A Promise of Augmented Reality?

[A descriptive analysis of mobile augmented reality gaming]

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Contents

Introduction

'Augmented Reality' is a term that was used for the very first time over twenty years ago. A researcher at Boeing, Tom Caudell, coined the term when he described a certain head-mounted digital display that could guide workers through an assembly of electrical wires when constructing aircraft. Caudell's definition of augmented reality was 'an intersection between virtual and physical reality, where digital visuals are blended in to the real world to enhance our perceptions' (Chen 2009).

While Caudell's definition is a very simple one, it still holds to the very basics of augmented reality, proposed by Ronald Azuma in 1997. He proposed that augmented reality is a combination of the real and the virtual, which Is interactive, in real time and presented in 3D. The products currently on the market cover a broader range of devices (Azuma 1997). In this thesis I will dive into the world of augmented reality, from now on referred to as AR.

A popular way to experiment with AR is by means of a smartphone. Smartphone sales have skyrocketed in the last few years, accounting for more than 19% of the worldwide mobile phone sales by the third quarter of 2010 (Gartner 2010). A large portion of these devices is outfitted with large (touch) screens, GPS-chips, a digital (solid-state) compass, one (or more) digital camera(s) and state-of-the-art high-end microprocessors with advanced graphics chips. While these devices are, of course, used for mobile communication, there is potential for mobile AR gaming. Smartphones devices offer possibilities for playing games like TETRIS, MARIO BROS., PLANTS VS. ZOMBIES or even FINAL FANTASY, however, there is another potential, the possibility to use AR as a gaming mechanic.

The technology for AR is available in current smartphones like the Apple iPhone or high-end Android smartphones. Although there are lots of AR applications like LAYAR, WIKITUDE or JUNAIO, the technology is seldom used in games. A few research projects like TIMEWARP, THE ALCHEMISTS and ARQUAKE, do, however, explore the wondrous world of AR and its promise of seamless integration of a virtual and real world. These research projects were part of experiments to explore the possibilities of AR technology. These projects often used bulky hardware, like a laptop and a large battery pack in a backpack and a helmet with a large head-mounted display (Broll et al. 2008). Broll et al. state that AR games even have the potential to create 'the ultimate gaming experience' (2008).

The statement above is typical for technology when it is reaching the ´Peak of Inflated Expectations', according to the Gartner Hype Cycle (Fenn and Linden 2003). When a technology is being hyped, like AR is at the moment, there is little to no negative press about the technology and vendors offering the technology are sprouting everywhere. Small start-up companies benefit greatly and are receiving funding for their concepts (Fenn and Linden 2003). Games like CONQUAR, ARDEFENDER, SKY SIEGE or STAR WARS ARCADE: FALCON GUNNER, PARROT AR.DRONE and GUNMAN are among the first commercial products currently available at digital stores for smartphones. Can they live up to the expectations? Or, are these games' expectations inflated and is this first generation of commercial available AR games already reaching the limits of the technology in its current state?

In order to answer these questions I formulated the following thesis question:

How is the hype surrounding AR influencing the development of mobile AR games?

In this thesis I will analyze the mobile AR games ARDEFENDER and SKY SIEGE. These games are currently on the market for smartphones. The methodology of Consalvo and Dutton (2006) will be provide guidance for analysis of the games. Consalvo and Dutton define a clear way to analyze games. In line with their methodology I will be playing the games mentioned above. To study the games I will analyze them using four distinctive areas prescribed by Consalvo and Dutton (2006). Their method prescribes the following areas of analysis: Object Inventory, Interface Study, Interaction Map and Gameplay Log (Consalvo and Dutton 2006). These different areas will give me insight about different parts of the game: "These areas represent the components of a game most relevant to play and encompass static and dynamic, changeable and unchangeable aspects of the game" (Consalvo and Dutton 2006). This analysis is necessary, because in order to answer the thesis question I will need insight into the games and their mechanics.

Firstly I will present a short history of AR as a technology and show the recent advancements and applications to get an updated view on the different technologies and the progress that has been made in the last few years. Secondly I will define the theoretical concepts, the promises and challenges that surround AR and form the hype. This step is necessary to understand the hype is the current (technological) challenges for creating (mobile) AR games/applications. Thirdly I will analyze the two games mentioned above, the analysis will demonstrate what challenges has been overcome and what new challenges appear. In my conclusion I will show that while development of mobile AR games may be influenced by a hype surrounding AR in general, there are certain limitations to the technology that need to be overcome before AR will be broadly accepted and used as a gaming mechanic. Innovative solutions may solve these limitations, but also influence the development of AR as a technology.

