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Mobile Augmented Reality and Interactive StorytellingConcepts, Integrations, Limitations and future

Sagaya Aurelia
Department of Computer Science
Faculty of Education
Beniwalid, Libya

Dr.Durai Raj
Department of Computer Science
Bharathidasan University,
Tiruchirappalli, Tamilnadu, India.

Dr. Omer Saleh
Department of Computer Science
Faculty of Education
Beniwalid, Libya

***Abstract*--Augmented reality (AR) is a technology that enhances user perception and experience, and allows users to see and experience the real world with virtual content embedded into it Augmented Reality. Versatility, Portability, GPS compass and Location based information are added advantage to Mobile augmented reality. This paper talks about the Mobile Augmented Reality (AR), its technological overview and architecture, Interactive storytelling and reasons how it can help to change the world when it is combined along with augmented reality are also stated. Thus, advantages and applications of MAR are highlighted to support the powerful technology with evidence.**

***Index terms* - Augmented Reality, Digital Storytelling,Interactive Storytelling, Immersive environment, Mobile Augmented Reality, Mixed Reality, Human Computer Interaction.**

I. INTRODUCTION

The ultimate goal of immersive environments that improve the process of understanding is to provide opportunities for the creation of spaces that are perfect displays for presenting seamless images, create the feeling of being there and present the content in the way that the medium (screen) is invisible. It also generates possibilities to access supplemental information. MAR systems integrate 3D virtual objects into a 3D real environment in real-time, enhancing user's perception of and interaction with the world.Interactive storytelling is a form of digital entertainment where authors, public, and virtual agents participate in a collaborative experience. The paper proceeds as follows: In section 1 definition, Technological overview, architecture and applications of Mobile augmented reality are discussed. In section 2 we discuss about the Interactive storytelling and augmented reality based storytelling. Section 3 the limitations and future of augmented reality are discussed and how can his augmented reality be used as a storytelling medium is discussed in section 4. Finally conclusions are stated in section 5.

II. AUGMENTED REALITY

Azuma [16] defines AR as systems that have the following three characteristics:

1. Combine physical and virtual reality
2. Interactive in real time
3. Registered in 3–D

Let us note here that although this definition is very broad, most researchers have concentrated on visual augmentation during thelast years. Milgram [6] defines the Reality-Virtuality continuum as shown in figure 1. The real world and a totallyvirtual environment are at the two ends of this continuum with the middle region called Mixed Reality. Augmented reality lies near the real-world end of the spectrum with the predominant perception beingthe real world augmented by computer-generated data. Augmented Virtuality is a term created by Milgram to identify systems that are mostly synthetic with some

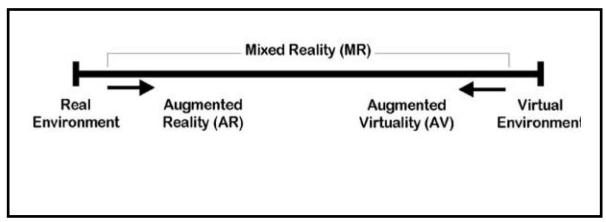

Figure 1.Milgrams Reality – Virtualitycontinuum[2]

real world imagery added, such as texture mapping video onto virtual objects [2].

Figure 1a.Real Environment Figure 1b. AR

Courtesy Ericsson Medialab Courtesy Ericsson Medialab

Figure 1c.AV
Courtesy Ericsson Medialab

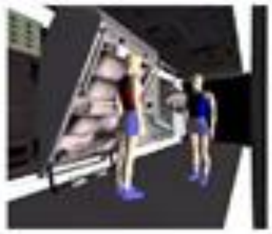

Figure 1d.Virtual EnvironmentCourtesy Ericsson Medialab

III. MOBILE AUGMENTED REALITY

We define MAR system which is: 1. what your eye can see through camera blends it with digital sources of information about what you are seeing; present both to you in a composite view, 2.Combination of reality and virtuality, 3. Execute in mobile mode real time.4.Object which are real and virtual registers (aligns) each other as shown in figure 2. The fundamental components of mobile augmented reality are (1) Hardware computational platform, (2) software, (3) Wireless network, (4) Tracking, (5) Display, (6) Wearable input, (7) User interaction[3].

