Physical Level Creation through Augmented Reality

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BSc (Hon) Computer Games Technology

2012

Table of Contents

Abstract

Augmented reality (AR) is growing in popularity and is attracting the attention of major manufacturers and developers. Everything required to build augmented reality applications can be found in a typical modern mobile device which means the market for such applications is on the rise. Level design is an important factor for games and even the most enjoyable game mechanic can be boring if the level is not designed to make it appeal to the player.

This research project will combine these two factors, augmented reality and level design, to test the mechanic to see if the outcome adds enjoyment and replayability, through allowing the player to be the level designer and creating their own game using augmented reality techniques.

An application will be built to test this mechanic using an SDK that utilises augmented reality so the main focus is on combining the two factors into a game.

Introduction

Augmented reality is the technique of augmenting a real world environment using computer-generated data.

Augmented reality has grown in popularity in recent years and has started to be used in modern advertising techniques and even utilised in many mobile applications. It has grown in popularity because of the target it can reach, most people own a mobile phone that has the capability to use Augmented reality techniques – a camera. These techniques are used to immerse the user using their natural surroundings.

Le Bar Guide – An application made by Anheuser-Busch InBev. This application simply finds bars that are rated and reviewed and allows you to view the real-world through the iPhone's camera with augmented reality overlays showing the bars, where they are and their ratings as shown in the picture below.
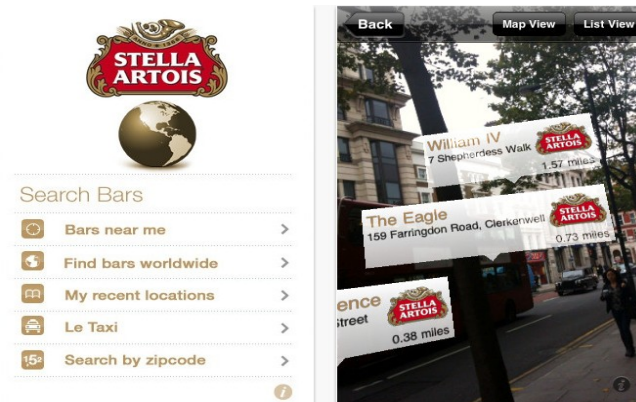
(AB InBev, 2010)

The challenges behind making augmented reality a core mechanic in a mobile game is designing a game that truly benefits from it. "Augmented reality does not necessarily add anything meaningful to the game play. Players will not have "more fun" just because some 3D objects are placed in the environment!" (Wetzel, R., Blum, L., Broll, W. and Oppermann, L., 2011).

Level Design is a test in itself without the added problem of executing it well with a feature like augmented reality. The designer must create a rich game that captures the player and hooks the player in through the level, environment and the game play. Level design is a way to teach the player the rules of the game – what skills they can use, how they progress, what they can and cannot do. As Shahrani (2006, p.1) says "the level designer is largely responsible for the implementation of the game play in a title". So with the tasks level design entails – like the creation of levels, game environments, any space the player has to use or interact with – can it be designed so there is a replayable factor so that players can enjoy playing the game over and over?

The Research Question

Can Augmented Reality be used when combined with physical level creation to add replay value and enjoyment to a game?

This question can be split into "what techniques can be used to implement the recognition needed for the user to create a physical level and how accurate are they?" aka markers or markerless, and "whether this game mechanic would add replay value and enjoyment for the user?"

Literature Review

Augmented Reality

Augmented reality is "a paradigm shift in accessing, understanding and experiencing information as it combines the digital and the real world around us. With Augmented Reality it is possible to make the digital a more natural experience." (Metaio GmbH, 2012).

There are a range of devices that are AR compatible as all that's required is: a processor, a display, sensors and input devices. However, some technology can allow the user to feel more immersed in the application depending on the display. There are different types of display, ranging from Head Mounted Displays to Handheld devices, anything that allows computer-generated data to be added to a view of the real world. The most recent developments in AR has been on the technology side with head mounted displays such as Google's Project Glass, which is currently being tested and even AR Contact Lenses are in development. Nitin Bhas, senior analyst at Juniper research said "We think smart glasses and other head-worn displays will be the next major form-factor for computing with adoption by consumers beginning around late-2014 to 2017" (BBC, 2012) which just shows augmented reality is the next big step for technology.

