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Augmented Reality Trading Card Battle Arena Game using Smart Terrain

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Abstract. It has become a trend to develop using augmented reality technology to create a mix between the virtual and the real. Augmented reality is widely used in several fields including entertainment, education, and engineering. Contextually speaking, there are many attempts to combine augmented reality with trading card games. However, most of the attempts only implement basic features of augmented reality. Therefore, an opportunity was presented to further innovate trading card game with advanced features of augmented reality technology. A prototype has been developed to improve trading card game. The prototype is a fully working game that integrates trading card game with an advanced augmented reality tracking method. The prototype has been tested out and a survey has been conducted to evaluate the benefits of innovating the trading card game with this technology implemented.

Keywords: Augmented reality, trading card game, smart terrain, advanced tracking, game.

1 Introduction

Trading card game (TCG) is losing its charm to video games. Today's generation are more familiar with video games due to its more appealing graphics. The graphical elements of a card are constrained to its size. With such a small dimension to work with, many features of the character in a card were cropped or omitted. In comparison, computer-generated graphics can be made as small and as large as required. Cards also lack the ability to produce audio and animation. Another feature that TCG are missing out on is the ability to play the game online on the Internet. While many TCG industries provide an online video game version of the same card game, it destroys the purpose of buying and collecting the cards in the first place. It is due to all the reasons mentioned that more and more card games are transitioning into video games.

However, this project provides an alternative solution to that problem by implementing augmented reality (AR) into a trading card game. This is possible with the help of augmented reality. To do that, this project tries to enhance a TCG without removing the need of buying and collecting the cards. The interactivity of the game will also be increased by providing an interface between the game and the user. Another aspect that will be modified is the gameplay. To do this, the project uses a real-time interactive combat system such as a battle arena. Finally, more features will be added to the trading card game such as inserting audio and animation to the character of the cards. In order to develop an intuitive and playable augmented reality trading card game, the following problems need to be addressed.

i. How to increase interactivity of a trading card game?
ii. How to make a user interface that satisfies the user for augmented reality trading card battle arena game?
iii. Finally, how to integrate augmented reality into a trading card battle arena game?

Based on the above problem statements, this project will develop an augmented reality trading card battle arena game using an advanced tracking technique and provides robust interaction technique between real and virtual elements in AR application.

In order to actualize the aim of developing this project, there are some objectives that need to be achieved which are:

i. To study the interactivity issues in traditional trading card.
ii. To integrate AR into a trading card battle arena game.
iii. To design a user interface (UI) for an augmented reality trading card battle arena game that satisfies the user.

In the next sections, previous works and projects done in this field will be discussed and comparison will be made. After that, the project methodology is explained

2 Related Works

2.1 DRAKERZ – Confrontation

DRAKERZ – Confrontation is a game described as a crossbreed between a board game and a tactical card game because the position of the player's card plays an important role in the gameplay. On the other hand, there are several card types, each with their own usage, that give players tactical maneuverability against their opponent.

The game features a turn-based combat system where the players take turn to attack the opponent's card. The game also provides many online features such as online multiplayer and online store.

Figure 1 Drakerz Confrontation gameplay

2.2 Nintendo 3DS

Nintendo 3DS AR games and tools are pre-installed in every purchase of Nintendo 3DS along with 6 paper cards that interact with certain games. Another pre-installed AR game is the Face Raider game which uses pictures of people's face and turn them into enemies for player to shoot. As other people walk into the background, their picture will also be taken and turned into enemies. It is also possible to use faces in the device's image gallery.

Figure 2 An example of Nintendo AR minigame.

2.3 Boboiboy Augmented Reality Card Battle

This game is a mean of improving or overhaul several aspects of TCG. This game involves a linear combat between two card facing each other. The game classifies the card into two categories; the protagonists and the antagonists. Two cards of the same class cannot attack each other as they are viewed as allies. Meanwhile, two cards of the opposite class will attack each other as they are viewed as enemies.