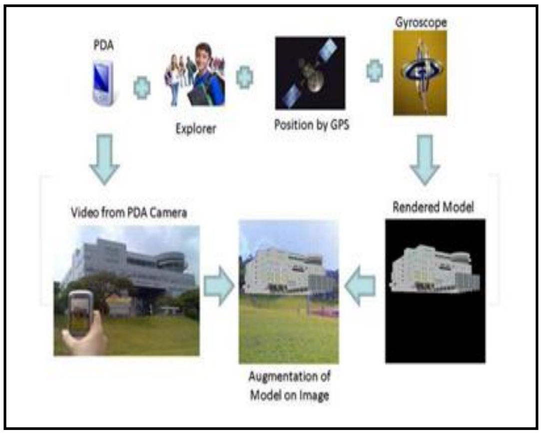

Figure 2. Stages in Mobile augmented reality[3]

IV. TECHNOLOGY OVERVIEW OF MAR

Four key factors highlight the main reasons for this rapid adoption by mobile users:

Democratization of smartphones: The high penetration of these mini computers coupled with the unlimited data flat rates associated with them have led to a market explosion for applications and Internet access from mobile phones, leading to the proliferation of on-the-go services.

Maturity of the market: Users no longer demand mere mobile applications, they want to live experiences that are easy to use and that add value.

A boom in location-based services: The suc-cess of location solutions in recent years acts as an enabler for the takeoff of AR solutions.

Consolidation of Apps Stores: In a very short period of time, Apps Stores have managed to position themselves as the user's favorite distribution channel of mobile applications and have created a reliable ecosystem for the development of new services.

At the moment, there are different kinds of AR services on the market that allow interaction with the outside world. These fall into two broad categories depending on the technology required to identify objects: Location and Recognition[1].

A. Location

If an individual knows their exact position and what their mobile camera is focused on, they can represent information about any object in their field of vision in 3D. This exploits the capabilities of the numerous navigation sensors in-corporate in the latest smartphone generation to help contextualize surrounding information:

A GPS to accurately locate the user's position using satellite triangulation.

A digital compass, also called a solid-state compass, to measure the relative position to the Earth's magnetic North Pole.

An accelerometer to detect changes in orientation and speed, and the variation of inertial motion, including falling and vibration shocks.

A gyroscope to support the accuracy of the accelerometer and correctvariations in the conservation of angular momentum.

All these features, which were unthinkable in a mobile phone just a few years ago, are now the basis for the development of all kinds of AR services that impose virtual information on real space. One example is the award-winning application Star Walk (Figure 3), where the terminal becomes a window for the recognition of stars from any position. By the phone at the sky and watching the screen, the user can obtain information about any known object in the universe and become a smart astronomer, at least for a while! [1].

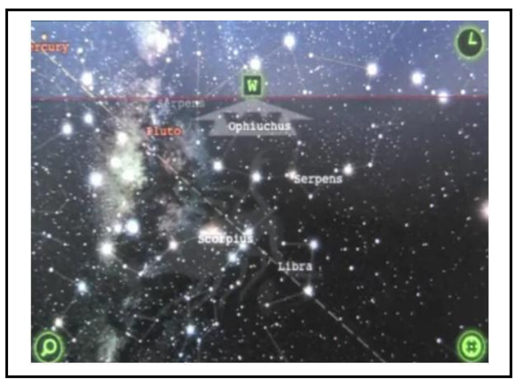

Figure 3. Example of iPhone Star Walk Application [1]

B Recognition

The second method is more complex. It is based on the way that the phone is able to recognize the shapes and sounds that surround it by identifying digital patterns. Unlike the previous approach, this method can also work in indoor spaces because it does not depend on the user's GPS positioning. How does it work?

