AUGMENTED REALITY – NEED, OPPORTUNITY OR FASHION

Alexandru TĂBUȘCĂ[1]

ABSTRACT

This article is focused on the Augmented Reality realities, from the point of view of a software developer in 2014. The first introductory part of the paper aims to familiarize the reader with the Augmented Reality applications today, from code development, programming languages and choices, history and relations to QR codes, up to the different implementation options available today. The main practical, scientific, result presented within the article is a new application developed for upgrading a previous AR solution presented in 2013. This new application makes a step forward from the 2D user-oriented presentation previously used, to a virtual 3D presentation of the AR content.

Keywords: AR, 3D, augmented reality, canvas, web services, QR, html5

1. INTRODUCTION

Augmented reality seems to be the next big hype for the IT business now-a-days, at least from the general audience point of view. As is the case with a lot of modern ideas and concepts, this one is also, actually, not so very new ☺. The first augmented reality device is considered to have appeared in the 1960s, more precisely in 1968, and its father is considered Ivan Sutherland[2]. He worked together with his student from Utah University, Bob Sproull, to design and build the so-called "*Sword of Damocles*", which is now widely regarded as the first augmented reality head-mounted display. Of course, time took its share and minimized the equipment as time went by. The "*Sword of Damocles*" received its name from its appearance: it was bulky and heavy, having to be actually suspended from the roof in order to be "wearable" on someone's head. Nowadays, we have the Google Glass and all those similar devices which are even thinner and lighter than normal glasses.

One of the first uses of AR, again like in many cases of technologies that helped humankind advance, of directly related to weapons – among the first uses of the AR systems was the improvement of fighter pilots helmets, from both planes and helicopters. By integrating concise and precise data related to the battlefield environment directly in front of the pilots' eyes, the head-mounted displays were a huge advancement in fighter plane technology.

A little bit later, actually decades later, the IT business field re-engaged the research and development related to AR. Truth be told, the delay was also due to hardware issues – even though the concept and technology were already available, the final product was not something easy to use and handle. As was the case with the first computers, the "size" of

[1] Lecturer, PhD, School of Computer Science for Business Management – Romanian-American University; e-mail: alextabusca@rau.ro

[2] Ivan Sutherland – famous IT researcher, specialist in computer graphics, computer science professor at MIT, Utah University and Harvard, ex-Head of the US Defense Department ARPA's Information Processing Techniques Office

the investment, talking about both money and space, was way too large compared to the actual gains for the normal technology-wise consumer. Keeping the proportions, it was like the trip to the moon – yes, it is possible, yes, it would be a great accomplishment but no, it is simply not worth the money to go there again now.

2. AR IMPLEMENTATIONS & USES

A technology consumer today can sit in its own armchair, open the computer or the table or even the smartphone, and visit the famous Louvre museum in France or the Guggenheim Museum in United States, research on medieval way of life, fly over the planet Mars or visit the dark side of the Moon. To get even more immersed in the virtual environment, using a Microsoft Kinect device (or something similar as there are already similar products available on the public market today), we can move our hands in the air, in order to play, stop, access or delete an electronically available resource.

Like any good old technical term, AR has an official definition, as seen on Wikipedia: "Augmented reality (AR) is a live, direct or indirect, view of a physical, real-world environment whose elements are augmented (or supplemented) by computer-generated sensory input such as sound, video, graphics or GPS data."

Augmented Reality is actually something that that resembles the Startrek holodeck from the iconic TV show. AR means a fusion of real-life facts and virtual reality. AR uses generally two different approaches in order to make this fusion happen: marker-based response and location-based response.

Markers are in fact patterns (images), like for example barcodes or QR images, that are recognizable by specialized software. The same software than imposes a digital image on the same spot of the screen where it has detected the known marker. Location recognition uses the positioning system of a device (either through GPS, GLONASS or Wi-Fi/Mobile data/3G/4G networks) in order to match a certain location with the need to display certain information relevant to the respective location.

