AUGMENTED REALITY BASED EXPERT LEARNING ASSISTANT MODEL

[1]AYTUG BOYACI, [2]MUSTAFA ULAS

[1]Firat University, Dept. of Digital Forensics Engineering, Turkey
[2]Firat University, Dept. of Software Engineering, Turkey
E-mail: [1]aytugboyaci@gmail.com, [2]mustafaulas@gmail.com

Abstract— Nowadays, increasing data should be converted into knowledge and competence and individuals should be grown with the ability to adapt this change. Thus, augmented reality techniques can be used for education. Augmented reality is a content enrichment system that aims to empower the perception of the user through placing computer-made voice, video, 2D or 3D objects on the real scene. Augmented reality applications have the structure to realize 3D interactive physical experience for the users by placing virtual objects on the real scene in line with the planned scenario. Thus, it helps the education processes to be more efficient while making it enjoyable. In this work, along with the current technologies, a new education model, which would carry the printed learning routines further to e-learning practices with the use of augmented reality, will be proposed. In this education model, the infrastructure realizes the use of the augmented reality objects through tablet, mobile phone or smart glasses as the education materials, a layered content management platform that would help both the creation of educational materials and users to receive them, analysis of the big data through data mining techniques and using the output for the user by the expert learning assistant will be proposed.

Keywords— E-learning, Expert System, Big Data, Augmented Reality, Data Mining

I. INTRODUCTION

With the use of new technologies in the education sector, the methods to achieve knowledge have changed and they are being gained faster [1]. In this context, to adopt the changing needs, educational processes should also be supported by the technological devices [2]. Currently, with the increase of knowledge, informational technologies is intensively used for supporting the learning with the modern tools and enrichment of the content [3,4,5].

E-learning rates are still less than the desired levels. It's considered that some barriers still exist [6]. Habits of people can be a good example for the reasons of the less-use of electronic learning contents. Most people are accustomed to learn through printed hard-copy documents. This habit is thought to be one of the major barriers that are blocking the conversion of classic learning to the e-learning platforms [7]. This study is proposing a model that would make this conversion possible through the awareness of this reality. Augmented reality applications offers significant importance in overcoming this issue [8]. Conversion of the printed documents to the e-learning platforms would help people realize this transformation process rapidly with a better efficiency [9].

Namely, the aim of the proposed augmented reality based education model is helping people's learning experience by adding the e-learning platforms into their education processes rather than forcing them to change their customs [10]. Thus, the best use from the advantages of e-learning platforms would be gained. The integration of the augmented reality applications on the education methods would particularly support the visual learning concept [11].

It can be clearly seen that the technological tools are not being used well enough while currently there are lots of educational media, e-books, and online education sites on the web [12]. This study is definitely addressing this topic. The work recommends the use of innovative technologies to realize the conversion of the education method which is gained by the printed documents to the interactive systems. Boosting the knowledge and competence of the targeted group, accelerating their learning experience with the changes in their learning processes and adapting to the rapid development of the technology through the augmented reality based interactive education-management platform model is the fundamental output of this work. This platform includes a model that would convert the educational materials such as books and assistive sources to interactive materials through innovative technologies, in line with another expert guidance model that would follow the education program of the users and make some recommendations for empowering their learning processes.

By the use of this proposed model, enrichment of the lacking educational content through the use of augmented reality in this current education program will be possible. Rich content usage statistics and success rates would also be possible.

II. RELATED WORKS

Augmented reality is currently being used in lots of ranges. Primary studies concerning augmented reality are related to education, health and military [11]. As a concept, augmented reality is a technology that combines computer-made data such as voice, video, graphics, GPS location information with the real

platforms, thus, it is used in educational purposes [12]. Classical e-learning methods cannot successfully fulfill the needs in learning with a satisfying visual perception. Augmented reality is preferred to empower and support the reality in education processes [13]. Augmented reality applications are previously used in some educational works;

- Adding a new dimension on the 2D education materials,
- Assistive methods in experiments and tests,
- Viewing some media related to the courses which needs a better perception such as physics and chemistry, *(eg. viewing a 3D cell structure)*
- Viewing animations for strengthening the concepts of mathematics and geometry lessons,
- Animating the maps with vector structures in geography science,
- Studies to increase the capability of individualsin health sector,
- Education of armed forces with augmented reality scenarios,
- Use in description of the tools and equipment for training of trainers and engineers. [14]