1. A Short History of Augmented Reality

1.1 The Early Concepts

The very first appearance of AR dates back to the 1950s (Carmigniani et al. 2011). Cinematographer Morton Heilig thought of a an innovation for cinema, where all the senses would be triggered. His 1962 prototype displayed a person sitting in a chair with his head encompassed by a screen to create an immersive experience. This prototype, named SENSORAMA, displayed a short film, which was presented in stereoscopic 3D. Only a few years later, in 1966, Ivan Sutherland created a device he called a head-mounted display (HMD). This device allowed one to see an 'augmented reality' through an optical see-through HMD (Sutherland 1968). This first type of AR device is still common in AR research projects. Then in 1975 Myron Krueger created the first AR room which he called the VIDEOPLACE. A room where he allowed the users to interact with virtual objects for the very first time. The term Augmented Reality is finally coined in 1990 by Tom Caudell, working at the time Boeing, he created a HMD to help workers assemble the wiring for an aircraft (Chen 2009). In 1992 the first fully functioning AR system, called VIRTUAL FIXTURES, is produced by Louis B. Rosenberg at the U.S. Air Force Research Laboratory, which demonstrated the possible benefits for human performance (Rosenberg 1992). Later that same year the first major paper on an AR system prototype called KARMA is presented at the Graphics Interface conference by Steven Feiner, Blair MacIntyre and Doree Seligmann (Carmigniani et al. 2011). Later, in 1994, Paul Milgram and Fumio Kishino develop a continuum to define the position of AR between the real environment and the virtual environment. Their 'mixed reality' is used to position AR and AV (Augmented Virtuality) between the real and virtual, AR being more real than virtual and vice versa. These innovations and concepts led to the idea that AR could change the way we interact with the world and created a goal for engineers to fuse reality with virtuality (Azuma 1997). Eventually the excitement, fueled by successful early concepts, led to the current hype surrounding AR in general. In this thesis I will explore what the hype does for the development of a technology that originated over fifty years ago and is only now getting the public's attention.

1.2 A Serious Technology

As stated earlier; Ronald Azuma wrote the first survey concerning AR in 1997. Together with the first International Augmented Reality Workshop, in 1998, the survey marked the point where AR is starting to become widely recognized as a technology worth investing and researching. A year later, in 1999, the introduction of the first AR tracking library with six degrees of freedom (6DoF), can be marked as another milestone for AR. The ARTOOLKIT became available as an open source project using the GNU General Public License, which means it is freely available for non-commercial use. Because of this license, the toolkit has since been used in countless research projects This toolkit remains to date a very popular kit to create AR games (Wagner 2009).

The first (outdoor) mobile AR game was ARQUAKE which was developed in 2000 (Thomas et al. 2000). This game was an outdoor AR-adaptation of the pc-shooter Quake. To play it meant wearing a large computer in a backpack to do the processing and tracking of the data gathered by a large helmet outfitted with a HMD. In 2003 the first commercial mobile AR game was released as a pre-installed game on the Siemens SX1 smartphone. The game, called MOZZIES, let the player shoot at mosquitos by moving the phone around and thereby moving the crosshair (Wagner 2009). Two years later, in 2005, THE INVISIBLE TRAIN was "the first real multi-user Augmented Reality application for handheld devices (PDAs)" (Pintaric, Schmalstieg, and Wagner 2005). This multi-user game allowed players to steer virtual trains over a real wooden track. The trains only appeared on the users' PDA. The user was allowed two different actions: the operation of the track switch and the speed of the trains; a collision ended the game (Wagner et al. 2005).

A jump to 2008 marks the introduction of WIKITUDE by Mobilizy, a browser which allows the user of an Android smartphone to overlay information on the real-time camera view. The launch of WIKITUDE is an important milestone for AR, because it shows the world a practical appliance for AR for the first time. A year later, in 2009, LAYAR is introduced by SPRXmobile. LAYAR is a more advanced variant of WIKITUDE. The mechanism is the same, but it has an open client-server platform, which allows corporations or users to create layers to share information, from tourist guides to Twitter messages (Wagner 2009). Later in 2009, Georg Klein demonstrated a variant of his PTAM (Parallel tracking and mapping) system on an iPhone 3G. PTAM is a system that can make and track small maps using a monocular camera (Klein 2009). The development of PTAM is to date the latest milestone for mobile AR game technology, because it allows game developers to easily create a virtual overlay using the data of the maps created by PTAM. This technology can be useful for the development of future games.