Developing AR software relies on the concept of overlaying some digital information, either 3D generated one or plain descriptions, over the images obtained in real-time, usually by the means of a webcam/smartphone camera. The 3D generated images are supposed to be realistic enough as to blend within the real-time viewable environment and the software has to be able to permanently track the markers or the location that triggered the overlay.

During the last years, we have seen a spree of new AR frameworks and toolkits, available virtually for all commonly used programming languages. Some of the most popular applications used for AR enabled application are: Augment-3D, Junaio AR, Aurecmedia-AR, Layar, Satellite AR, BlipAR, Augmented, Google Goggles, iOnRoad, Wikitude, Theodolite or SkyMap.

In order to produce the AR enabled applications, we have to install and develop with the help of specialized software tools, such as: Metaio, Layar, Vuforia, ARToolkit, ArMonkey, Total Immersion D'Fusion, Wikitude, String (unfortunately this is not developed anymore) or ARLab [1]. I have personally used several of these software packages, and in the end I consider Metaio and Vuforia as some of the best and easy to use tools of their kind. A short comparison between these two software development kits is presented below. Even though Metaio has, at least for the moment, the upper hand in both usability and features, we have

to mention that Vuforia is fast becoming a very strong contender. Besides the very good API implementations on the supported platforms – which are Java (for Android development), C++ (for Android/iOS) and Unity (Android/iOS) – Vuforia is supported by Qualcomm, one of the best and most powerful companies that play on the smartphone platform market.

	Vuforia SDK	**Metaio SDK**
Platform		
iOS	Yes	Yes
Android	Yes	Yes
Web	Yes	No
Feature		
GPS	Yes	No
IMU Sensor	Yes	No
Cloud support	Yes	Yes
Content API	OpenGL, 3D Renderer	OpenGL
Unity (3D)	Yes	Yes
Markers	ID Marker	Image
	Picture Marker	Cylinder
	Markerless	Text Recognition
	Markerless 3D	Frame Marker
	LLA Markers	Custom
	QR & Barcode	Virtual Button
Non-Optical Tracking	GPS	
	Inertial Sensors	
	Dummy	
Non-Optical Tracking	Free + Commercial	Free + Cloud Service Charge

Figure 1. Metaio – Vuforia, SDK comparison, table by Java Code Geeks[3]

In the next paragraphs I will review ten examples of real-life use of augmented reality, all of them directly targeted to mainstream retail cases, nothing very scientific wise or restricted to research labs and university research areas. All these examples involve now-a-days shopping experiences, enhanced with what will probably be the next standard for modern retail business over not so many years from now ☺.

The fist example comes from Moosejaw, and is based on the X-Ray App. The application reads the catalog image of a model wearing a Moosejaw product and lets the user "undress" the model and make him/her wear a new product in order to check how the products look.

[3] Comparison table available on the internet, from http://www.javacodegeeks.com/2013/10/android-augmented-reality.html

Figure 2. Mossejaw X-Ray App[4]

Number two in this list of innovative AR uses comes from another prestigious fashion retailer, Burberry. Their Convent Garden shop uses an AR application in order to let users choose their skin color and tone and then choose different nail patterns to see which one fits best the color and the cloth of the customer.

Usage number three comes from the sport shoes industry, namely Converse brand. Their AR application let customers choose different snicker models from the catalog and then "try them on" virtually. The user has to point the phone or tablet camera directly to his/her feet and the selected model appears like magic on your feet.

Figure 3. Converse Sampler App[5]

The fourth example comes from, finally, from one the world's most prestigious IT companies, IBM. Their AR application is not focused on a certain product, being somehow a common use application. As a result of a scientific research IBM assesses that around 60% of the classical shops in the US want to further verify and check the information about a product prior to its purchase and that around 20% of the clients browse for such information on the mobile devices (either phones or tablets). Having these numbers in mind, IBM thought that launching an AR application to further enhance shopping experience while classically going through a store would be a good idea.

