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Improving Primary Education Styles using Child-Computer Interaction: A Practical Framework

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Abstract: Researchers observed that child is a visual, aural, physical, social, solitary, and logical learner. These learning styles spurred current teaching techniques towards integrating the child with interactive 3D user interfaces and the real-world using mobile devices. In this paper, we present a framework that enhances child learning experience using augmented reality (AR) applications. AR capabilities are one of the most influential human-computer interaction paradigms by integrating learning materials with the real-world. The development of such interfaces requires creating a collaborative classroom involving usable digital content for children and teachers.

Keywords: child-computer interaction paradigm, augmented reality, educational applications, 3-dimensional user interface, user experience.



1 Introduction

An education process in the current era faces many revolutions, which change the content of courses in terms of more creativity, interaction with students. These revolutions are the result of the technology, which allows the inclusion of new applications and the use of education in particular. Therefore, when the technology becomes an important trend for all students, education becomes more enjoyable using these tools.

Many technical tools appear in the field of education in a suitable manner with the nature of learning process. One of the tools that changes the world of education is "Augmented Reality Technologies[1] ."

Augmented reality is one of the most important technologies that will have a promising future and it can be defined as a technology based on the projection of virtual objects in the real user environment. In the contrast of Virtual Reality which based on projection real objects in a virtual environment.

A user can deal with information and virtual objects in AR by several devices, as smart phone, glasses and contact lenses [2]. Today, enhanced reality technology is used in several fields. Entertainment, military training, engineering design, robotics, manufacturing and other industries, that gradually integrated into education.

There is no doubt that learning through practice is more effective than reading and writing [3]. Thus, an AR can participate strongly in this field by entering classrooms, which will be an incentive way to learn, and to increase focus. The AR of virtual objects in the real environment for students will give them the opportunity to see and move 3D objects and interact with them. Many previous apps take place in AR interactive education. For example, Quiver app, Earth AR, Chemistry 101, etc. [4]

Popularity of digital devices make real-world activities unexciting as coloring. So, AR holds unique potential to affect this situation by providing a bridge between real-world activities and digital enhancements.

In this situation, we provide an AR interactive educational coloring book as our enhanced system. Coloring books will help in capturing the fiction of the child and provide him with one of the earliest opportunities for creative expression. It is designed to help children and students of ages 6 to 8 years, in order to learn which includes presentation of various graphics that is colored by children in 3D and many other functions using a smart mobile device. [3]

Preparing the children or students and bringing them to the level that the community needs is primarily the responsibility of the teacher; it is not reasonable for our Arab teacher to practice his profession in the way he has practiced in the last century [5]. Even though education over the past decades, number of significant humanitarian achievements has achieved, but it is still low in terms of quality, performance, and the adoption of traditional methods of education, which contains many of the most important problems:

- 1- Focus on traditional ways of education like chalk and talk methods, and neglect activities that show skills, talents.
- 2- Attention to the mental side of the student through memorization of concepts and knowledge, neglect of other aspects, and neglect the use of educational aids.
- 3- The sense of teacher and students is bored, in addition to the fact that the teacher is a device for registration, and the student is a permanent listener [5].



The view of the outputs of public education Arab world finds that a large proportion of them are not at the desired level in terms of possessing the basic skills in reading, writing, sports and science in different branches. There is a general weakness resulted from several economic, cultural and political factors. Despite the efforts made by teachers, supervisors and state institutions, they did not achieve the desired results. In order to deal with this, there must be a treatment for the various factors affecting, including the quality of teaching provided to students, and method of teaching and learning.

As the development of technology in our time has been the establishment of many technological means by developers and experts in this area, which will help to develop education and various areas more than the existence of so-called enhanced reality. We have established this system to teach children through the enhanced reality, which in turn stimulates and develops the basic concepts in the child and works to attract his attention more through graphics and activities. This makes him able to acquire more information and embed it in his brain through the augmented reality.

2 Related Work

There are several existing applications that target Child-Computer Interaction. One application is augmented reality coloring book with transitional user interface application (Cho, Kim, & Lee, 2016), this app describes an AR coloring book with a transitional user interface. It comprises a paper book and a smart phone. The proposed AR coloring book enables the user to enjoy content by switching between real worlds, augmented reality, virtual reality, and networked virtual reality. An interactive augmented reality coloring-book is another application that presents a new type of mixed-reality book experience, which augments an educational coloring book with user-generated three-dimensional content (Clark & Dunser, 2012).

