

# Capture The Flag: Engaging in a Multi-Device Augmented Reality Game

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## Introduction

This project challenges the traditional setup of a multi-player game and examines the possibility of engaging a group of players in a single game, while still allowing the possibilities that a computer or video game provides. It uses Augmented Reality (AR), an indirect view of the physical world, to provide each player with his or her own information unavailable to other players. Augmented Reality involves “augmenting the real world with computerized information” [1]. In this case, the real world is locked on top of a shared tablet screen that displays certain aspects of the game to users. This project experiments with different information being displayed on different devices to highlight important information.



Figure 1. Three players playing the Capture the Flag game.

## Implementation

In order to investigate the possibilities to engage the user with multiple devices, a Capture the Flag game was implemented. The game was created to be run using a XPS 18 Windows Multi-touch Tablet and 2-4 Android smartphones.



Figure 2. The hardware used as the platform for the Capture the Flag game.

The game was created using Unity and written in C#. The UNET networking system from Unity is used to accommodate the multi-device aspect of the game. In order to include features specific to the Android platform, Java plugins were also written. Vuforia was used to incorporate the Augmented Reality features.



Figure 3. Different software tools used to develop capture the flag.

## Game Rules

The game begins with each player at their own base. The players can gain the view of the playing field on their devices by pointing the smartphone's camera at the tablet. The Vuforia system can recognize the target, and the objects will appear as a 3D representation over the board. The augmented representation reveals more information to each player about where he or she has already been than can be seen on the tablet.