2.0 Promises and Challenges

2.1 Technology

Ronald Azuma's A Survey of Augmented Reality described the 1997 state of affairs in the world of AR and the possible uses in the future (1997). According to Azuma, AR is a kind of middle ground between Virtual Environments (completely synthetic) and telepresence (completely real): "Ideally, it would appear to the user that the virtual and real objects coexisted in the same space, similar to the effects achieved in the film 'Who Framed Roger Rabbit?'" (Azuma 1997). According to Azuma some [unmentioned] researchers thought of AR as limited to HMDs, he stated that this limitation should be avoided and defined AR as a set of three characteristics: "1. Combines real and virtual. 2. Interactive in real time. 3. Registered in 3D" (Azuma 1997). By proposing this broad definition other technologies were able to be accounted for as 'AR technology'. Azuma defined six classes in which applications were explored by 1997; medical, manufacturing and repair, annotation and visualization, robot path planning, and entertainment. While Azuma strictly thinks of AR as a technical application, there are uses for consumer entertainment purposes. For instance: the in 1997 founded Vuzix company creates personal display devices to be used for AR applications (Vuzix 2011). Azuma's point of view, concerning entertainment purposes, was mainly the use of AR to create virtual movie sets in order to reduce film production costs (Azuma 1997). The follow-up survey from 2001 described the recent advances in AR and Azuma et al. acknowledged the possibility for AR to be used in games. They stated that for AR to be accepted by the public ideal hardware must be created that is not bulky and has an intuitive interface (Azuma et al. 2001).

2.2 The Ultimate Limited Gaming Experience

In their 2008 article Toward Next-Gen Mobile AR Games, Broll et al. acknowledge the possibilities for AR gaming proposed by Azuma et al. (2001). However, they take the acknowledgement to a higher level and state that: "[AR-systems] have the potential to create an ultimate gaming experience" (Broll et al. 2008). In their study Broll et al. analyze two experimental mobile AR games by comparing their results with past experimental mobile AR games. They analyzed two different types of games. One of them being a pervasive location-based AR game, which can be played by different types of mobile AR devices. The other one is a game that needs to be set up first. Markers need to be placed in a building or a large area where the game can be played. They stressed in their conclusion that AR does have the potential to facilitate 'the ultimate gaming experience', because it can immerse players in a physical and virtual world (Broll et al. 2008). In order to achieve this, further work needs to focus on high-quality displays with support for an unobtrusive view. Secondly the tools need to become more advanced to allow the support and development of different mobile target platforms (Broll et al. 2008).

The article by Broll et al. was published in 2008. Since then a lot of progress has been made and the limitations posed by Broll et al. seem to be overcome. However if we look a little closer at the hardware currently available there are a few technical limitations left to overcome. Next I will discuss a few recent innovations and their (dis)advantages.

Smartphones are very powerful devices, with the processing capability that was previously only available in desktop computers. Yet they can hardly interact with the real environment without using some kind of marker (Cheok, Chia, and Xu 2008). These appear in the form of printed markers or GPS markers. Pervasive AR games like TIMEWARP make extensive use of GPS markers. GPS systems are often lacking precision, so they are complemented by inertial tracking techniques like accelerometers, gyroscopes, rotation sensors and digital (solid state) compasses (Carmigniani et al. 2011). GPS does not work indoors, so visual tracking techniques are used, again accompanied by inertial tracking systems. Visual tracking techniques have the disadvantage of being very inaccurate when moving rapidly. These techniques are frequently used in HMD setups (with the aid of inertial tracking systems). Visual tracking techniques require lots of processing power and are therefore mostly used to track certain pre-installed markers.

A new technique proposed by Adrian Cheok, Kar Chia and Ke Xu in their article presents a system to track objects in the real world in order to properly place virtual objects on top of them (2008). Although this system provides real-time, it relies heavily on brute processing power. The test setup needed a Pentium 4 to perform the calculations for real-time 6DoF tracking of an arbitrary scene using a reference image. These algorithms show great promise: the system can track the current camera position by analyzing corners in previously made reference images. Although current high-end smartphones can probably match the processing power of a Pentium 4 processor, there would not be anything left to process the rest of the games' visuals.

