Augmented Reality: Its Applications And Future Trends

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Abstract- *Augmented reality, in which practical content is seamlessly unified with displays of real-world scenes, is a expanding field of collective design. With the rise of personal mobile phonesproficient of producing impressive augmented reality environments, the possibility of AR has begun to be explored. This paper surveys the presentand newest technologies in augmented reality. It explains the work achieved in different application domains, Architecture of augmented reality(AR) and how augmented reality is better than virtual reality(VR).Future specifications and fields requiring further research are popularized and considered.*

Keywords- Augmented Reality, Virtual Reality, Augmented Reality Browser, Mobile Augmented Reality.

I. INTRODUCTION

The term Augmented Reality (AR) is used to characterized a combination of technologies that allows real-time linking of computer-generated information with live video exposure. AR depends on methods created in VR [1] and communicates with a virtual world as well as has a level of relationship with this present reality.As declared in hugues11, “augmenting” reality is senseless in itself. On the other hand, this term bodes well when we refocus on the person and on his perception of the world. Augmented Reality is an innovation that chips away at mainframe vision-based detection algorithms to expand sound, video, designs and other sensor based physical world objects using the camera of your device. It is a decent method to render real world data and present it in an intuitive way with the goal that virtual components turn out to be a piece of this present reality.Reality cannot be increased but its perceptions can be increased and developed.

Augmented Reality (AR) is an area of research that aims to intensify the physical world by superimposing computer-generated information [2] on top of it. Azuma recognizes three key points of AR systems:

(1) Mixing virtual images with the real world,
(2) Three-dimensional registration of digital data and
(3) Interactivity in real time.

The first AR came in action with these characteristics was refined over 40 years ago, but mainstream adoption has beennarrowed by the present technologies.

Ronald Azuma and his team providing valuable and rich investigations on the field of augmented reality in 1997 [1] and next in 2001 [2]. Yet, the last decade has been mostly rich in advances in this rising research field which released viewpoints for several opportunities to use AR in various application domains. To the best of ourawareness, no updated surveys in the literature have tackled AR technologies with respect to the several application domains, theeffect of mobile technology and the connection that holds between Augmented Reality (AR) and Virtual Reality (VR).

During the last years, the AR applications have expelled to be portable and largely accessible on mobile devices. Moreover, the AR has flattered one of our audio-visual media (for example;gaming, means of entertainment and sports, shopping, path navigations). In addition, it is being lately used in many areas such as electronicbusiness, Education, Medical and advertisements.Likewise, it has revolved to be a very substantial part of the Virtual Reality (VR)field. The AR possesses clear advantages in similarity to the traditional VR. One of the benefits gained by AR is having a better sagacity and interaction of reality whereas it lays importance on the organic combination of virtual environment and the natural world [1].

In this article we present a review of the state of the art in Augmented Reality (AR). Our target is to deliver a good understanding of the present and future application areas in this evolving field. The rest of this paper is organized as follows: Section 2 presents an overview of Augmented Reality (AR), Section 3 evaluates the architecture of AR system, Section 4 examines about different applications of AR, Section 5 discusses the future trends of AR, and finally Section 6 concludes the paper.

II. AUGMENTED REALITY- AN OVERVIEW

Augmented reality (AR) can be well-defined as able to deal with the latest information instantly direct or indirect thus influence the substantialreal-world environment that has

been enriched/augmented were by adding virtual computer-generated data to it [5,6]. Also, the AR is defined by Azuma in 1997 [7]. He indicates that the AR is not only restricted to the technical hardware whereas it brings the real and virtual items together in a real environment. In addition, it records the real and virtual objects together and then runs jointly in real time in three dimensions. Milgram and Kishino [2] defined the continuum of reality-virtuality where AR is considered a portion of the overall subject area of mixed reality. Both virtual environments and augmented virtuality where the real matters are sub-joined to the virtual ones can additional the end-to-end environment by a virtual one. On the contrary, the local virtuality is submitter by the augmented reality. The goal of the AR is to make the life of the user easier through providing the virtual information to his adjacent environment as well as to any indirect view of the real-world environment like the live-video stream. Another goal of AR is to develop the user's insight into and communications with the real world. The virtual reality or the virtual environment as named by Milgram engages users totally in an artificial world without seeing the real one. On the other hand, the augmented reality boosts the sense of reality through laying virtual items over the real world in real time. AR not only adds items in real word but also represents useful digital information in real world [5,6].