- *Using Markers:* Small images that allow the ***mobile*** device to recognize or translate content must be given. For example, when 2D barcodes (Figure 4), now ubiquitous in the market, are read by a terminal they are capable of generating an action: play a multimedia video, send an SMS, connect to a mobile web device, etc. LLA Markers from Junaio Company, can generate 3D content in real time from latitude, longitude and height as transmitted to the terminal that is then superimposed on the screen.

- *Marker-less indirect recognition*: the mobile device hears a song on the radio and is able to identify the album information to tell the user who the author is and simultaneously allow them to directly purchase the content. The sound is captured about for 20 seconds and is then sent in digital format to an Internet server, where it is compared with a database of songs to find similarities and return a result (title, album, singer, lyrics, etc.). A similar system, processing the data in the cloud and delivering a result, is used by the Google AR product known as Google goggles. Among its features is the ability to provide information about any monument, translate texts, read labels on wine bottles, download information from a picture in a museum, etc.

*Marker-less direct recognition:*This mode is by far the easiest to use as it is based on live image recognition in real time. Any image or object is susceptible to being digitized to provide a digital identity that permits it to be recognized. Once this has been done, a user simply approaches it with their mobile camera and an AR application can identify patterns that shape it and display information or media, or project an image of a 3D object to enrich it[1].

Figure 4. Example of 2D code[1]

V. ARCHITECTURE OF MOBILE AUGMENTED REALITY IN LAYER

Layered approach architecture of mobile augment reality as shown in figure 5. As shown in layer 1 data generation capture the scene/object and the position using capturing device, supplementary details also adding by sensor. After that temporary data stored and forward in augmented unit. Data generation layer after mixing virtual and augmented environment sends data to augmentation layer .Finally display environment generated and display it[3]

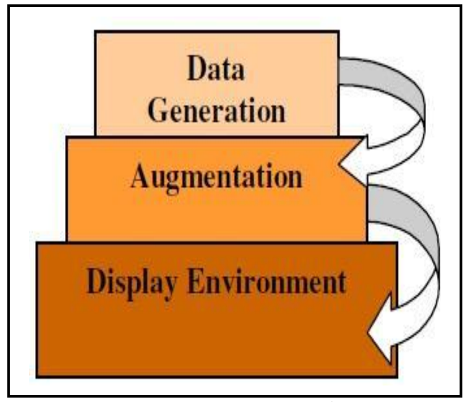

Figure 5. Layered Architecture of MARS[3]

VI. HAND-HELD DISPLAYS FOR AUGMENTED REALITY

Hand-held displays as shown in figure 6 are tracked devices that can be held with the hand(s) and do not require precise alignment with the eyes (in fact the head is rarely tracked for hand-held displays). Hand-held augmented reality, also called indirect augmented reality, has recently become popular due to the ease of access to smartphones and tablets. In addition, system requirements are much less since viewing is indirect–rendering is independent of the user's head/**eyes [7].**

Figure 6. Zoo-AR from GeoMedia and the iKat app from Zenitum are examples of hand-held augmented reality [7].

As the smartphone market continues to grow, consumers are using their devices to interact with all kinds of digital information. The experience of using your smartphone to connect the real and digital worlds is becoming more familiar for consumers, making them more likely than ever to engage with interactive experiences by scanning with their phone. Connecting meaningful and useful digital content to the real world isn't the future anymore, it's here today [8]. Figure 7 shows how mobile devices will rule the future world.

