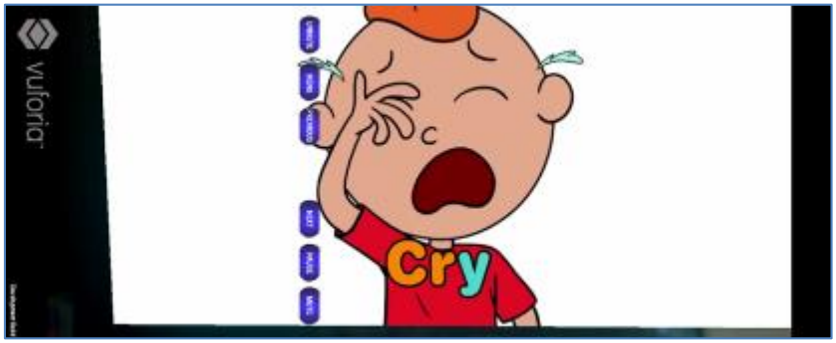

Figure 13 Phonetics Result or Lesson of a Word Cry

Another phonetics lesson for the Child with the word CRY expand the Child's knowledge by teaching the Child a sample sentence about why CRY, as shown bellow

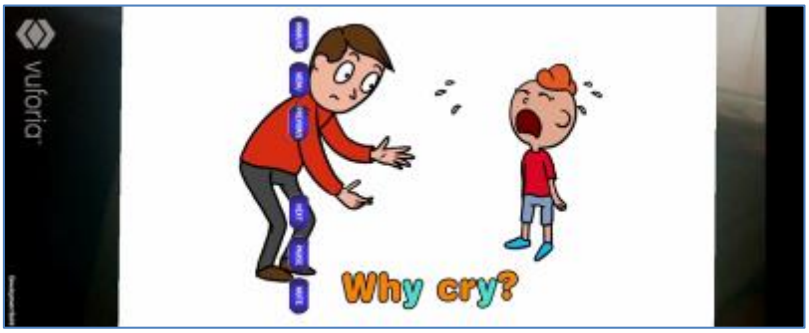

Figure 14 Phonetics Teaching The Child Why Cry

Figure 15 Asking Why Is She Crying On Phonetics

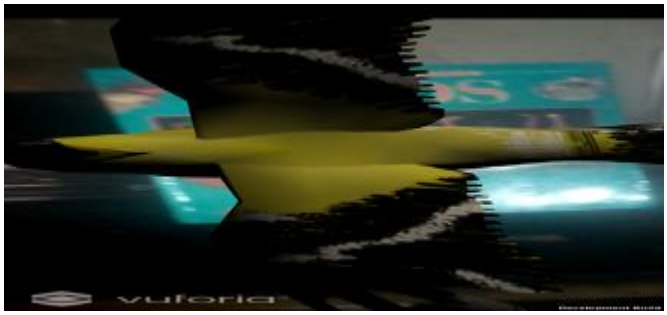

Figure 16 Interface of a bird flying on image Targeting

This interface displays the bird flying after the book build with th System by augmenting the image display on the book to show the bird flying when the device scans. The screenshot of the book is displayed below.

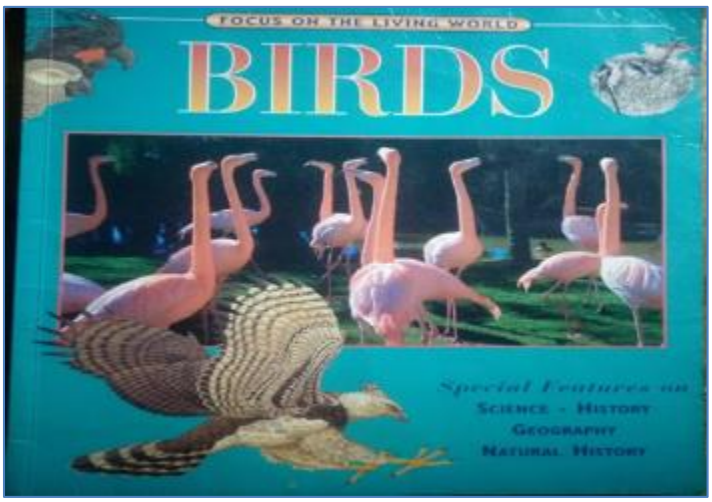

Figure 17 Augmented book for child learning

4. Conclusion

As the innovative technology industry progresses into a world of more sophisticated reality applications and interactive experiences, the capabilities of augmented reality are improving quickly. Consider adding this valuable skill to your portfolio and become part of today's expanded reality industry.

Recommendations

The augmented reality (AR) industry is transforming user experience through its interactive headset technology. The recent announcement of Facebook Metaverse is a testament to this growing industry. According to Statistics forecast, the global augmented and virtual reality industry will create 23 million jobs by 2030. If you want to be a part of this advanced tech industry and work for tech giants like Facebook, you must acquire a wide range of AR skills. Below are the top five skills needed to practice augmented reality projects I recommend.

- **It is augmented reality programming.** You must develop expertise in several general-purpose programming languages in this field. You must learn C++, Python, C#, Swift, JavaScript, Java, and React Native.
- **3D development.** Augmented reality projects include many 3D fields. You will need an in-depth understanding of various 3D aspects, such as modelling, images, game engines, and application development skills.
- **Unity 3D engine.** The Unity 3D engine is one of the most popular augmented reality game development engines. You need to master the Unity 3D game engine to do various AR projects.
- **User experience and user interface.** Augmented reality applications use innovation, neural networking, and virtual reality to provide optimal interactive experiences to their users. You must have excellent user experience and interface skills to deliver these applications.

