Capture the Campus!

Initial Report

Submitted for the BSc in
Computer Science

October 2016

By

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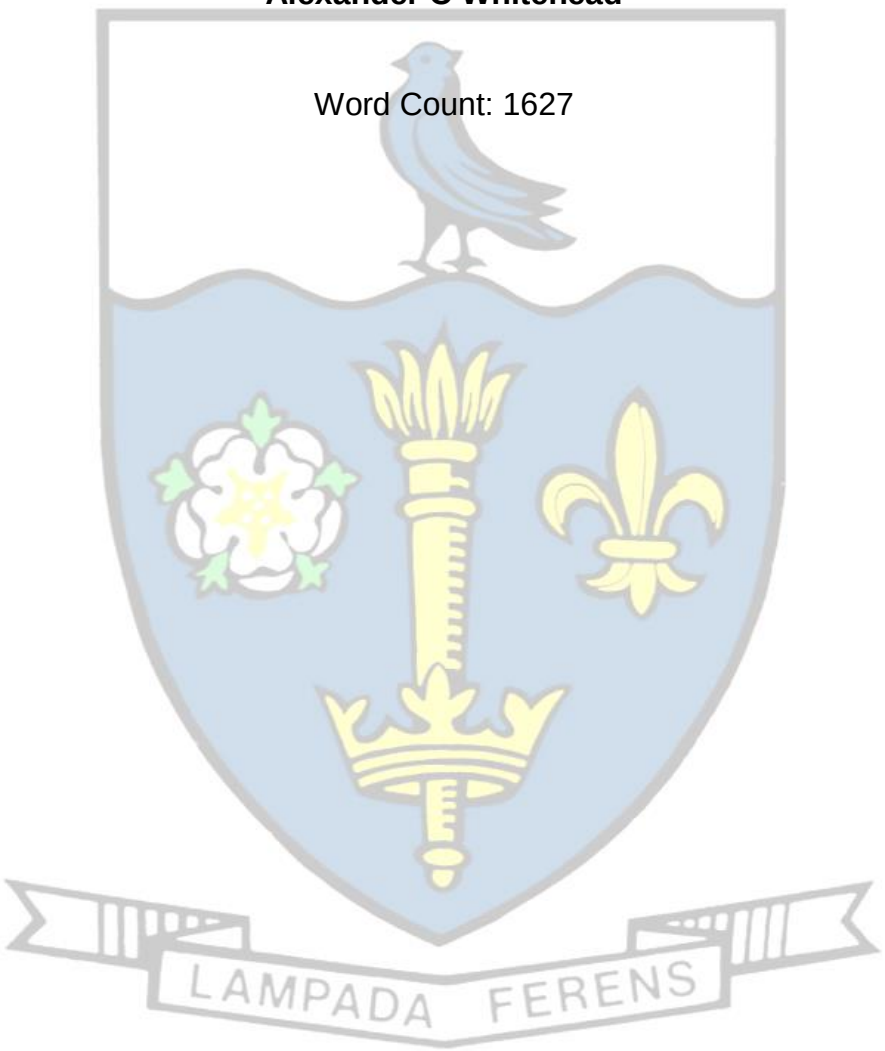

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1 Introduction

Capture the Campus is a game based on a combination of; the classic 80's arcade game Qix-wherein players control a character around a box taking squares of area while avoiding enemies (System 16, 2014), Pokémon GO (Niantic, 2016), and Ingress (Niantic, 2016).

Figure 1: This is an image showing the gameplay of Qix (The International Arcade Museum, Museum of the Game, 2016)

The objective of the game will be to either in teams or individually capture parts of a definable area by physically traveling through it, the game-running on a mobile device in the player's possession-will then track their movement.

This is a report describing the initial design and research stages of the project to build Capture the Campus.
This report includes: A section discussing background research conducted and creative/contextual decisions made thusly, a section covering the aims and objectives of the project, a breakdown of the intended task list and time required to complete each individual task, and a risk analysis section which will identify and then attempt to rectify any risks associated with the intended project.