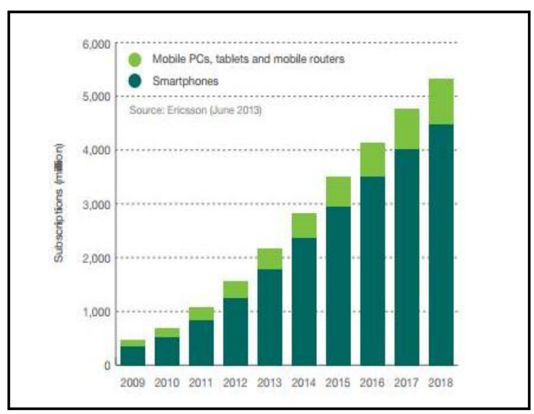

Figure 7. Smartphone, PC, mobile routers and tablet subscriptions with cellular connections 2009-2018 [15]

VII. MOBILEAUGMENTED REALITY APPLICATIONS

MAR helps people make decisions in a simpler way from a few years ago, by:

- Showing the pharmacy that is closest and indicating how to get there.
- Drawing the virtual route of the road whilst a user drives on the real road.
- Guiding the user in the supermarket to a specific product.
- Indicating where and in what direction the nearest public service office is and checking opening times.

Figure 8. Indicating where the nearest city bike[1]

- Indicating where the nearest city bike can be found (Figure 8).
- Showing the way to the assigned gate when transferring at an unfamiliar airport [1].

VIII. What is digital storytelling ?

Digital storytelling at its most basic core is the practice of using computer-based tools to tell stories. There are a wealth of other terms used to describe this practice, such as digital documentaries, computer-based narratives, digital essays, electronic memoirs, interactive storytelling, etc.; but in general, they all revolve around the idea of combining the art of telling stories with a variety of multimedia, including graphics, audio, video, and Web publishing[9].

The term "digital storytelling" can also cover a range of digital narratives (web-based stories, interactive stories, hypertexts, and narrative computer games) [10].

As with traditional storytelling, most digital stories focus on a specific topic and contain a particular point of view. However, as the name implies, digital stories usually contain some mixture of computer-based images, text, recorded audio narration, video clips, and/or music. The topics used in digital storytelling range from personal tales to the recounting of historical events, from exploring

IX. Interactive Story Telling

Interactive storytelling is a form of digital entertainment where authors, public, and virtual agents participate in a collaborative experience. [17]Defines interactive storytelling as a form of interactive entertainment in which the player plays the role of the protagonist in a dramatically rich environment. The experience offered to the public by an interactive story differs substantially from a linear story. An interactive story offers a universe of dramatic possibilities to the spectator. In this form of entertainment, the audience can explore an entire set of storylines, make their own decisions, and change the course of the narrative.

Typically, the way viewers interact with a storytelling system is directly linked to the story generation model: character or plot-based model. Character-based approaches [18][19][20] give to the system great freedom of interaction. Usually, the story is generated based on the interactions between the viewer and the virtual characters. In some cases, the viewer can acts as an active character in the story. In plot-based approaches [21][22], the interaction options are quite limited**.** The users can perform only subtle interferences to guide the progress of the narrative plot.

The level of interaction in storytelling must be careful planned. Viewers should keep their attention on the narrative content and should not be distracted by the interaction interface. Another important aspect that must be considered during the design of an interaction model for an interactive storytelling system is the need of a multi-userinterface. As in conventional TV and cinema, there may be more than one viewer watching the story atthe same time. An interaction model must offer equal possibilitiesof interaction to all viewers. Another aspect that must be observed by an interaction system is the existence of several stereotypes of viewers. Some viewers like to interact actively with the story, others prefer to opine only on key points, while some prefer just to watch the story. The interaction system should adapt itself to the different types of viewers [13].

X. ARIS Tool: Augmented Reality Interactive Storytelling

ARIS is a user-friendly, open-source platform for creating and playing mobile games, tours and interactive stories. Using GPS and QR Codes, ARIS players experience a hybrid world of virtual interactive characters, items, and media placed in physical space. As we contemplate open access and innovation, it is impossible to ignore the potential offered by ARIS (Augmented Reality Interactive Storytelling System). ARIS is not only a great tool, but a project that is gaining international notoriety. Here is list of five reasons why the language learning community should pay attention [11].Some features of ARIS are

1. ***Place-Based, Augmented Reality (AR) is Ideal for Many Areas of Language Learning***

As language educators, the value of study abroad, service learning, and community interaction as beneficial for language learning are discussed. AR allows us to design interactive experiences, enhanced by mobile devices, to either create place-based interactions. The same way we might explore restaurants in a neighborhood using YELP, learners can explore (and hopefully expand) their surroundings via place-relevant resources.