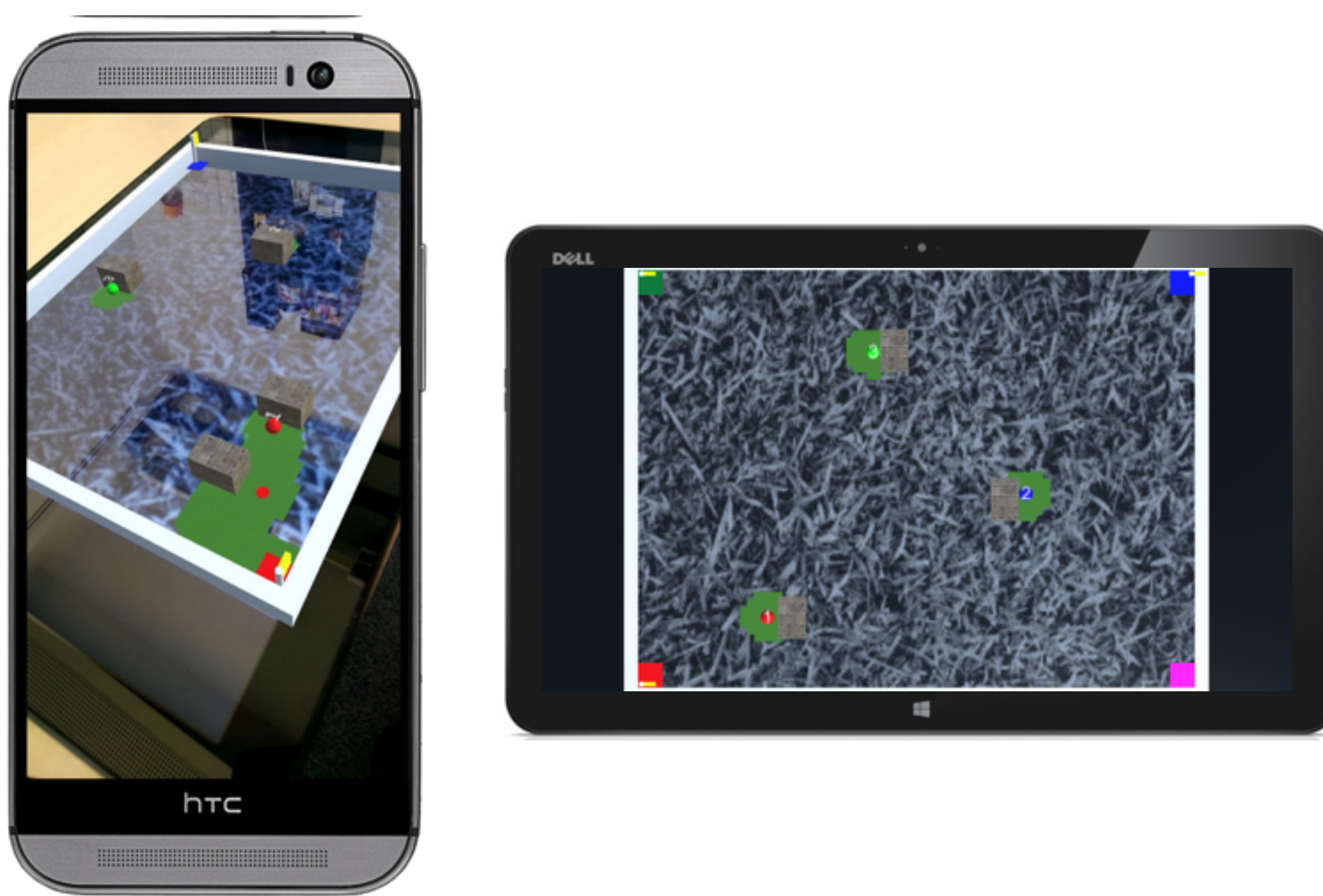


Figure 4. Two devices displaying the same moment in the game. The smartphone depicts the view that player 1 sees, and the tablet shows the public view.

Each player can then move by touching the target location on the game world representation on his or her smartphone. The player can also blow into the microphone on his or her smartphone in order to move faster and place traps using volume controls. The goal of the game is to steal other players' flags by going onto their bases, then tapping on the tablet to pick the flag up, and then bring the flag back to his or her own base. The last man standing wins the game.

## Tablet Interactions

In order to create a game that used multiple devices but also created a feeling of