Another innovation that shows great promise is visual tracking and mapping is the PTAM (Parallel Tracking and Mapping) system. This algorithm allows to track arbitrary images/video and create a map on which to display augmented objects. PTAM uses two separate threads, one to track the real world and one to create a virtual map. The threads run asynchronously which makes for a very accurate system (Klein and Murray 2009). A version of this system has been altered for compatibility with the iPhone. This technology could provide an accurate system to interact with the real world on the iPhone. However, the disadvantage of this system is the camera on the iPhone. It has a very narrow field-of-view as well as a very low frame rate. The results from the PTAM system can therefore be quite blurry when the phone is moving.

The hardware related limitations stated above can probably be solved by increasing the processing power on smartphones. Recently 2011 manufacturer LG launched their newest smartphone, the LG Optimus 2X, this phone is the world's first smartphone to holster a dual-core nVidia Tegra 2 processor (Shimpi 2011). The (commercial) popularity of smartphones obviously fuels the hardware development of the processors. Although, in order to create immersive mobile AR games, there are other limitations to overcome. At the moment (mobile) AR is still a technique hardly used for commercial products. However, lots of researchers and companies are investing in this technology, that is because the development of (mobile) AR (games) is currently driven by the hype that is surrounding it.

2.3 Hype Cycle and Reverse Salients

2.3.1 Hype Cycle

In their article Jackie Fenn and Alexander Linden formulated a clear definition of the Hype Cycle: "Gartner's Hype Cycle (Appendix 1 & 2), introduced in 1995, characterizes the typical progression of an emerging technology from overenthusiasm through a period of disillusionment to an eventual understanding of the technology's relevance and role in a market or domain" (Fenn and Linden 2003). In addition to other models that chart a technology's performance, the Hype Cycle includes the human attitude toward a technology. According to Fenn and Linden, the Hype Cycle curve is initiated in the early days of a technology's life cycle. The peak (of inflated expectations) should occur at a point when there is "almost no adoption in the marketplace and the performance of products (if there are any) is poor". At the lower level of the peak the technology is still in a very early stage with no commercial products available. Working prototypes only exist in laboratories and small scale experiments; in the case of mobile AR games these prototypes include THE ALCHEMISTS and TIMEWARP. The hype is mainly vacuous because there is little understanding of the ultimate uses of the technology. hype surrounding AR may be caused by a science-fiction-style fascination for fusing the virtual with the real (Azuma 1997; Fenn and Linden 2003). Creating something virtual to appear in the real world has something magical, especially since the technological promise of AR is far ahead of its current capability. It is the fascination with the technology that is infusing the hype with attention it is currently receiving. Positive press leads AR into the upper level of the peak (of inflated expectations). At the same time the positive media attention about promises and possibilities have created a couple of early commercial mobile AR games like ARDEFENDER, SKY SIEGE, STAR WARS ARCADE: FALCON GUNNER or MOZZIES. However, AR as a useful technology has yet to create a healthy ecosystem for itself. As all new technologies they create obstacles that have to be overcome.

2.3.2 Reverse Salients

As I stated earlier, current prototypes or first-generation products are highly limited by, for instance, hardware; however, there are many companies that receive funding for their innovations and concepts. Because of the hype surrounding the technology, AR has received have a lot of momentum, even though the technology seems highly flawed.

Thomas Hughes explains this phenomenon as a reverse salient, originally a military term which refers to a backward bulge in an advancing military front. The bulge slows down or stops the front from progressing. A reverse salient is not to be confused with 'Disequilibrium' or 'bottleneck' (Hughes 1983:79). These terms are relatively too straightforward or symmetrical. Hughes defines a reverse salient as follows: "[A] reverse salient refers to an extremely complex situation in which individuals, groups, material forces, historical influences, and other factors have idiosyncratic, causal roles, and in which accidents as well as trends play a part" (Hughes 1983:79). Hughes states that when a technology is evolving towards a goal, certain aspects tend to fall out of line. The aspects that are out of line form reverse salients. As a result of this, the evolution of a technology or the growth of an enterprise is halted. The correction of a reverse salient often leads to the invention of new technologies (Dedahayir and Mäkinen 2008). While these new inventions fix part of the reserve salient, they usually find other uses (Hughes 1983). Takeishi and Lee state that an evolving technology does not only have reverse salients of a technological nature, but also of a social nature (Takeishi and Lee 2004). In their study of mobile music business development in Japan and Korea they point to a lack of adaption by copyright management institutions. The failure of adapting strategies by music copyright institutions can be seen as a reverse salient in the rapid advances of mobile music businesses (Takeishi and Lee 2004). The lack of coordination by the music industry led to the invention of the (former) popular music sharing application Napster. The public did not want to wait for a legal alternative when using Napster was so easy and had a very extensive library (Takeishi and Lee 2004). The lack of a legal alternative was a reverse salient for the development of a legal alternative.