III. AUGMENTED REALITY AND VIRTUAL REALITY

The term virtual reality is commonly used by the widespread media to describe imaginary worlds that only exist in computers and our minds. However, let us more quietlyexplain the term. According to [11], virtual is defined to be being in core or effect but not in fact. Reality is defined to be something that creates a real or actual thing as differentiated from something that is simply apparent; something that occurs independently of ideas perceiving it. Fortunately [12] has more recently well-defined the full term virtual reality to be an artificial environment which is experienced through physical stimuli (as sights and sounds) provided by a supercomputer and in which one's actions moderately determine what happens in the environment. [13] further defines a virtual reality to be a computer-generated environment that can be cooperated with as if that environment was tangible. A good virtual reality system will allow users to physically walk around objects and touch those objects as if they were real. Ivan Sutherland, the creator of one of the world's first virtual reality systems stated "The ultimate display would, of course, be a room within which the computer can control the existence of matter. A chair displayed in such a room would be good enough to sit in. Handcuffs displayed in such a room would be confining, and a bullet displayed in such a room would be fatal" sutherland68.

Figure 1: Adapted schema of a virtuality continuum. Inspire from Milgram et al. [14].

IV. ADVANTAGES AND DISADVANTAGES OF AUGMENTED REALITY

Advantages of AR

- Can increase knowledge and information
- People can share experiences with each other in real time over long distance. [11]
- Games that provide an even more "real" experience.
- Things come to life on people's mobile.
- Form of escapism

Disadvantages of AR

- Spam and Security.
- Social and Real-Time vs. Solitary and Cached
- UX (User Experience): Using AR can be inappropriate in social situations. [11]
- Interoperability: The lack of data portability between AR environments (such as Wikitude AR and Layar AR browser).
- Openness: Other people can develop their own layers of content to display

V. ARCHITECTURE OF AUGMENTED REALITY

The four tasks carried out by the AR system are: scene capture; scene identification for choosing the accurate information for boosting it; scene processing and visualization of the augmented scene [8,9]. These tasks are described in details as follows:

5.1. Scene Capture

Generally, the devices used in scene capture are physical components which recognize the reality which should be boosted. There are two types of scene capture devices: Video-through devices: Such devices capture the reality in a

different way than the other devices used for visualizing the augmented reality (for instance, video cameras, and smart phones) [9]. See-through devices: Such devices capture reality and give a picture of it with the augmented information (for instance, head mounted displays) [9].

5.2. Scene Identification Techniques

Scene identification classifies the scenarios. Also, it is considered one of the main actions taken in reality augmentation. There are two basic types of scene identification techniques which are discussed as follows:

- Marker-based: The marker-based approach uses the markers which are in the form of visual tags contained within the real scene which is perceived by the AR system [9].

Figure 2: Example of marker [10].

- Non-marker-based: AR systems which do not utilize markers make use of devices for scene identification. Such as AR browser uses tags in order to help users envisage and surf digital data in real world environment. For instance, you may go around the town searching for your preferred restaurant. Through the video feature that exists in your AR browser, you can easily find the restaurant you search for instead of having a look on a map. In addition, as long as you move around, the browser can easily give information concerning your place, e.g. the specific point location you are interested in, clinics, restaurants, etc. [11].

Figure 3: Example of non-marker [10].

5.3. Scene Processing

After calculating the spot of a specific marker in real space according to inner and outer parameters of the camera, the system looks for the corresponding virtual model to each marker in the 3D.

5.4. Visualization Scene

At the end, the system produces the image of the projected 3D object and real space and passes on the scene image that mixes reality and virtuality in case using marker and present digital information when used non-marker scene of identification techniques [8].

VI. APPLICATIONS OF AUGMENTED REALITY

The number of applications utilizing augmented reality is increasing continuously and the outcomes are clear in many domains e.g. health care, business, education and amusement. This section concerns with summarizing the prior researches that exploit the augmented reality applications.

6.1 Medical

6.1.1 Medical Learning

It is well known that AR has presented new ways of submitting information. The health care world would be reorganized to be represented in a mobile AR way. Such health-related information can be submitted by AR in its extreme visual. The AR became widespread by virtue of the smartphones that are supplied with sensors and camera. Such sensors permit the provision of precise context information to the environment aware situations, the matter that permits doctors to gather information, illustrate and identify the measures and procedures.

Figure 4: Example of augmented reality medical school practical books from student view on phone display [12].

Also, doctors can easily have control over the sick persons needing constant intensive care, e.g. measuring the temperature and heartbeats, etc. This information can be submitted through the AR. As indicated in Figure 4 of apps utilizing AR in medical school [12].