Handheld gaming platforms (Nintendo's 3DS and Sony's PlayStation Vita) are also now equipped with all the hardware they need to use augmented reality techniques. The 3DS was released with pre-installed games that utilised AR: Face Raiders and AR Games.

Augmented reality is used in mobile game applications to create games that can be played anywhere and any time and it breaks the borders of mobile gaming by generating an undefined edge to gaming.

There are different options for software to start creating augmented reality applications. One of the first, and still widely used, was the ARToolKit which was developed by Hirokazu Kato of Nara Institute of Science and Technology in 1999. It is also available for Flash development (called FLARToolkit developed by Saqoosha). Other SDKs are also available for non-commercial use for augmented reality development like Metaio (released in 2005), Wikitude (released in 2008), Layar (released in 2009) and Vuforia (developed by Qualcomm).

Each software development kit uses different methods of detecting markers or objects through the mobile's camera. ARToolkit for instance uses a "basic corner detection approach with a fast pose estimation algorithm". Another method would be to use a standard edge recognition algorithm (utilizing the Sobel operator).

With the number of people who own a smartphone is on the rise, the market for augmented reality mobile games is a continually appealing approach. The mobile game developed for a research project 'Arhrrrr!' is a fast-paced first-person shooter action game. The player has to point their device at the city map, which is augmented into a fully modelled and textured virtual city where the player needs to save civilians from the invading zombies. It combines this action of having to move the camera, to zoom in and out and move around, with real-life props that trigger in-game events.
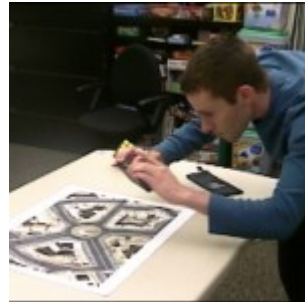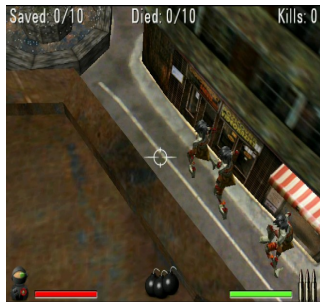
Here are two screenshots showing the level of graphics and gameplay and a picture of a player using the application.

Google has recently put their latest project to the test and their game 'Ingress' is currently in a closed beta test, with the public able to earn invitations through multiple competitions. Ingress is an augmented reality based MMO, where you play as one of two opposing forces (The Enlightened and The Resistance) and whilst using your mobile as you move through the real world, use the Ingress app to discover and tap sources of this mysterious energy to push your team's success forward. Ingress highlights the uprising market of augmented reality games that use it as a key feature and along with the Project Glass, Google are taking augmented reality to new bounds.

Level Design

Good level design is crucial to a good game. Without it, even with the most compelling game mechanics, if they aren't shown and used in the right environment, the player can easily lack enthusiasm for the game.

Level design can be broken down into several fundamental aspects: theme, linearity, flow and optimisation.

Theme describes the levels architecture, materials and general infrastructure. The level designer must show a basic understanding of the time period and place, as well as basic human development (cities were built near rivers, places of high trade value etc.). Understanding the time period of the level means several factors are taken into consideration when building the level, like road width: these may be single dirt roads in lesser developed and old era games; in highly dense cities, roads would be wider to allow horse and carriages by; in a future science-fiction type period, there may not even be a need for roads as the main mode of transportation. The buildings will also need to be considered, what height, style, material, size and placement, for example, for a level based in London during the industrial revolution in poor sectors, the buildings were cramped, with large families sharing rooms and toilets would be outside with open sewers. Weapons available to the player during an Iron Age era, would contain iron swords, daggers, bow and arrows but would not have access to guns. The place the level is based in may be another part of the world and languages may be different, which means road signs will need to be translated and altered to fit into where the level is. The theme lends credibility and a lot of research is required by the designer to create the atmosphere the level needs to immerse the player.