2 Background

2.1 Examples

Pokémon GO is a game developed by Niantic, the objective of which is to move around the real world attempting to capture virtual pets-which spawn randomly-faster than other real life people also playing the game (Niantic, 2016). The user interface of this game shows a player character which moves around a map the likes of which would work well in Capture the Campus. Ingress-the predecessor to Pokémon GO-also uses map data and landmarks in a capture the flag style game (Niantic, 2016).
One useful critique of Pokémon GO comes in the form of a YouTube video by Extra Credits (Credits, Extra, 2016).

Figure 2: This image shows a standard game screen for Pokémon GO (Anon., 2016)

2.2 Platform

Firstly, it must be decided which platform the application will be run on. In this case it must be a mobile platform as it would be impossible to move something like a desktop computer around in order to play, also they do not usually contain GPS tracking hardware.
The options for mobile platforms which contain GPS tracking hardware are limited, they include; Android phones, iOS phones, Windows phones, and GPS trackers.

Out of the choice of mobile platforms GPS trackers can be disregarded almost immediately as the software should ideally be easily distributed, in order to run the software with dedicated GPS trackers the trackers would probably have to come bundled with the software which is infeasible and expensive.

This leaves the choice of the three main mobile phone operating systems; Android, iOS, and Windows. Windows can be eliminated because it has such a small market share (Statista, 2016).

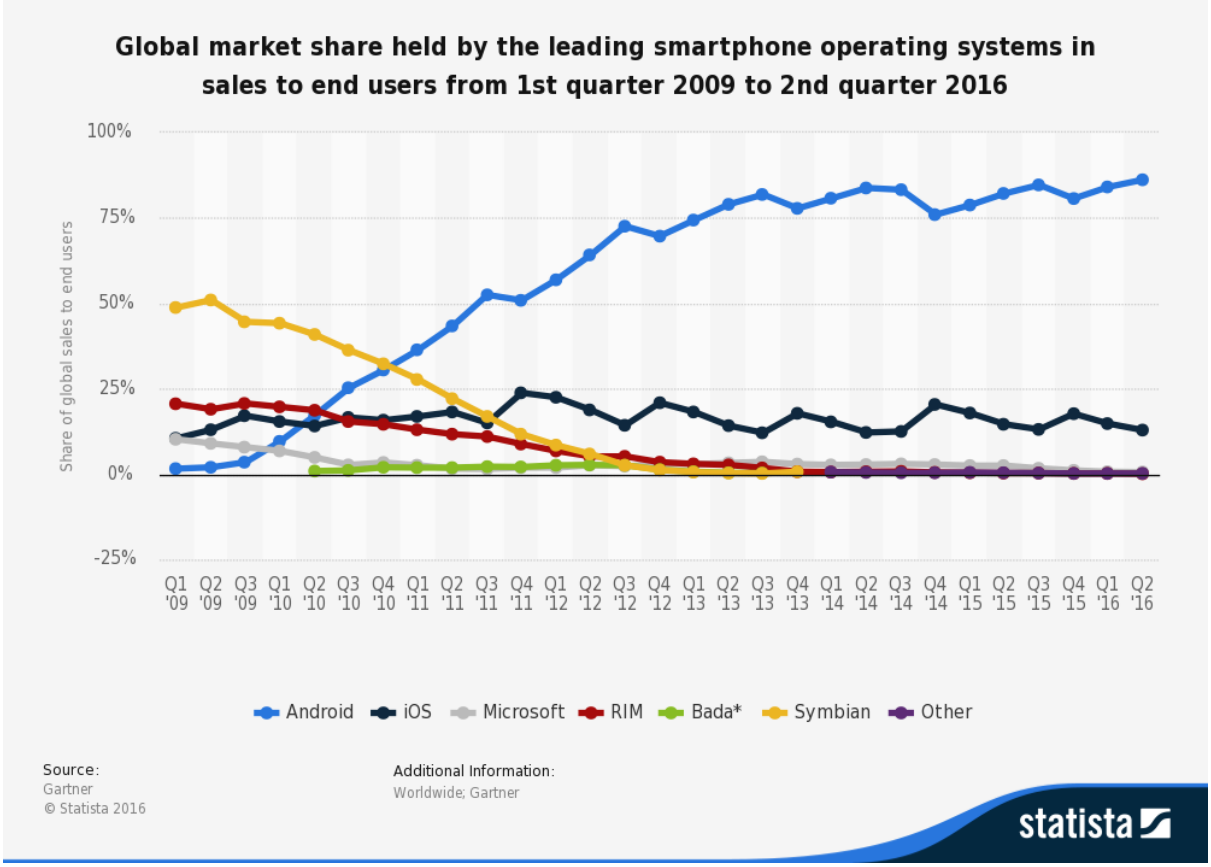

Figure 3: This image shows the current market share of mobile operating systems (Statista, 2016)