The fifth example comes from the furniture business. The software company Sayduck joined with several furniture retailers in order to bring the products at home prior to actually make the real purchase. Taking into account that it would be quite difficult to get rid of a

[4] Application and catalog available on http://www.moosejaw.com/moosejaw/shop/content_lp-xray-catalog
[5] Application and catalog available on http://www.rga.com/work/converse-the-sampler-3/

large cupboard after buying and dragging it to your home it is a very good idea to be able to completely visualize your future piece of furniture before actually spending any money on it. The Sayduck application uses the Vuforia SDK for developing their applications.

Figure 4. Sayduck Furniture App[6]

The next example is somehow related, being brought to the customers by a furniture business giant, IKEA. Their application for AR is almost a veteran, being launched for the 2013 summer. The IKEA augmented reality catalog went even further than other similar applications, being able to measure the width and height of the real-life room seen through the camera's objective and then render a very accurate piece of furniture, in relation to the rest of the actual surrounding environment.

The seventh example comes from a very expensive environment – the jewelry business. One of the biggest brands in the diamond jewels business, the famous De Beers Company, employs an augmented reality application suitably called "Forever Fitting". The potential clients can try on different models of jewelry, taking into account different shades of light or the skin color.

The eighth example comes from Shiseido, a world known skincare, makeup and fragrance selling company. They developed a sort of Snow-White mirror ☺. The augmented reality application takes a picture of the client and then this one can try on all the cosmetic products sold by Shiseido in order to test how the products would look like on their faces.

[6] Application and catalog available on http://www.sayduck.com/download/

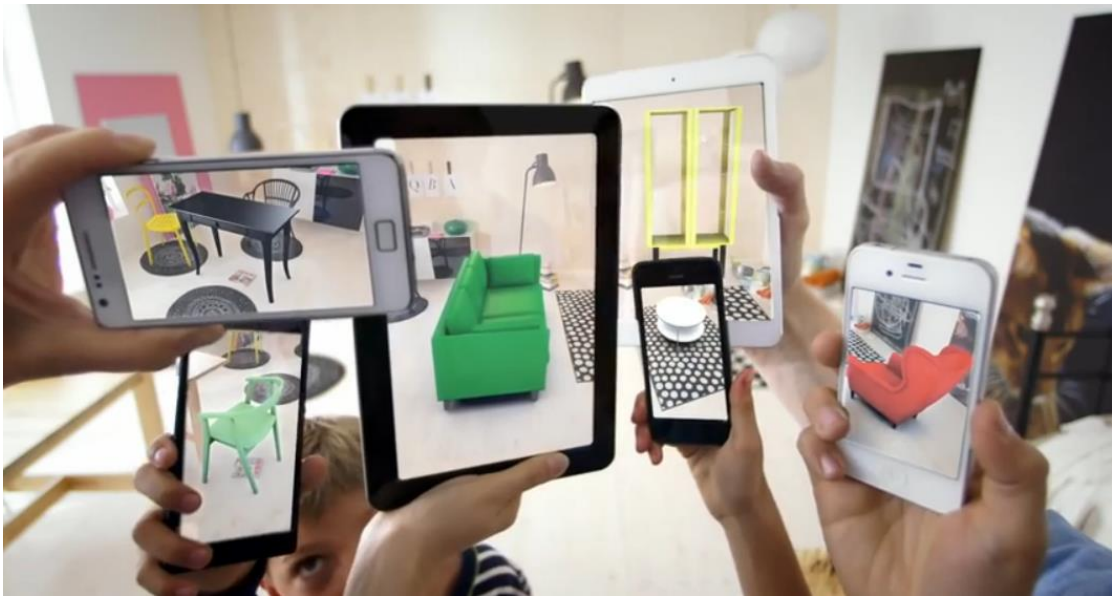

Figure 5. IKEA AR Catalog[7]

The ninth application comes from the tourism industry. The AR application is called somewhat un-inspired, Travel Guide. The application has the possibility, besides offering the classical maps, to overlay markers for the famous landmarks directly on your smartphone display, guiding you visually to reach them as easy as possible.