AR technology currently has lots of challenges to overcome; the lack of processing power, lack of a clear purpose for everyday use and our understanding of user interfaces (Azuma et al. 2001). Limitations create a Walhalla for engineers and inventors. Overcoming these reverse salients concerning AR technology are a perfect way for developers of games/applications to receive funding for their projects. In the following analysis I will explore two mobile AR games and expose possible reverse salients that have been overcome or need to be overcome in the future.

3.0 Game Analysis

In this analysis I will analyze the following mobile AR games: ARDEFENDER and SKY SIEGE.

As mentioned earlier, Azuma et al. concluded a few obstacles for future AR implementation (2001). The selection of these games is made by selecting a two of the newest available mobile AR games on the market.

3.1 ARDefender

ARDEFENDER is a mobile AR tower defense game created by Int13 for the Apple iPhone and Samsung Bada.

3.1.1 Object Inventory

The object inventory will be used to identify the objects used in ARDEFENDER. ARDEFENDER basically has just two objects in the game. The real-life marker and some (virtual) ammunition boxes.

The first object is the marker. ARDEFENDER is a tangible mobile AR game; it uses real life objects, markers, to identify where the virtual world should be projected on, in the case of ARDEFENDER the tower. The marker needs to be printed beforehand or the game can't be played.

The second object is virtual and is an Ammunition Box. During the game airplanes will drop ammunition boxes on the ground. These can be picked up by moving the crosshair over them. This will refill either the rockets or laser ammunition.

3.1.2 Interface Study

The interface of ARDEFENDER is quite simple. The interface contains useful information like the health-bar on the top-left, the counting clock on the top-right counting down the seconds left to destroy the enemies, on the bottom there are counters of the amount of ammunition that is left for various weapons, a home-icon and a fire-icon, finally a crosshair is shown in the middle of the screen. As the game is played by means of a touch-screen most parts of the interface also function as buttons. The fire-icon, for instance, is also used as a fire-button. The double function of these interface items provide information while at the same time provide an easy control scheme. As opposed to a regular controller where the button just says 'X' or 'A'. An interface like this is very easy for first-time users.

3.1.3 Interaction Map

Opposed to the SIMS study of Consalvo and Dutton (2006), ARDEFENDER does not offer a way of interacting with other Non-Player Characters (NPCs) since there are none; therefor the Interaction Map cannot be made.

3.1.4 Gameplay Log

The gameplay element in ARDEFENDER is very basic: the player has to move his phone around the tower to kill the enemies. The center of the phone shows the crosshair, thus by moving the phone, the crosshair will also be moved. During a level enemies will spawn (appear) on the battlefield around the marker and the player is supposed to shoot them using the different weapons.

3.1.5 Feedback and Theoretical Integration

ARDEFENDER is definitely a game that makes clever use of a marker to create a virtual world. The developers could have learned from previous tangible AR games like THE ALCHEMISTS. However, there is apparently no processing power left to implement more markers or other real life objects to interact with virtually. The marker is only used to create a base for the presentation of the tower. The game shows the potential or AR as a way of making a game world anywhere. Just take the marker anywhere and start playing. What the game lacks is variation. With only three types of weapons and a handful of different enemies the game quickly becomes boring. Next to that it is a single-player game only. Defending multiple towers with friends could make the game more interesting. The game shows that the developer has great ideas with the use of AR in a mobile game. But the lack of variation, depth and goals make it seem more like a technical demonstration for AR as a mechanic, rather than an actual immersive mobile AR game. Samsung bought an (early) version of the game to be released with their Bada smartphone, a new operating system (OS) developed by Samsung. ARDEFENDER served as a technical demo to show other companies the power of the Bada OS. ARDEFENDER can be categorized as a game that makes good use of the AR hype to by Int13 to attract investors for future projects.