This leaves Android and iOS.
It could be argued that Android and iOS both hold similar market sway because, even though the market share for Android is greater iOS users tend to on average spend more money on content (Sinicki, 2016). However, it can also be said that Android is much easier to design and publish for because; the terms used to convey design ideas in Android are less convoluted, and the Google play store is easier to publish games to as anyone can upload their APK and be approved in minutes, whereas Apple insists on testing all apps on real-life humans which takes time and has a high rejection rate (Sinicki, 2016).
Currently the features of both operating systems are too close to call a superior platform.

2.2.1 Language

In order to begin designing a project a language must be chosen to develop it in, for Android there is the option of developing in Java using Android Studio, in C# via Xamarin using Visual Studio or in a multitude of none native solutions. for iOS there is the option of developing in Swift using Xcode or in C# via Xamarin using Visual Studio.

Both Java and Xamarin take advantage of native features of the Android operating system (Google Inc., n.d.) (Xamarin Inc., 2016) and are therefore more suitable than none native solutions but no more suitable than each other for native Android development. However, Xamarin does allow for the use of standard .NET libraries (Montemagno, 2016) thus increasing the speed and efficiency of work flow due to developer knowledge of the standard .NET libraries.

Both Swift and Xamarin take advantage of native features of the iOS operating system (Apple, 2016) (Xamarin Inc., 2016) and are therefore no more suitable than each other for native iOS development. However, as previously discussed Xamarin allows for the use of standard .NET libraries (Montemagno, 2016).

Although as Xamarin allows for the porting of its code to both Android and iOS devices there is no need to choose one platform over another as the project can be created with both operating systems in mind thus opening up the theoretical user base that the product can appeal to from 86.2% to 99.1% (Xamarin Inc., 2016) (Statista, 2016). Therefore, C# via Xamarin using Visual Studios is the superior language in this use case.

2.3 Networking

To implement online multiplayer game functionality a client and server should be created. The client will be created using Xamarin as it allows for the development of a cross platform solution that is easily debugged for rapid prototyping (Xamarin Inc., 2016). The server will be created using Xamarin as this will allow for the server to be run from both a desktop or mobile device, this is desirable as it allows the use of a predefined external server or alternatively a local server run from the client's mobile device.

There are a number of protocols that the server could be written to accept, each with its own advantages and disadvantages in a given scenario. Protocols include; UDP (User Datagram Protocol) a low latency, low reliability protocol (TechTarget, 2015), and TCP (Transmission Control Protocol) a high latency (compared to UDP), high reliability connection-oriented protocol (TechTarget, 2014) (Diffen, n.d.).
Because of its low latency and general broadcast ability UDP is perfect for gaining an initial connection to a server from a client (Mey, n.d.), TCP is then useful once the initial connection has been verified to pass sensitive game data.