Figure 5. Travel Guide[8]

[7] Application and catalog available on http://www.ikea.com/ca/en/about_ikea/newsitem/2014catalogue
[8] Application and catalog available on https://itunes.apple.com/us/app/travel-guide-ar-augmented/id365582380?mt=8

The last example, number ten, comes from the mobile gaming industry. Actually, this was the most difficult one to choose, as there are now lots and lots of gaming applications that take advantage of these AR environments. I finally choose quite a simple application, just as a demonstrator for the augmented reality concept implementation, and not the sake of the actual game. ARBasketball is the name of this application and it makes court design and building as inexpensive as printing a piece of paper.

3. CASE STUDY

AR was at first more or less restricted to the use of high level programming languages for implementation – such as Java or C++. Nowadays, there are more and more developers that rely on the new HTML5 in order to build such applications.

From the evolution point of view, the AR can be regarded as the advancement of the QR codes that made their mainstream appearance several years before (and became market relevant around 2011). The "Quick Response Codes" could actually be seen as the beta version of the AR. The QR codes are in fact 2D codes that triggered a certain action when scanned and interpreted by a special software called QR reader. Most of the time, QR codes just send the user to a classical website or any another web based resource that is linked with by the developer of the QR code. The most important difference between AR and QR is in fact the "destination" that the client reaches after using the software application. The QR code let you see the real thing (a barcode, an object, a printed page, a flyer etc.) and if you read it by the means of a special software application you are redirected to a web location containing detailed information on that certain subject. The AR implementation reads the marker and then the software does not in fact redirect you to another location – the client receives new data directly over the real-life image seen through the objective, as an overlay put on top of the real environment. As I like to say, the QR sends you away while the AR brings things over to you.

As I was considering in a previous paper, in 2013, over the 2014 year the big players on retail market - being from almost any field of products as I have shown in the previous chapter by presenting AR application from very different areas – have expanded their use of AR as a marketing tool. The applications became more and more user friendly and they start become something normal for the most technology wise and modern shoppers.

For implementing a real-life scenario of using AR applications, I have chosen a development environment based on JAVA and Vuforia SDK. Working with already available object and graphic images and implementing a marker-tracking algorithm publicly available on the internet, I have managed to develop a simple basketball game quite similar to the free or paid apps of this kind available in Apple's AppStore or in Google Play.

The image used as background, the basketball court image, was downloaded from the internet (after an easy google search), the basketball graphical object was also available as a 3D model in a free public library and the algorithm for marker-tracking was also found on the internet. During several days I have just assembled this pieces and programmed everything with the use of Qualcomm Vuforia SDK[9]. As I am much more accustomed with JAVA programming in Windows environment I preferred to download the Vuforia SDK 3.0.8 for Windows. Besides the Vuforia SDK you will also need to install and set up the JDK (Java Development Kit), the Android Developer Tools (ADT) which comprises Eclipse IDE, Android SDK Tools, Android Platform Tools plus Android SDK Platform, and the Cygwin environment.

The AR scenario of the game is simple enough – the camera needs to see a certain printed code and then it will overlay a drawing of a basketball hoop. The player starts with a basketball at the lower margin of the display and the ball is released when the display is touched. The algorithm just send the ball with the same speed at the vertical of its initial position. Actually, in order to score, the player just has to try a few times to position the hoop on the display as to have it exactly on line with the vertical from the ball's initial position, then it takes several tries to find out the actual trajectory of the ball in order to score. Of course, in order to build a complete game there still are, at least, several things that have to be implemented: a score keeping mechanism, a timing system, a system to control the speed of the ball and a system to control the starting point of the ball.