Analyzing the augmented reality studies used in education sector, "MagicBook" created by Billinghurs & Poupyrev in 2001is the first one [15]. In this work, visuals on the books are empowered with the animations; in other saying, another dimension was added on the print. At a science museum in Tokyo in 2007, augmented reality system was used to view the dinosaur era [16]. In that work, the visitors of the science center were able to see the skin of the dinosaur while looking at the skeleton over a mobile device. The study carried out by Di Serio et al. in 2012 ended up with a successful increase in motivation of the students by the use of slides and augmented reality in a visual arts class in a junior high-school in Spain [17]. Elford et al. carried out another research in 2013 for the training sessions of junior high-school teachers [18]. In this work, the decision competence of the teachers in an interactive game was analyzed. Majaros et al. testified that the augmented reality methods were successfully complemental the works of in production and maintenance [19]. Kaufmann et al. performed a study which especially exposed the significance of augmented reality applications in mathematics and geometry studies [14]. In this work, an enriched learning experience was gained through the visualization of complicated 3D structures, thus the competences of the students in solving the mathematical problems was improved. Shelton et al. used the augmented reality technology in geography science [20]. They've carried out education sessions showing the relation between the concepts such as earth and sun, seasonal changes, relation of the light

and temperature and equinox. Augmented reality was also used for the military education and Yeh et al. was a group of researchers who has performed this study [21].

Also there are several studies which were carried out for the health and medical education and implementations such as viewing the x-ray images on the patient, simulations of the operation and birth processes; creation of the 3D models of the patients [22]. Analyzing these examples and other similar augmented reality projects in various sectors, it's pretty clear that the studies relating the education sector would be very beneficial. Open-source augmented reality tools were analyzed by the studies carried out by Ulas et al. in 2014 [23]. Using the Vuforia infrastructure, they have created a marker based educational documentation. They've also studied to enrich the education platform with the augmented interactive reality objects in 2015 in order to improve the quality and efficiency of the learning experience [24].

III. AUGMENTED REALITY AND LEARNING PROCESS

Augmented reality technology assures positive results in education appliances by combining the real and the virtual objects on the same scene and creating a real-time interaction between the objects. The results are;

- Helping a better learning process through 3D viuals,
- Converting the abstract notions to tangible ones,
- Accelerating the perception period of concepts and processes,
- Correcting the delusions of the concepts,
- Increasing the educational motivations,
- Developing the multidimensional thinking capabilities,
- Increase in the operation processes of the knowledge by the use of technology in education,
- Increase in problem-solving capabilities.

The principals of the augmented reality are based on a real-time scene viewed by the camera on a mobile device and a comparison – matching of it with a pre-defined image on a database. If the object in real scene is matched with the image that is previously defined, the virtual animation or the object would be viewed on the real vision.

There are several software tools for the creation of the augmented reality based applications. Mostly used ones are;

- Vuforia
- Paralel Tracking and Mapping (PTAM)
- Ar Toolkit

- ArUco
- Argon
- Handy AR
- Visual Learning
- Mixare

Vuforia is an application used for the creation of augmented reality based applications and its working principal is shown in Fig.1.
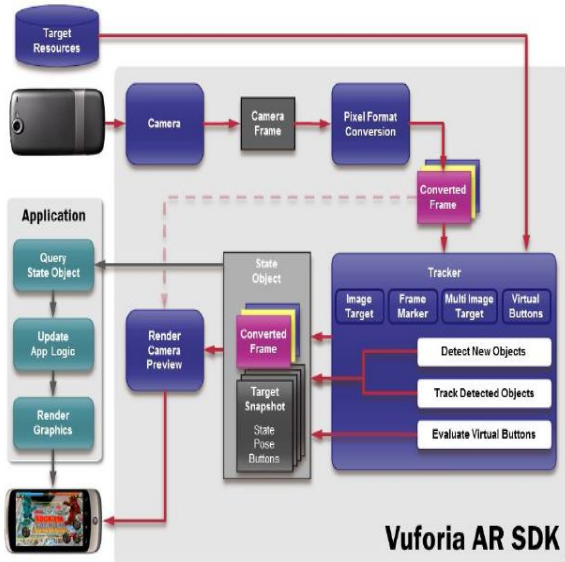