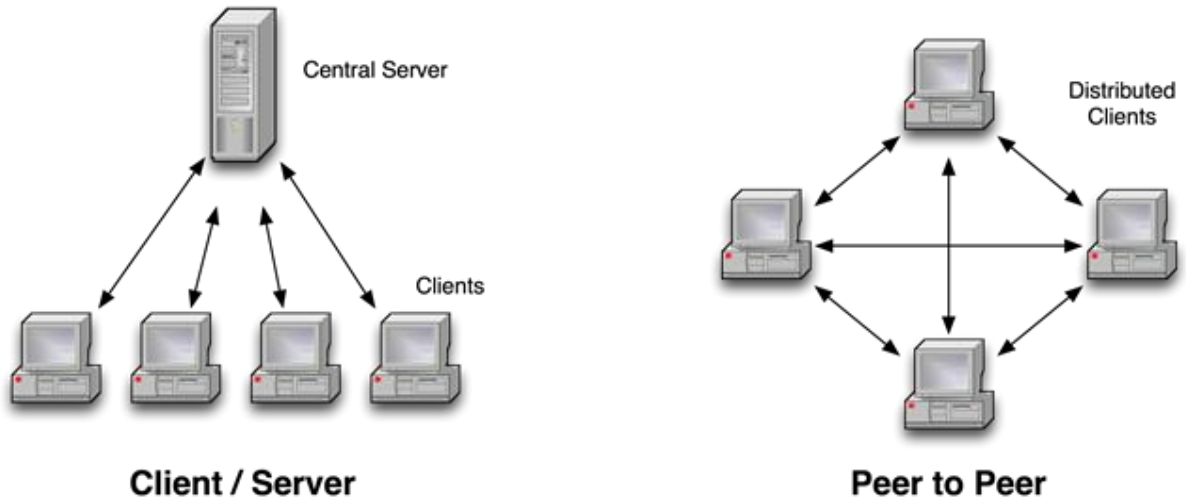

Figure 4: This image shows a visual model of the difference between a client/server model on the left and a peer-to-peer model on the right (Philips, 2014)

There are also a number of models of how and where a server can be implemented and how and what will send and receive information where. Models include; peer-to-peer whereby each instance on a network shares its files equally with each other, with no central storage or authentication (Posey, 2000), and client/server where there are separate dedicated servers and clients (Posey, 2000).
Peer-to-peer handles large numbers of users badly because, the whole network is bottlenecked by the slowest connection. Conversely client/server handles larger numbers of users with ease as each person's connection is only as slow as their own connection to the server, but for this to work it is required that an offsite server/s be dedicated to the game 24/7.
For this project a client/server model would be most efficient as there could possibly be an infinite number of players at any one time and the lag caused by this would be astronomical under a peer-to-peer architecture, also most people will be connecting to the network using mobile data so drops in connection will occur regularly causing others gaming experience to be affected if a peer-to-peer model was adopted.

3 Aim and Objectives

The aim of this project is to create a mobile platform based, augmented reality, Qix like, Pokémon GO inspired, area control game

This aim will be achieved by completing the following objectives:

1. Create a client library
2. Create a UDP/TCP server
3. Add multithreading to server
4. Create a simple map based GPS locator
5. Add single player gameplay
6. Add multiplayer gameplay
7. Add team based multiplayer gameplay
8. Enable multiple instances of the game to be run from the server

Objective 1 – Create a client library

Before a server can be created a basic client library must first be developed to test the prototype server with. The client should be able to send messages using UDP and TCP protocols. Development of the client shouldn't end until both it and the server are completed. The client library can be integrated into the game once completed and reused in future projects.

Objective 2 – Create a UDP/TCP server

A server will store all of the locations for each player and when traversing the playing area also their path. The server should be discoverable using a UDP broadcast and then swap to accepting TCP connections after initial contact.
The server should be able to run from a phone if necessary for local multiplayer.

Objective 3 – Add multithreading to server

The server should accept multiple requests at once and write a log of all connections for debugging, a server contents backup file shouldn't be necessary.

Objective 4 – Create a simple map based GPS locator

Before the game is created a simple map based GPS locator application should be developed, this should display the current location on a map. The map should translate, scale and rotate.
This application can then be transformed by the addition on gameplay into the intended product.

Objective 5 – Add single player gameplay

Gameplay for a single player version of the full game should be added including; a definable playing arena, tracking, area controlling mechanics, and scoring.
An AI player or enemy with killing mechanics should also be added for single player mode.

Objective 6 – Add multiplayer gameplay

The client and server should be used to track the location of player in an online multiplayer session and apply killing mechanics to those who cross paths, the server should also track score.

Objective 7 – Add team based multiplayer gameplay

A game type should be implemented where gameplay is team based with score being cumulative. It is not necessary for players to choose their teams.

Objective 8 – Enable multiple instance of the game to be run from the server

Code should be added to the server that allows multiple instances of the game to be run from it at once.