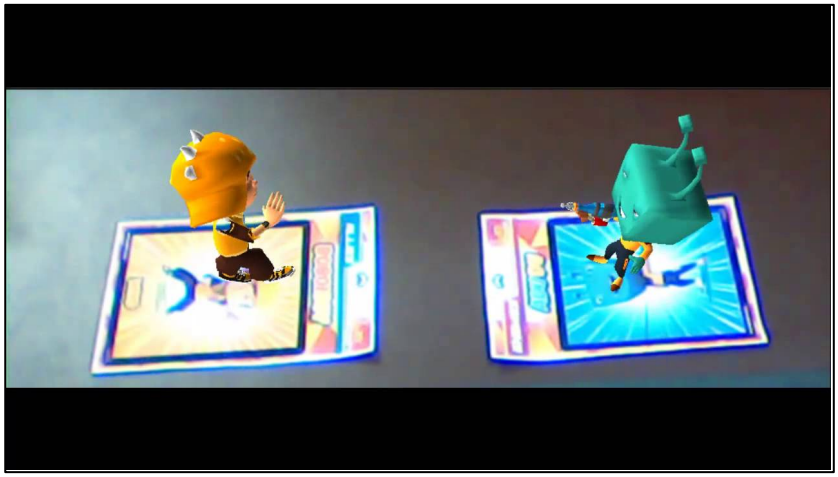

Figure 3 Cards of opposing class attacks each other.

2.4 Comparisons between Similar Games and this Project

Table 1. Comparisons between commercialized software or applications and this project.

Criteria	**Drakerz Confrontation**	**Nintendo 3DS AR**	**Boboiboy AR Card Battle**
Gameplay	Turn-based 1 versus 1	Minigames Real time 1 player	Linear battle 1 versus 1
Online features	Online battle Online store	Online download	None
Interactivity	Interactive	Interactive	Not Interactive
Game mode	Multiplayer: Player versus Player Player Versus AI	Singleplayer: Player Versus AI	Multiplayer: Player Versus Player

From table 1, we can see that these three games have completely different approach of implementing augmented reality in several aspects. In comparison to these games, this project will implement a real time combat system which implies all interaction are done in real time without having to wait each respective players' turn. Other than that, this project does not implement any online features as that is not the objective of the project. Besides that, this project will make use of the mobile device's touchscreen input for interactivity. Finally, a survival mode is created by using simple AI algorithm for the enemy.

3 Methodology

Figure 4 illustrates three main segments to guide this project on its design and development cycles. In order to construct an AR 3D mobile game with advanced tracking, an AR environment with high real-time performance for virtual world must be mixed with the real world. Therefore, several phases of project development are planned as follow:

i. Preliminary investigation and data collection of AR for 3D trading card battle arena game
ii. Design a 3D mobile game that implements AR with a suitable UI.
iii. Develop AR trading card battle arena game
iv. Integrate 3D mobile game with AR advanced tracking system
v. Testing and evaluation

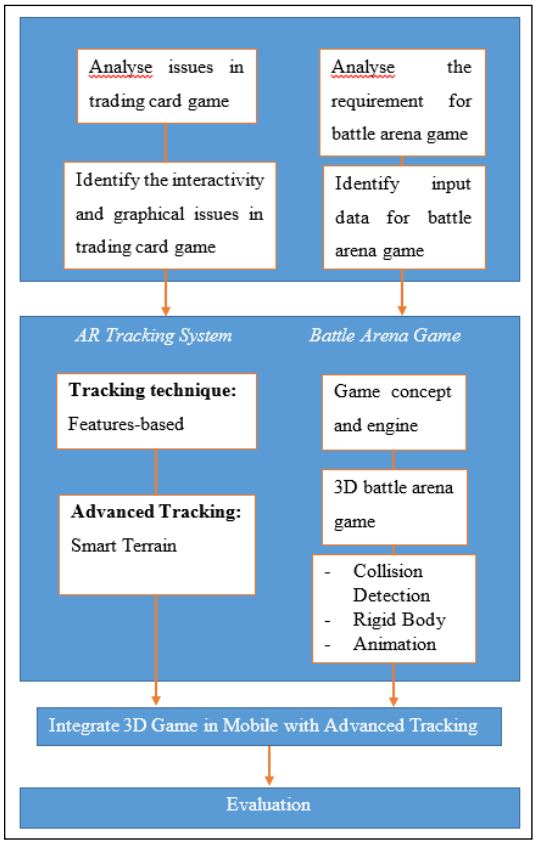

Figure 4 Project Methodology

4 Implementation

AR tracking system is implemented to enable AR technology to this game prototype. The feature-based tracking system is executed by Vuforia library which is imported into Unity game engine as a Unity package file.