ARDEFENDER is a noble attempt in making an immersive mobile AR game, although it is far from perfect as stated above. I state that this game in itself can be seen as a reverse salient. While it is clearly an innovative game, by translating the classic tower defense genre to the world of AR. it creates new challenges to overcome. Challenges like the lack of variation and the limitation of a single tower.

3.2 Sky Siege

SKY SIEGE is a 3D mobile AR first person shooter for the Apple iPhone and Google Android smartphones. It was developed by Simbiotics for the iPhone. The Android version was developed in partnership with Simbiotics by MADfirm. The game makes use of the gyroscope on the iPhone 4 and the electronic compass on previous iPhones or Android smartphones.

3.2.1 Object Inventory

SKY SIEGE does not have any movable objects. The only usable objects are the ammunition caches on the ground. They hold ammunition for the three weapons (Flak-gun ammunition, Missiles and Guided Missiles) and can be collected by pointing at one of the three ammunition caches.

3.2.2 Interface Study

The interface of SKY SIEGE is very clear. There are buttons for all the necessary commands needed to play, as there are very little hardware buttons on Android phones or the iPhone. These buttons include a Zoom-button, a Fire-button, Switch-weapon button. Apart from buttons to show the settings menu or pausing the game, there is a button to activate the AR mode. When it is activated the pre-rendered background view is swapped for the AR view which renders the enemies right onto view coming from the camera. Next to the buttons the interface has room to show the score and the ammunition left. The middle of the screen holds the crosshair, red arrows indicate that there is an enemy in the direction the arrow is pointing. It should be noticed that there is no health-bar. To show that the player is nearing death the screen turns red.

3.2.3 Interaction Map

As with ARDEFENDER, SKY SIEGE does not have any NPCs in the game, and therefor the Interaction Map cannot be made.

3.2.4 Gameplay Log

In SKY SIEGE, the player is the center object. The enemies come from almost any angle (except from the ground) and try to shoot and kill the player. In return, the player must try to shoot the enemies using one of the three weapons. The player earns points for each kill and the goal is to kill as many enemies until the player gets killed himself, which ends the game. The goal is to earn a high score. During the game the player needs to move around a lot to find the enemies and shoot them to earn a score. This can be quite challenging because the electronic compass is not a very accurate. However, even though the system is not very accurate, it is very sensitive; this results in a blurry view.

3.2.5 Feedback and Theoretical Integration

As I stated before the player needs to move around with the phone to find the enemies. After playing for about 20 minutes I got quite dizzy. This shows that, although the gameplay may be interesting, the playability of the game has clearly not been thoroughly analyzed since no warning has been given by the developer. SKY SIEGE offers the players a limited game where enemies can be shot that appear to fly in the room with the player. The challenges of the game are very clear. The game only has three weapons and there is no real interaction with the environment and the visuals. There is no shadow on the ground from any of the aircraft and the aircraft stutter often due to the inaccurate, yet highly sensitive, digital compass. So, the added value of AR is very limited. In this case the digital compass reveals itself as a reverse salient. A bulge in the development for a smooth AR game.

This reverse salient has been overcome with the introduction of the iPhone 4, because it made use of the addition of a gyroscope. This updated device solved the problem for the ineffective digital compass to control the canon in SKY SIEGE and led to a more smooth operation of the game.

SKY SIEGE shows that with minimal marker interaction (opposed to ARDEFENDER), a mobile AR game can be created. The lack of depth in the game shows that the integration of AR was solely a gimmick to show what might be possible in the future when combining a game with AR. SKY SIEGE feels, like ARDEFENDER, more like a technical demonstration rather than a mobile AR game. The PTAM system would be a great addition to the way SKY SIEGE draws the enemies on the screen. Because the electronic compass or gyroscope are used, there is no visual reference to the real world. Integration of PTAM could provide this reference.

4.0 Conclusion

AR is still very much hyped. Lots of new AR applications like LAYAR, JUNAIO OR WIKITUDE are all fighting for a piece of this potential market. As for mobile AR gaming, the games that are currently available for smartphones like the iPhone are all little more than technical demonstrations. They all possess very little gameplay elements and variety. SKY SIEGE, for instance, has no more than three weapons, all of which are not upgradable or replaceable. ARDEFENDER is another example of a mobile AR game that does not have extensive gameplay or goals and can therefore hardly be described as a game.