[9] Software and guidelines available at https://developer.vuforia.com/resources/sdk/android

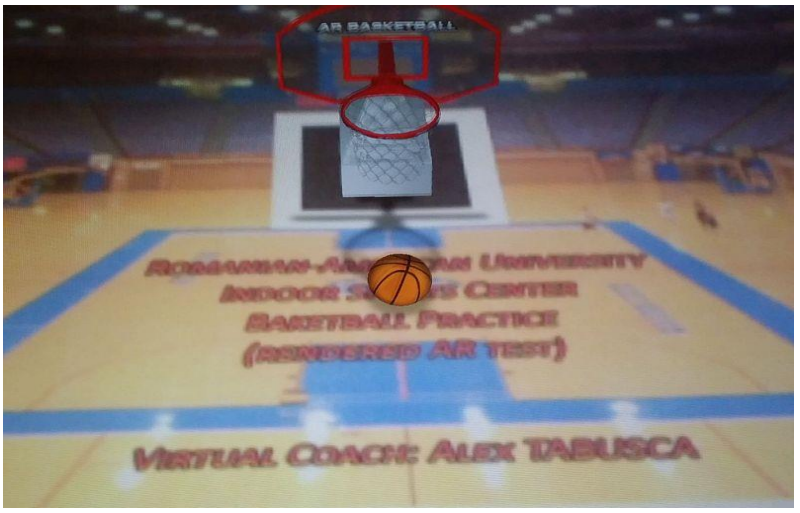

Figure 6. Image captured from the sample AR applicationConclusion

As the trend seems to encompass more and more implementations of AR applications, I personally think that AR is a term that is already dying – over not so many years it will not have any use because everything will be somehow augmented by the use of virtual reality, so the use of a special term would not be required any more.

A first next evolutionary stage that I think is going to come very soon will probably be based on the Google Glass and its similar siblings. Although I personally think that for the present time there is not much practical use of such devices – as they actually just record images and video for the time being – they will have a significant role in getting the consumers accustomed to modern wearable devices. The hardware is here – we just need to develop the software that would make these devices really usable for all-day use and not only as a statement of technology or fashion. These new applications could probably require more and more processing power. Even though our current processing units have become very small and their computing power just increased as they shrunk, I think that the normal next step for exponentially increasing the available computing power at one time, is to make use of the enormous raw processing power that is available, and unused most of the times, over the internet. Nowadays, internet connection, at least in most civilized and modern countries, is not a luxury anymore, but a common utility, as needed and as normal as running water or electricity. The first step in stating the internet access as such a normal and vital resource was formally made by Finland, where internet access is legally granted right since 2010 [2].

Most of the graphics cards today are very powerful, some PC GPUs being more powerful than the CPUs. The software developers could establish a link, over the internet, giving access to their application, tapping in to the unused GPUs, perhaps based on Nvidia CUDA architecture – who is already demonstrated to be very significant for improving different non-graphical computer applications [3]. The latest Nvidia processing architecture has huge computing power that is not used most of the time. The prowess of these GPUs has been established officially this year, by making them a part of the next super-computing project of the US.

In 2013, China became the owner of the most powerful super-computer in use (at least from publicly available information) – the TIANHE-2 (translated as "*Milky Way – 2*"), developed and used by the National University of Defense Technology. The super computer is based on Intel Xeon IvyBridge CPUs and is rated with 33.86 petaflops (thousand trillion point operations per second).

The US has just awarded a government deal with IBM and Nvidia for building two new super-computers that would be operation somewhere in 2017 or 2018. These two super-computers will be based on IBM Power8 CPUs and Nvidia Volta GPUs. Each super-computer will amount to the unthinkable rate of 150 petaflops and will "only" use 13.1 MW power, a huge improvement over the present Top500 king, the TIANHE-2 who uses 17 MW for an approximate five times lower speed.

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