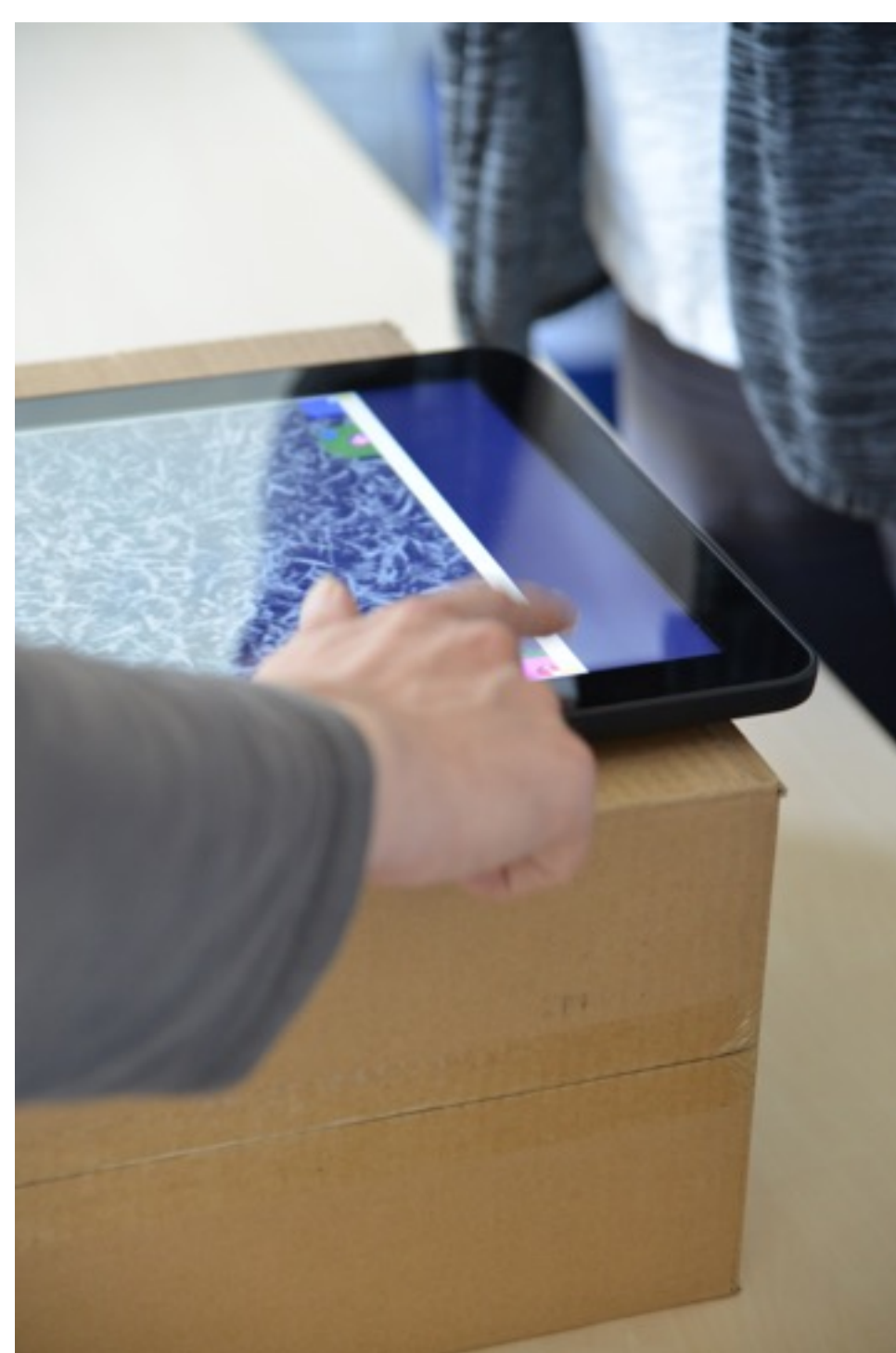


Figure 5. A player reaching to steal a flag from a base.

interacting with one another that is often created with board games, interactions were distributed between the smartphones and the tablet. The tablet interactions (eg tapping to steal the flag) are used to draw attention to important events that users should pay attention to.

## References

1. Emmanuel Dubois and Laurence Nigay. 2000. Augmented reality: which augmentation for which reality?. In *Proceedings of DARE 2000 on Designing augmented reality environments (DARE '00)*. ACM, New York, NY, USA, 165-166.

## Design Decisions and Results

### Real Time vs Turn Based

The game was initially intended to be a turn based game, allowing only one player to move and act at a time. The decision to switch from this initial set up to the real time game that was ultimately implemented was made in order to increase the engagement the players would need to have with the game.

### Movement

Several options were considered for the input method for player movement.

1. With the camera focused on the tablet, the user then clicks on a location on the smartphone screen. The player will then move in the direction of the location that the touch is pressing in the game world.
2. Four buttons appear on the user's smartphone screen. Each button corresponds to a direction that the player can move in. These directions are relative to the view that the user sees with the augmented reality, so that the arrow pointing away from the user, will move the player away from the player as well.
3. With the camera focused on the tablet, the user can then focus the center of the camera to a particular location in the game world. The player will then move towards the location that the player is focusing on.

The merits and drawbacks of each method were considered to ultimately choose the first option. However, further testing may need to be conducted to determine how well the different options test.



Figure 6. The user is trying to move the player to the top right corner of the board

### AR Component

The AR component was included in an effort to draw the players to the tablet. A problem with the AR in the game scenario was that it was sometimes difficult to see due to size. After initial testing, the tablet was moved closer to the level on which the smartphones were being held.

### Information Overload

An issue that arose during design and implementation of the capture the flag game was adding new features without overloading the user.