6.1.2 Medical Training

AR has had great implications for the medical industry; however, its more innovative apps come about because of the popular usage of mobile technology. AR is considered very beneficial in the field of healthcare training. For example, the healthcare provider can easily install a program or an application on his mobile. Such program or application may contain the main list of medical measures for the healthcare providers to select from. Once the healthcare provider chooses one of the measures from the list, the first screen will display where the tracking patterns should be situated in the sick person's body. After applying the patterns, the training model will begin. The training program will show an animated simulation in 3D, indicating precisely when, where, and in what the various maneuvers should be performed. Also, the user can alter the point of view of the simulation through moving the mobile phone, either forwards or backwards, via the animation. In addition, he can display extra notices in the course of particular points of the measures [3]. As indicated in Figure 5 one of apps utilizing AR in medical training.

Figure 5: Example of augmented reality Medical training.

6.2 Education

6.2.1. E-book

This application depicts a physical interface (augmented book) relying on augmented reality technology for learning standard mechanical components. Such book has been contained in the course of an engineering graphics subject in a mechanical engineering degree of a Spanish university [4]. Figure 6 depicts the augmented book.

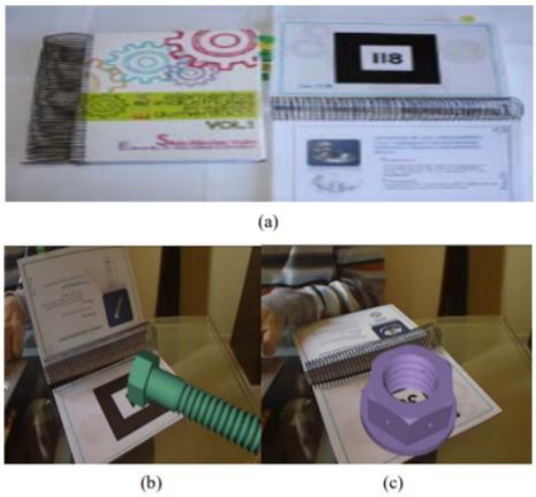

Figure 6. (a) Augmented book; (b) Examples of hex-head screw; (c) Examples hex-nut perforated [14].

6.2.2. Children Education

FETCH! Lunch Rush is defined as an AR application that is concerned with teaching mathematical proficiencies to primary pupils via making use of visualization.

Designed in 3-D, the application utilizes in smartphone camera to place photos on your camera over real-world surroundings. After that, the application instructs primary pupils to add and subtract through utilizing real-world situations that permits visualization at the time of solving mathematical problems [5]. Figure 7 depicts the FETCH Lunch Rush application.

Figure 7. FETCH lunch rush application [15].

6.3 Commerce

6.3.1 Clothing Shopping

E-commerce is considered as one of the most beneficial applications of the AR apps. Specifically, on line clothing shopping due to the users cannot predict whether the clothes will fit them or not. Hence, individuals start to connect

AR with electronic shopping, e.g. clothing shopping. This step helps to get overcome a biggest obstacle user face in choose clothing and at the same time improve the quality level and competitiveness of this business to new levels [7] as shown in Figure 8.

Figure 8. (a) Application search for the marker; (b) Marker replacement with a virtual object [17].

6.3.2. Products Shopping

AR apps provide customers with valuable content. This content may tackle the product characteristics and advantages or may provide information that assists customers to make a comparison between the different types of products and hence take the best shopping decisions [4].For example, when the consumer who suffers from health problems wants to buy cereals but there are many brands to choose from, he can easily tap an AR app to know all the products relevant in this information and thus can easily compare between the different brands and choose the best one for him [8] as shown in Figure 9.

Figure 9. Mobile trends for products shopping [18].

6.4 Entertainment and Gaming

6.4.1. Sightseeing Guidance

Through this app, users can easily publish and share sightseeing information through making use of mobile devices. Hence, this app will assist users to enhance sightseeing information. Moreover, the suggested application system utilizes AR which boosts the real environment with computer-generated objects. Consequently, the application system can be utilized as a sightseeing guidance system that overlays annotations on a real world. Particularly, the suggested application system submits virtual tour guides in order to help their tour [8] as indicated in Figures 10,11.

Figure 10. Augmented Reality View[24].

Figure 11. Detailed Information View[24].

6.2.2 AR Gaming

An augmented reality game often superimposes a pre-created environment on top of a user's actual environment. The game itself can be as simple as a game of virtual checkers played on a table surface. More advanced AR games may actually build an environment from user surroundings. Such a game could involve, for example, in-game characters climbing from coffee tables to sofas on virtual bridges. Environment creation is a time-consuming task in game making and there is a constant demand for new scenery because once a user has explored an environment fully they want to move on to a different one. AR gaming expands the playing field, taking advantage of the diversity of the real-world environment to keep the games interesting.