The hype surrounding AR is influencing the development of mobile AR games in a way that is leading to an avalanche of mobile AR games (STAR WARS ARCADE: FALCON GUNNER, ARDEFENDER, SKY SIEGE, PARROT AR.DRONE, GUNMAN). The thesis covered only two of these, but the analysis showed them to be flawed technical demos of a technology that to date holds an unproven promise; to create the ultimate gaming experience. In order to fulfill that promise, a lot of challenges and reverse salients have to be overcome. For example: the hardware of smartphones is currently not powerful enough to analyze and track moving visuals, and digital compasses are not accurate enough. While some of these reverse salients can be easily overcome, like replacing the digital compass with a gyroscope, others, like developing more advanced processors, take time and require a lot of innovation.

The current position or AR in Gartner's Hype Cycle states that the technology is reaching its limits and soon the technology will receive more and more negative media attention causing a downfall (Gartner 2010). Until that time we can consider mobile AR gaming as one of the many reverse salients for AR in general. The implementation of the technology in games is not very advanced and therefore slowing down the front line of AR as a technology. These reverse salients do, however, stimulate innovation and the development of new techniques, like PTAM for the iPhone, which ultimately may lead to the integration of AR in our daily life. So, while developers may use mobile AR gaming to receive funding for their company, their prototypes and technical demos ultimately support the innovation of AR in general.

So, while games like ARDEFENDER and SKY SIEGE may pose as technical demos driven by a hype with lots of limitations and reverse salients, they are innovating and overcoming certain challenges that could ultimately lead to an ultimate gaming experience.

5.0 Appendix

Figure 1. Source: Gartner Research (May 2003)

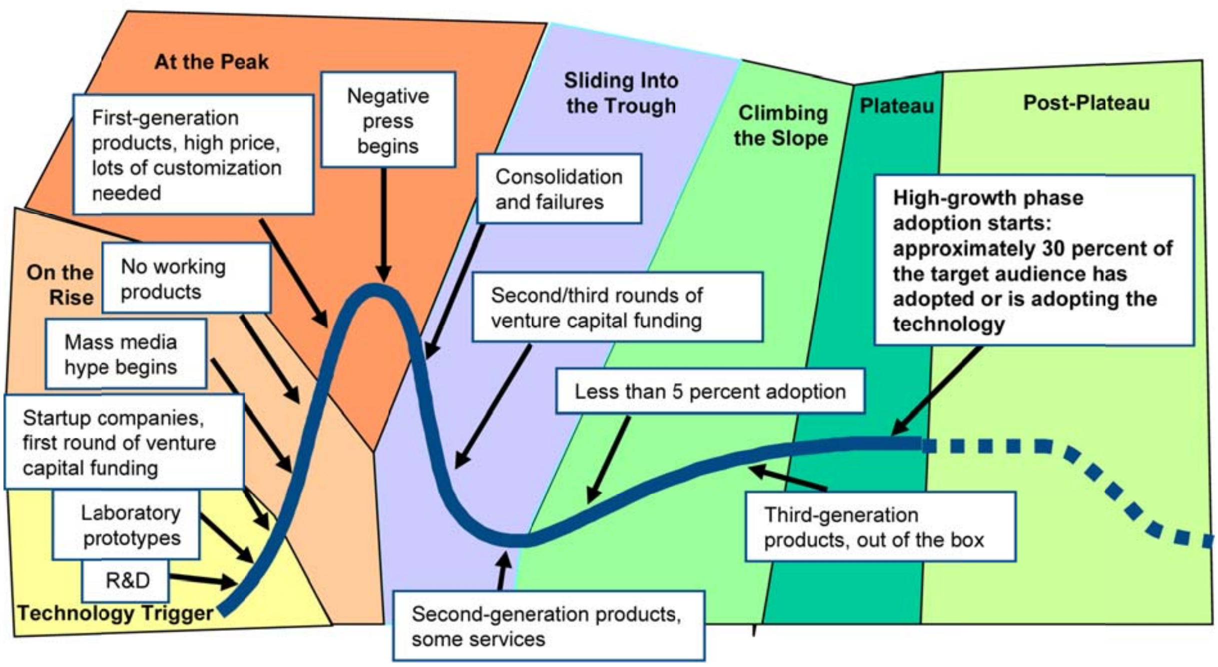

Figure 2. Source: Gartner Research (May 2003)

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