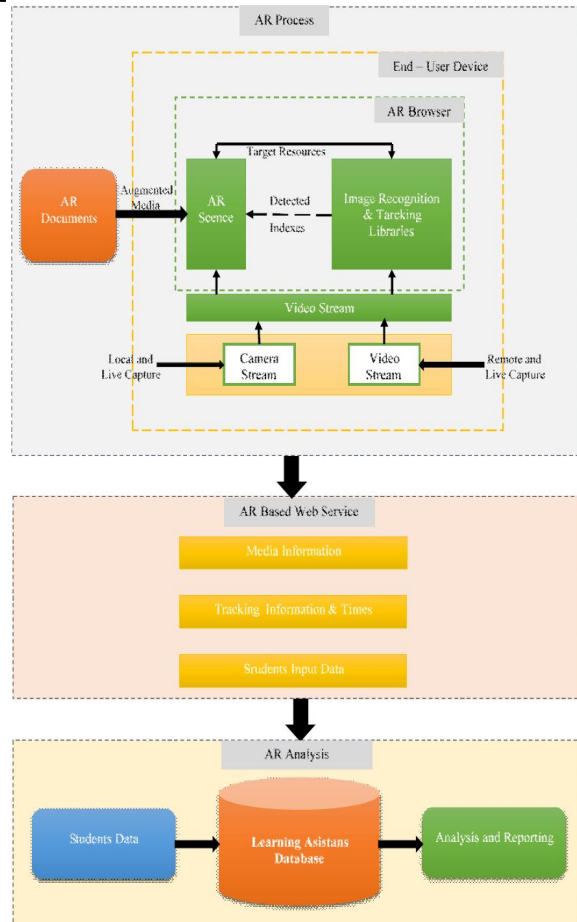**Fig.1 Working principal of an augmented reality based system [25]**

Analyzing the augmented reality applications created for the education sector, leading ones are the systems for the recognition of barcodes, the systems that are reacting through the colored strips affixed on fingers, the systems working with GPS locations, the systems in which virtual objects can be placed on the real scene broadcasted by a camera, a virtual object that can be placed on a real object or the systems with virtual animations.

IV. AUGMENTED REALITY BASED LEARNING MODEL

The basis of the model that was suggested in the study is based on adapting augmented reality methods on the classical and e-learning educational appliances when they lack in performance. On the suggested model of the study, the aim is to convert a classical education material to an interactive document by the use of augmented reality technologies.

The statistics that were gained over the document that was converted to be suitable with the augmented reality infrastructure can be analyzed by the development tools mentioned in Part-3. By this way, the augmented reality usage information could be gained related to a document. The augmented reality based assistant model that is suggested in the study is shown in Fig.2.

Fig.2 Augmented reality based education assistant model

The suggested model is consisted by the AR Process, AR Based Web Service and AR Analisis modules.

AR Process Module: In order to make a printed document suitable for the augmented reality appliance, first there should be markers designated for the objects that are aimed to be made interactive. The markers and the corresponding objects should be correlated and designated in the systems of the development tools. Possibility of running an augmented reality application on a document using a mobile device would be possible after this phase. AR Process Module shows the operation of the augmented reality application. By this way, students would see the enriched interactive media on the printed document looking through the device with the augmented reality infrastructure.

AR Based Web Service Module: The usage statistics and the processes that have been carried out using the AR Process Module by the students are logged by this tool. Within these analyses there are several detailed statistics of use such as the viewing statistics of the AR media, the usage statistics of the users, access logs, usage periods, re-use statistics. The suggested system proposes this information through a web-service and correlates with the profile of the student.

AR Analysis Module: The information regarding the students is placed in the student information system. The profile consists is the personal information regarding the student, grades and other needed information concerning the educational system. The correlated analysis of this information with the information gathered from the augmented reality application can bring out the success levels of the students. The study suggests the AR analysis module in order to be able to receive some feedback relating the students' development levels after passing up to the augmented reality learning module. Thus the success analysis could easily be analyzed.

CONCLUSIONS

This study proposes an augmented reality based education assistant model. Within the study, augmented reality systems and the specifications of the development tools were analyzed. Conversion of the classical education materials to the e-learning materials through interactive augmented reality applications was suggested. Thus, through the augmented reality learning system, current education system would be consolidated when it lacked in efficiency, the educational contents would be enriched, the usage statistics of the rich content may be listed and the statistics of the success rates can be obtained.

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