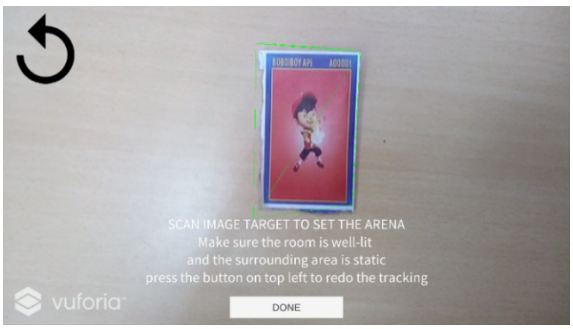

Figure 5 Smart Terrain setup

Figure 5 demonstrates how Smart Terrain is used in the game. Player will need to find and scan the marker. Player will know when marker is identified and configuration begins when

a green wireframe mesh appears around the marker as shown in the figure. Player can keep scanning for more area and objects until the Done button is pressed.

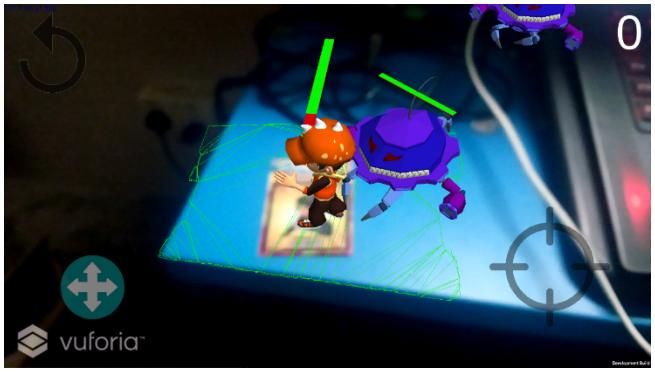

Figure 6 Game scene

Figure 6 displays the Battle scene. The UI of the game consists of a Restart button, a Fire button, a directional pad made of 4 buttons, Health bars for both player and enemies, and a Score text. The Restart button takes the player back to the Smart Terrain setup. The directional pad moves the player character to the specified directions. The health bars displays the current health of the objects beneath them. The Score text displays the total score player receives from defeating enemies.

The rule of the game is to survive as long as you can as enemies are spawned endlessly. Player can control their character by using a joystick and a button on the screen. The player is only provided the ability to move around and shoot projectile. Spawned enemies will start moving towards the player immediately and attacks when in range.

5 Result and Testing

Usability testing is carried out to determine the reactions of participants towards the game. The testing deals with user behaviour when playing the game. Testing is done by handing out questionnaires to participants that have tried out the prototype. A total of 5 participants have been chosen for this task of which 2 of them are novice testers and the others are non-novice testers. Testing is carried out to determine the suitability of the UI and the performance of the game to measure the feasibility of implementing AR technology into the game.

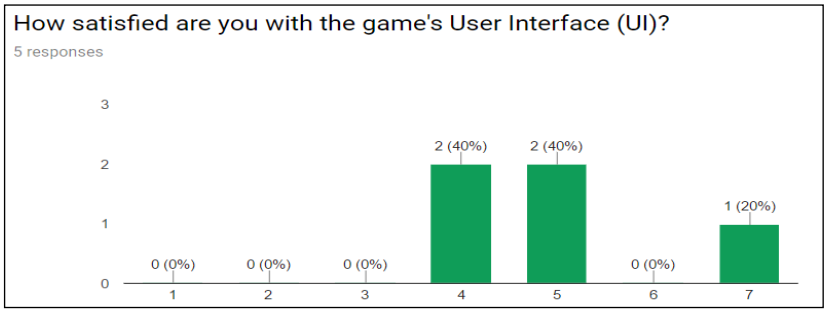

Figure 7 User satisfaction with the UI

Figure 7 illustrates the testers' satisfaction with the UI provided in the game. Three the testers show clear satisfaction with the UI placements and clarity. The other two are unsure of their satisfaction with the UI.

Table 2. A comparison of AR tracking robustness between all tested devices.

	Marker Detection		
	Device 1	**Device 2**	**Device 3**
Camera Angle:			
45	yes	yes	yes
60	yes	yes	yes
90	yes	yes	yes
Distance (m) from Marker:			
0.5	yes	yes	yes
1.0	yes	yes	yes
1.5	yes	yes	yes
2.0	yes	yes	yes

Based on Table 2, it is clear that the AR tracking system in the game works well regardless of device specification. It is also proven in the table that implementing Smart Terrain feature also increases the degree of freedom (DOF) of the tracking due to the high level of robustness.

4 Conclusion

As a conclusion, a lot has been achieved throughout the duration of the development of this project. The prototype has successfully integrated augmented reality with TCG. Besides that, the TCG interactivity is also increased from the integration with AR. The UI provided in the prototype has also proven to satisfy the users. However, a number of limitations have been imposed to the project due to several factors. As such, there are room for improvement in several aspects of the project.

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