A new multimedia reading experience app (Grasset, Duenser, Seichter, & Billinghamurst, 2007) introduces an interface with a seamless integration of different modalities, while keeping the high value of the physical properties of the book. In addition, the HIT Lab NZ (Billinghurst, Kato, & Poupyrev, 2001b) developed "The MagicBook". The MagicBook is a mixed reality interface that uses a real book to seamlessly transport users between reality and the virtual environment. This work describes a potential applications and user feedback that stimulates children learning using hand-held devices (Billinghurst, Kato, & Poupyrev, 2001a).

Another work proposes an AR coloring jigsaw puzzles which provides users with puzzle pieces for coloring and AR/VR worlds for colored 3D animations. The AR coloring Jigsaw puzzles with an algorithm that translates the painted Jigsaw pieces to the virtual 3D models. The proposed puzzle is composed of a jigsaw puzzle with unpainted pieces and a smart phone application (Lee, 2015).

The available applications that are focused on the field of child-computer interaction are few (Arcos et al., 2016). Therefore, we should focus on more applications in the field of education using child-computer interaction and improving the work of education.

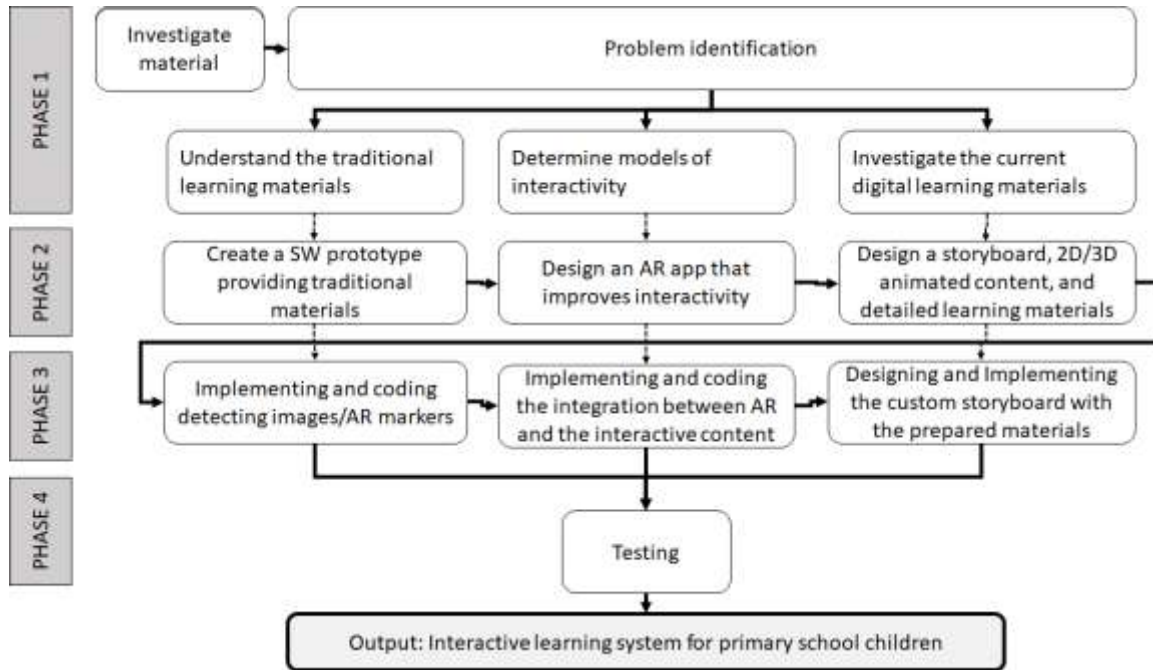


Figure 1: A framework for interactive learning system development

3 Methodology

Previously, the education system depends on the blackboard, chalks and books, which has become conventional methods with the advent of technology and the development of teaching techniques using interactive education, such as Quiver app [4] which is mentioned in chapter one, this app used to bring colored pages to life by converting graphics into 3D objects. For our paper we will use this feature as a similarity between them; moreover, there will be other functions developed like sounds stored in database, movements, and other options for each graphic. In addition, our app will be easier and friendly to use for children than the previous app, which lacks any icons to help children in using this technology features and devices. Using technology and interactive techniques in education will guarantee to raise the level of interaction between teacher and children. 3D experience will provide clear and more accurate information for child and increase teacher efficiency in education; this will contribute to raising the level of education. Also, increase educational effectiveness such that AR achieves tangible results in collaborative and experiential learning processes, includes methods provided by AR for education: physical perception, and mental work. Moreover, the research adds a very useful value, that it is very important step for children to enter the world of technology, to deal with its techniques and to expand their mental perception.

Figure 1 shows a framework that describes the phases of the development of an effective UX/UI AR application to achieve an interactive learning system for primary school children.