Linearity is the way the player is lead through the world. Linear levels are where game play events 'follow a strict line laid out for the player to follow' (Kremers, R., p.56, 2009). The advantage of a linear level is that the designer has complete control over what the player sees, does and experiences. The disadvantage of this is that the player can not make any decisions on what they want to do or explore. Semi-linear levels are a hybrid, they allow players to make decisions and explore a specific number of possibilities for gameplay events but will bottleneck them into continuing on in the level. It allows players to feel like they have control over when and what they do but in reality the designer is in control of their progress through the level. A semi-linear level can also feel like a disadvantage if not carefully designed, the player will feel constrained at the bottlenecked events and feel unguided during the times they have choice. A non-linear level is

where the actions are completely left up to the player, this is also called an 'open world', where the player is not pushed from one area to the next and the player can travel through with many choices along the way (Co, P., p. 49, 2006). An example of a non-linear game is The Elder Scroll V: Skyrim (released in 2011 by Bethesda), where the player is given free reign in the world. The player can choose where they go, what they do, what quest chains they pick up and can explore anywhere at any time.

The flow is the speed, or urgency, that the level is played at. Various factors influence the flow from slow-moving to quick-paced. One factor could be a timer, the player must be at a certain place within the timer or else a detrimental event will happen. Another way to increase flow is to suggest impending danger through music or narrative. A good example of this is in Portal 2 (released in 2011 by Valve), the impending danger of what GlaDOS (the main antagonist) might do directs the player to urgently progress through the levels, where in reality, the player can spend as much time as they want exploring the level. The use of music and lighting can also influence whether the player feels safe enough to explore the surrounding area. It can also guide the player through these suggestions and make paths seem more appealing than others, for example a lightened corridor in a horror level would seem more appealing than a dark shadowy corridor, in order to keep up the flow of the level.

Optimisation is about how long the level designer should spend on designing an area. It is a small consideration the designer should take on how long the player will use the area and how detailed it should be. If the player only needs to go down a corridor once and is moving quickly due to the flow of the level, he will not spend much time looking out the window in the corridor and therefore a simple texture over the window will suffice and more than likely go unnoticed by the player. The same goes for the opposite, if the player has free reign and they are influenced to spend a lot of time in one specific area then the area should be highly polished and detailed. The first few levels should be carefully designed and polished accordingly as 90% of gamers do not hit the end of the game (Snow, B., 2011).

Replayability

Replayability defines how much value there is to be had from replaying a level or game that has already been completed. It can be influenced by different features of the game, such as plot, multiple classes, multiple characters, alternative paths/endings, unlockable characters and content and modifiability.

The plot, like alternative paths and endings, can make the player want to play through more than once to find out what each of them are. If the game has multiple classes, the play style can be completely different like in Champions of Norrath: Realms of Everquest (released in 2004) where there are 5 different classes: Barbarian Warriors; the typical brute force, Wood Elf Rangers; the ranged with a bow-and-arrow, High Elf Clerics; a melee with strong healing capabilities, Erudite Wizards; uses magic as the main source of damage and Dark Elf Shadowknights; a strong melee with some dark magic skills. Multiple characters ties in with unlocking new content, playing through the game on a new character with areas that were previously locked due to not having the needed skills that a new character does. Modifiability will encourage players to modify levels and create their own levels. The large following behind the game LittleBigPlanet (released in 2008) all create and play the customisable levels. Players can receive scores and feedback and create fun levels with content they have unlocked in the main story. "All of these choices add up to replay value, which changes a game's life span from a few hours of enjoyment to a few years." (Co, P., p. 48, 2006).