2. ***The Notebook***

Real time, geo-tagged, user-created data that can be made available to others within a public or restricted space and turned into game elements. Students can collect and share their language learning experiences (e.g., conversations, images, videos) for any number of reasons.

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3. *Potential for Student and Teacher Design and Building*

The ARIS editor is designed for non-programmers and has an extensive documentation system and active discussion group always willing to offer help. This means your students can be up andrunning in a matter of a few hours. Design and creation have a great deal of potential as learning tools as well, which makes this feature great on multiple levels.

4. *Innovative Funding Model*

People contribute as they can to build different needed features, server space, etc. Also, the code is open to those wishing to work with it. ARIS success is a key model in terms of sustainable projects.

5. *Free to Use*

This is a key feature for many educational contexts [11].

XI. Limitations and the Future of Augmented Reality

Augmented reality still has some challenges to overcome. For example, GPS is only accurate to within 30 feet (9 meters) and doesn't work as well indoors, although improved image recognition technology may be able to help [23].

People may not want to rely on their cell phones, which have small screens on which to superimpose information. For that reason, wearable devices like SixthSense or augmented-reality capable contact lenses and glasses will provide users with more convenient, expansive views of the world around them. Screen real estate will no longer be an issue. In the near future, we may be able to play a real-time strategy game on our computer, or can invite a friend over, put on AR glasses, and play on the tabletop in front of us.

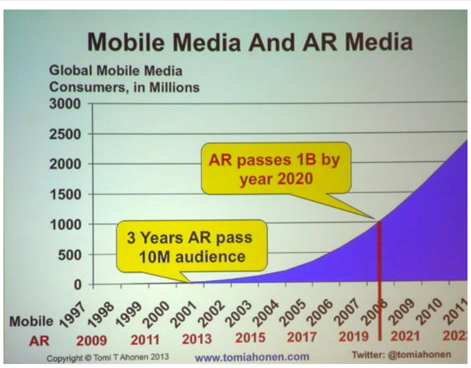

Figure 9. Future of Mobile media and AR media [15]

There are also privacy concerns. Image-recognition software coupled with AR will, quite soon, allow us to point our phones at people, even strangers, and instantly see information from their Facebook, Twitter, Amazon, LinkedIn or other online profiles. With most of these services people willingly put information about themselves online, but it may be an unwelcome shock to meet someone, only to have him instantly know so much about your life and background.

Despite these concerns, imagine the possibilities: we may learn things about the city we have lived in for years just by pointing your AR-enabled phone at a nearby park or building. In construction, you can save on materials by using virtual markers to designate where a beam should go or which structural support to inspect. Paleontologists working in shifts to assemble a dinosaur skeleton could leave virtual "notes" to team members on the bones themselves, artists could produce virtual graffiti and doctors could overlay a digital image of a patient's X-rays onto a mannequin for added realism.

The future of augmented reality as shown in figure 9 is clearly bright, even as it already has found its way into our cell phones and video game systems [12].