Figure 12: AR gaming application - PokemonGo

Pokémon GO, considered the breakthrough AR app for gaming, uses a smartphone's camera, gyroscope, clock and GPS and to enable a location-based augmented reality

environment. A map of the current environment displays on the screen and a rustle of grass indicates the presence of a Pokémon; a tap of the touchscreen brings up the capture display. In AR mode, the screen displays Pokémon in the user's real-world environment.

6.5 Design

6.5.1 Furniture Design

Having a good application, the chamber while sitting down on your sofa. With the AR application, you can easily see the general view of the new furniture in the sitting room or you can know the suitable color for the office. AR is considered an amazing notion which can easily deliver virtual furniture into our houses. Also, this application can arrange the new furniture in your house on screen in real time. In addition, it can easily alter the color, size, and location of every piece for full customization [12] as indicated in Figure 13.

Figure 13. Home design interior space using augmented reality [26].

VII. FUTURE TRENDS OF AUGMENTED REALITY

AR is still in its initial phases; consequently, its upcoming potential applications are never ending. Advanced research in AR takes accounts of suggest for an era where the interaction between individuals and information is done in a straight line without needing the utilization of any halfway device. As shown in Figure 14, MIT Media Lab project "Sixth Sense" is the best model of AR research and Parviz's contact lens project proposal find environment where information can only be viewed by the user [5]. Moreover, augmented reality provides an opportunity to replace and remedy the absent senses for some impaired individuals, i.e. AR could be utilized as a sense alternate instrument. Hearing-impaired individuals could be given visual signals guiding them to catch missed aural signals and sightless individuals could be given aural signals guiding them to unknown visual events [6]. An additional in future some AR applications are not far from challenges social acceptance issues, privacy concerns, and ethical concern arising. Alternatively, a small number of related studies have been prepared for the approval and the usability of AR systems and innovations in manufacturing instructions and training that require additional investigations andresearch in future.

Figure 14. Example of futuristic augmented reality [5].

Nonetheless, since many experts and researchers positively declared the potential likelihood of AR in industrial and commercial fields in their studies, AR in manufacturing venues has an opportunity for the growth of its extent into other business fields such as manufacturing, services, government-related sections, and other industrial settings. Along with such sections appears a good opportunity of AR to be experienced in occupation safety check up in power plants, chemical plants and oil refineries and ,OSH training for executives and members of staff with computer-generated 3D settings, as well as AR games and simulations about dangerous resources management [2].

An additional app provided by application developer Crowd Optic may head for a new development in augmented reality apps. This new technology of Crowd Optic put fans gathering like shows or sports events in focus [30].

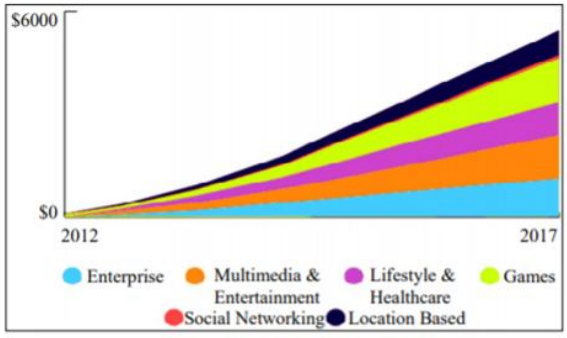

Figure 15. Revenues of augmented reality mobile application from 2012 to 2017 [32].

In the future augmented reality will provide opportunities for businesses and dealers to spend their money and efforts in new fields of AR. The researchers expected all augmented reality applications returns will come up to $5155.92 million by 2016 [31]. Also, as shown in Figure 15 the total mobile AR revenues from 2012 to 2017 will be come up to $5.2 billion on mobile devices split by different categories of application [32].

VIII. CONCLUSION

Augmented reality is considered a competence that has been around for years. Augmented reality is still in its initial phases; and thus the upcoming possible apps are endless. A lot of AR products have been presented in several kinds and spread around the world. The layering of information over 3D space creates completely new experiences of the world, and supports the broader transition of computing from the desktop to the mobile devices, and at the same time raising new outlook concerning reaching information and new chances for learning. In spite of the fact that AR is utilized broadly in the customers sector, for example it is used in social engagement, entertainment and marketing, new forms of usage appear every day. It can be easily utilized as a tool for developing new apps. In addition, AR will be more accessible in recently future and will be complementary part in our lives.

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