- **Vuforia.** The Vuforia software development kit (SDK) is a popular engine used to build Android augmented reality applications. You must attain Vuforia engine skills to complete augmented reality infrastructure projects.

Compliance with ethical standards

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We would like to extend our sincerest thanks to the educational institutions and educators who graciously allowed us to implement and test our project within their classrooms. Their cooperation and feedback were invaluable in the refinement of the project. Furthermore, we express our gratitude to the technical teams who were integral in the development of the augmented reality components of this work.

Disclosure of conflict of interest

Daniel Aliu and Suleiman Ibrahim Abubakar jointly developed the manuscript and contributed equally to the research and development of the project. There are no conflicts of interest to declare. Neither of the authors have any affiliations with organizations that have a direct or indirect financial interest in the subject matter discussed in the manuscript.

Statement of ethical approval

All procedures and methods used in the development and testing of the "Enhancing Pupil Engagement and Learning Through Augmented Reality-Based Interactive Phonetics Education" adhered strictly to the ethical guidelines set out by our respective institutions and followed widely accepted best practices within the field.

Statement of informed consent

Informed consent was obtained from all individual participants involved in the study, which primarily includes the educators implementing our project and indirectly the pupils using it. Prior to the study, all parties were thoroughly informed of the purpose and procedure of the study, as well as the handling and confidentiality of data. They were also informed of their right to withdraw from the study at any time without penalty. Following this, written informed consent was acquired from each participant and, in the case of the pupils, their parents or guardians.

References

[1] Alessin, C., Alarcon, R., and Nussbaum, M., (2014.) Implementing collaborative Learning Activities in the classroom supported by one-to-one mobile computing: A design-based process. Journal of Systems and Software

[2] Alessin, C, and Voigt, F.P.A. (2011). Augmented Reality in Astrophysics and multimedia technology And space Science.

[3] Billinghust, B., Markopoulos, P., Gielen, M., Vermeeren, A., and de Ridder, H., (2015). Powerball, the design of a novel mixed-reality game for children with mixed abilities. In Di Serio, Á., Ibáñez, M.B., and Kloos, C.D., (2012). Impact of an Augmented Reality System on Students' motivation for a visual art course. Computers & Education, Proceedings of the 2015 conference on Interaction design and children - IDC'15. ACM Press, New York, New York, USA.

[4] Billinghust, B. L Augmented Reality Survey Experience: Initial Perceptions of Higher Education of Learning using the Augmented Reality (November 12, 2014).

[5] Baillot, Santos, M.E.C., Chen, A., Taketomi, T., Yomamoto,G., Miyazaki, J., Kato, H.,(2017). Augmented Reality Learning Experience: Survey of Prototype Design and Evaluation. IEEE Train, Learn.

[6] Fonseca, D. Pifarré, M., Redondo, E., Alitany, A., and Sánchez, A., 2013. Furch, D. Pifarré, M., Redondo, E., Alitany, A., and Sánchez, A., (2014).

[7] Furh, Navarro, I., Surel, I., (2011). Augmented Reality Experience: Initial Perceptions of Higher Students. International Journal of Instruction.

[8] Folarin, Olaleye, Habeeb. "The Educational Policies before 1960 till Date" Presented (April 13, 2014). Retrieve for use (July 26 2021).

[9] Galantey, B., Rienties, B., Tempelaar, D., and Gijselaers, W., (2012). Investigating the relations Between motivation, tool use, participation, and performance in an e-learning course using web-videoconferencing. Computers in Human Behavior.

[10] Guerra, R., Torpus, J.,and Engeli, M., (2011). "Living-room" Interactive, Space-Oriented Augmented Reality. In Proceedings of the 12th annual ACM international conference on Multimedia '04. ACM Press, New York, New York, USA.

[11] Junwei, Yilmaz, R. (2016). Education Magictoys Developed with Augmented Reality Technique: A Literature Review for Augmented Reality and its Application, Limitation and Future Direction.

[12] Milgram, P., and Takemura, H.,(2008). Augmented Reality: A Class of Displays on the Reality-Virtuality Continuum. Telemanipulator and Telepresence Technologies.

[13] Martí, N., and Fonseca, D., (2013), Active Learning Units Interrelated using TIC's Tools in Archit. Construction.

[14] Mahdi M., and Tomico, O., (2013). Bipolar laddering (BLA): a participatory subjective Exploration method on pupil's user experience. In Proceedings of the 2007 Educational Conference in Nigeria. Designing for User experience. ACM, New York, NY, USA.

[15] Modlo, Y., Semerikov, S., Bondarevskyi, S., Tolmachev, S., Markova, O., & Nechypurenko, P. (2019). Methods of using mobile Internet devices in forming the general scientific component of bachelor in electromechanics competency in modeling of technical objects.

[16] Redondo, E, Sánchez, A., Perede, A., and Fonseca, D., (2013). Geo-Elearning: Geolocated Teaching in urban environments through mobile devices. A case study and work in process. In Schumaker, R. (Ed.), 15th International Conference on Human-Computer Interaction, Part II, Lecture Notes in Computer Science - 8022-, Springer, Heidelberg

[17] Roxes. Zelinka, S., Azaryan, A. A., and AzaryN, v. A., (2012). Investigation of Opportunities of the Practical Application of the Augmented Reality Technology in the Information and Educative Environment for Lower Educational Establishment.

[18] Sun, J., and Hsu, Y., (2013). Effect of interactivity on learner perceptions in Web-based Instruction. Computers in Human Behavior.