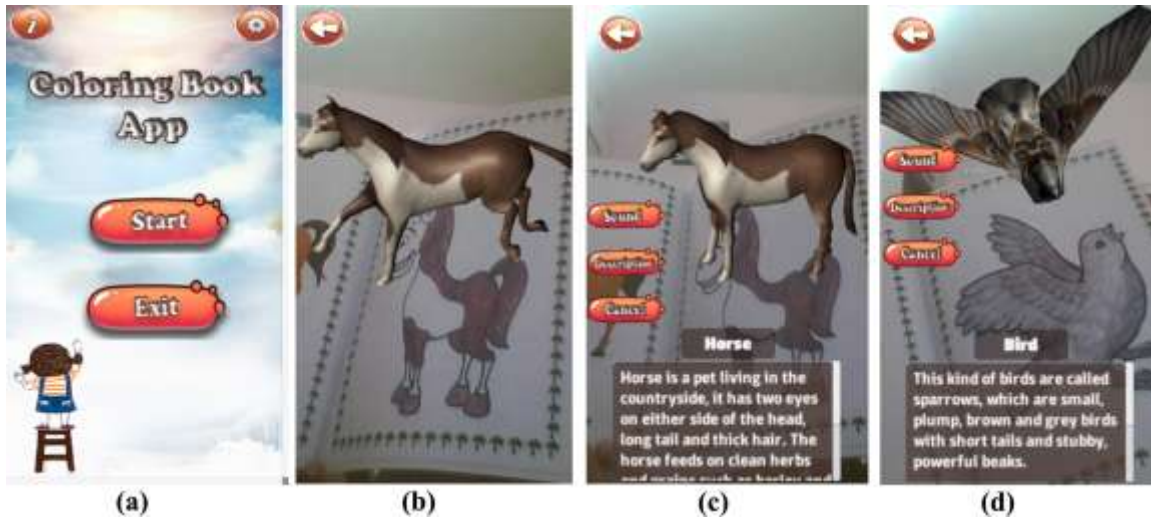


Figure 2: (a) the app's starting screen. (b) an example of the on-play AR screen showing a 3D horse animation laid on the colored book. (c) Once the child presses on the 3D horse model, a details menu pops up showing information. (d) another example of a 3D bird.

4 Discussion

The purpose of this study is to use AR applications in education fields by serving and increasing its performance to avoid it from being boring. AR enters the classrooms for children of 6-8 years to make the education operation more interactive and productive, this will be achieved by introducing the old methods into the new ones, we designed a mobile app to use an educational coloring book, which is the children's favorite, in order to present what they colored in a 3D model with other features.

The general goal for the research is to create an interactive app for coloring book, which is specifically provided to children in order teaching and entertainment goals. Therefore, children will be able to:

1. Viewing graphics that are colored by them in a 3D technology, with the same colors, they chose.
2. Having the possibility of knowing more about the animal by clicking over it and reading its name and description, also they can hear its voice.
3. Display specific movements for some animals.

This is an expected picture of how the object will be look like in 3D is illustrated in Figure 2.b, 2.c and 2.d.

We chose to use the prototyping software model for some reasons such that the cost of accommodating the app changes requirements is reduced, more flexible, and easier to get children's feedback on the work done during development than when the system is fully developed, tested, and delivered.

We have collected and analyzed sufficient subjects (children) related data through research. We have also studied the children needs primarily, because the child is the basic user of this application. So that one of the priorities of our study for this application is its ability to attract the attention of children and simulate their age abilities, this will be done by building an app, which is friendly and easy-to-use, then we will continue studying the other important factors like economic, technical and financial effects in order to



ensure its success. Finally, we will move on to start analyzing, designing and implementing the research based on those studies, to achieve this we tend to use the Unity IDE depending on the C# language and storing data using XML. During this study, we faced some limitations while working, these restrictions may be related to software, hardware, or time limitations such as cases when children usually do not have mobile devices, they are generally difficult to use for them. This is a restriction to deal with the children who are not familiar with new mobile app environments such as AR.

The functions we incorporated in the mobile app are: start app, centralizing by the app camera on specific pictures (objects), read objects, analysis and processing the elements for specific pictures (objects), merge/manipulate the read object with the suitable voice, admin/assistant login (where the assistant acts as admin), search for object from the xml files and retrieve it for making some modification, add, update, delete specific objects, exit app.

As for minimum hardware requirements for the running the app: includes a gyroscope sensor, camera, at least 5 to 6 inches screen to get immersive experience, at least a 2GB RAM, any GPU which supports h.254 encoders, any quad-core 1.9 GHz or above processor.

5 Conclusion

In this paper, we introduced a framework for a software system including modeling diagrams that represent the system functions and objects in an abstract way, and in different perspectives. Those diagrams target the future of current primary education system. We admire to widely spread our system as an integral educational system, which will include all ages and cover various fields like medicine field.

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