Methodology

Practical

     Little Projected Planet was an experimental prototype that combines aspects of the level creation from Little Big Planet with augmented reality. It uses a projector phone to "augment the hand drawings of a user with an overlay displaying physical interaction of virtual objects with the real world" (Löchtefeld, M., Krüger, A, and Rohs, M., 2011). The level creation through design and through augmented reality is what adds the enjoyment aspect to the game and also the game mechanic that adds replayability.
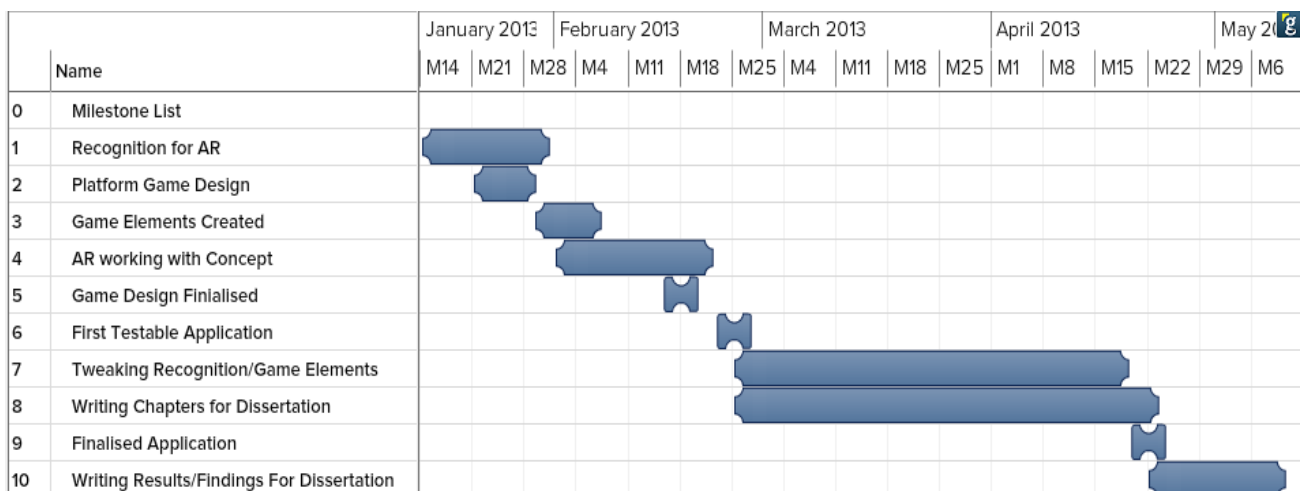
     Influenced by this prototype, an application will be built that recognises and creates a map/level based on physical objects/markers that the user places in the real-world in order combine the mechanics of level design and augmented reality to test replayability and whether the user can take enjoyment out of creating their own levels.

     The project's main goal will allow a user to place objects or markers and use the application to create a basic map/level which will be made into a playable platform game. The application will be built using the Vuforia by Qualcomm SDK and will be implemented for use on the Samsung Note, which is a modern mobile phone device.

     For the application itself, there are some minor side objectives that if time permits would be implemented:

○   Implement markers for various game elements (power-ups/enemies)
○   Be able to load/save maps/levels.

This project will be guided by the following time scale:

	Name	January 2013			February 2013				March 2013					April 2013				May 2013
		M14	M21	M28	M4	M11	M18	M25	M4	M11	M18	M25	M1	M8	M15	M22	M29	M6
0	Milestone List																	
1	Recognition for AR																	
2	Platform Game Design																	
3	Game Elements Created																	
4	AR working with Concept																	
5	Game Design Finialised																	
6	First Testable Application																	
7	Tweaking Recognition/Game Elements																	
8	Writing Chapters for Dissertation																	
9	Finalised Application																	
10	Writing Results/Findings For Dissertation																	

Evaluation

The application will be user-tested to collect data on the replayability aspect of the game and also whether the core augmented reality level creation mechanic adds enjoyment to the experience.

Replayability data will be collected two-fold; via in-app counting of game-plays of several default-created levels and user created levels (created by the tester) and from opinions collected via questionnaire. As enjoyability is a subjective term it should be collected from the testers themselves through the same questionnaire.

Data will be collected on the accuracy of levels/maps aka the recognition of objects/markers based on different angles; markerless & markers and what type of objects can be recognised (only cubes, only patterns etc.). This will be done by manually modelling a few different maps/levels then make it in the real world under different test conditions and read it back in through the application. These maps/levels will differ in complexity in shape and number of objects in order to evaluate how accurate the recognition is.

Testing will involve several people. The group should contain users with varied games and mobile device experience. The same device should be used to remove any issues with differing usability outwith this test. The counting of games played from developer or user created levels can be done discretely to provide a less biased answer.

Summary

As previously indicated, augmented reality is growing in popularity and a lot of development projects are taking place to signify a strong future for augmented reality. For mobile applications, mobile phones are becoming quicker and can process augmented reality algorithms faster, making it easier to develop applications. Level design is an important factor in all games and without thoroughly thought out level design, even the most enjoyable game mechanic can be boring and not appeal to the player.

The game that combines these two factors, augmented reality and level design, will test the mechanic to see if it adds replay value and enjoyment through allowing the player to be the level designer and creating their own game using augmented reality techniques.

By undertaking this project, the outcome will see if there are new ways of combining mechanics with the latest techniques to create an enjoyable and memorable feature that players can play over and over.

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