XII. How MAR can be used in Digital Story Telling

Using these six basic ‘‘ingredients,’’ digital creators can cook up a great diversity of augmented reality experiences for people to participate in. They include[4]:

1. Playing games. There is an almost infinite variety of games users can play: trivia games; adventure games; mysteries; ball games; role-playing games; and so on.
2. Participating in a fictional narrative.
3. Exploring a virtual environment.
4. Controlling a simulated vehicle or device: a fighter jet, a submarine, a space ship, a machine gun.
5. Creating a character, including its physical appearance, personality traits, and skills.
6. Manipulating virtual objects: changing the color, shape, or size of an object; changing the notes on a piece of music; changing the physical appearance of a room.
7. Constructing virtual objects such as houses, clothing, tools, towns, machines, and vehicles.
8. Taking part in polls, surveys, voting, tests, and contests.
9. Interacting with smart physical objects: dolls, robotic pets, wireless devices, household appliances.
10. Learning about something. Interactive learning experiences include edutainment games for children, training programs for employees, and online courses for students.
11. Playing a role in a simulation, either for educational purposes or for entertainment.
12. Setting a virtual clock or calendar to change, compress, or expand time.
13. Socializingwith others and participating in a virtual community.
14. Searching for various types of information or for clues in a game.

This is by no means an exhaustive list, though it does illustrate the great variety of experiences that augmented reality based interactivity can offer, and the uses to which it can be put.

XIII.Conclusion

Interactivity, as we have seen, profoundly changes the way we experience a work of entertainment. We go from being a member of the audience to becoming a participant. Instead of passively watching, listening, or reading, we take on an active role. Interactive works are immersive[4]. The 4 expected I's in storytelling such as Immersive, Interactive, Integration and Impact are fulfilled via augmented reality. Mobile Augmented reality which is going to be the further technology will lead the users to the next level and give a new dimension to storytelling medium. Therefore, when immersive technology such as mobile augmented reality are used in interactive storytelling medium, the usability level increases and thereby the involvement and the level of understanding also increases.

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Author Profile

Er. Mrs. Sagaya Aurelia(November 9,1978) is a research scholar in BharathidasanUniversity. Now she is with department of Computer Science, Faculty of Education, Azzaytuna University, Bani-walid, Libya. She received her Diploma in Electronics and Communication (1997),B.E (Bachelor of Engineering specialized in Electronics and Communication Engineering(2000) and M.Tech in Information Technology(2004), she has also done her Postgraduation diplomasin Business Administration(PGDBA) and Journalism and Mass Communication(PGDJMC). She has received Brainbench certification in HTML. Her current research interest includes Virtual reality, Augmented reality and Human Computer Interaction and User interface Design. She has authored 15 papers and attendance several national and international level workshops and conferences.

Dr. Durai Raj is currently working as Assistant Professor, School of Computer Science, Engineering and Applications, Bharathidasan University, Tiruchirappalli, Tamil Nadu, India. He completed his Ph.D. in Computer Science as a full time research scholar at Bharathidasan University on April, 2011. He received master degree (M.C.A.) in 1997 and bachelor degree (B.Sc. in Computer Science) in 1993 from Bharathidasan University. Prior to this assignment of Assistant Professor in Computer Science at Bharathidasan University, he was working as a Research Associate at National Research Centre on Rapeseed-Mustard (Indian Council of Agricultural Research), Rajasthan, and as a Technical Officer (Computer Science) at National Institute of Animal Nutrition and Physiology (ICAR), Bangalore for 12 years. He has published 27 research papers in both national and international journals. His areas of interest include Artificial Neural Network, Soft Computing, Rough Set Theory and Data Mining.

Dr. Omer Saleh MahmodJamah (January 25,1973) is now the Director of Post graduate cum Research and Development and Head of the department of Computer science, Faculty of education, Azzaytuna university, Baniwalid, Libya. He received his B.Sc. in Control System and Measurement (1995), M.Sc. in Electrical and Computer Measurement (2004), and Ph.D. in Electrical engineering, Automatics computer science and electronics from AGH University of technology, Krakow, Poland. He has done his Diploma in Planning and time management from Canada Global Centre, Canada. Now he is heading Computer Science department, Faculty of Education, Azzaytuna University, Baniwalid, Libya. His research interest includes multicriteria optimization for solving optimal control problems and Fuzzy logic. He has published 13 papers and attended various national and international Level conferences and workshops.