4 Task List

#	Task Name	Description	Duration (weeks)
1	Research	Conduct research that will aid in the writing of reports and initial designing of the project	11
2	Initial report	Write the initial report deliverable	2
3	Create server client library	Create a client library that is capable of interfacing with the server	5
4	Create TCP server	Create a TCP server that can accept TCP packets from the client	2
5	Add UDP to server	Add UDP to the server that can be used to identify the IP of the server	1
6	Add multithreading capabilities to server	Add multithreading to the server so that it is capable of accepting more than one client request at a time	2
7	Create main menu for game	Create a main menu for the game that will be displayed when the game is started and between every game instance. The main menu should display all options for game types and settings	1
8	Add game screen and assets to game	Add a game screen to the game that is displayed once the play game option is selected and also add assets to the game to be used to display player characters	2
9	Add map to game screen	Add a suitable map to the game screen	3
10	Add translations and scaling to map	Add translations and scaling to the map so that it is possible to move the map around and zoom in and out	2
11	Add player character and	Make the player character move as the player moves, this should work via GPS	2

	movements to map		
12	Interim report	Write the interim report deliverable	3
13	Final report	Write the final report deliverable	14
14	Add client calls to store and recall player positions from server	Make the game send its current location to the server at a reasonable interval and also make it so that the game requests the location of every other player	3
15	Add tracking data and bounds of playing field to game	Make it so that the game then draws all the players at the correct locations and that it is possible to create the area of play	2
16	Add taking mechanics from tracking data to game	Make it so that when a player completes a run from one side of the playing area to another they take the smallest area for their own team	2
17	Add killing mechanics from tracking data	Make it so that if a player crosses the track of another active player one of the players dies	2
18	Add scoring data to game	Make it so that the score of all players is tracked based on the area of land taken	2
19	Add team mode to game (Optional)	Make it so that players can play in teams, this is an optional extra if development is kept to schedule	3
20	Add multigame server (Optional)	Make it so that multiple game instances can run on one server, this is an optional extra if development is kept to schedule	3

5 Time Plan

#	Task Name	University Calendar Weeks																																	
		4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
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17	Add killing mechanics from tracking data																														
18	Add scoring data to game																														
19	Add team mode to game (Optional)																														
20	Add multigame server (Optional)																														

6 Risk Analysis

Risk	Current Risk			How to Avoid	How to Recover	Residual Risk		
	Severity (L/M/H)	Likelihood (L/M/H)	Significance (Sev. x Like.)			Severity (L/M/H)	Likelihood (L/M/H)	Significance (Sev. x Like.)
Data loss	H	M	HM	Keep Backups	Reinstate from backups	L	M	LM
Loss of backups	H	L	HL	Multiple Backups	Use alternate	L	L	LL
Underestimate workload	H	M	HM	Regularly review progress against Time Plan	Invest more time into work, possible reduction of objectives	H	L	HL
Critical error in deliverable	H	M	HM	Perform adequate research	Debug code	H	L	HL
Skill Risk	M	M	MM	Perform adequate training	Invest more time into research	L	L	LL
Scope Creep	M	H	MH	Fully define scope	Define scope at current point	M	L	ML
Inefficient Program Performance	H	L	HL	Spend time testing code	Remove extraneous features	M	L	ML

Server Crashes	M	M	MM	Attempt to optimize server code	Implement alternative servers	L	L	LL
Incompatible with target device	H	L	HL	Create program with target device specifications in mind	Create alternative version for target device	L	L	LL
Medical emergency	H	L	HL	Care for developers health	Comment code regularly so that it is well understood	M	L	ML
Development software unavailable	H	H	HH	Place key dll into SVN	Download key dll	L	L	LL
User injured while using application	H	M	HM	Only allow authorized access to application while in development and provide warning messages while in play	Medical attention may be required if a user is injured while using the application	H	L	HL
Optional extras are not complete	L	M	LM	Keep to Time Plan	Ensure deliverable is acceptable	L	L	LL

Appendix A: Capture the Campus!

Capture the flag is a well-known game (sub-) genre that requires players to capture the flag. Often there are two opposing teams each of which has a flag that must be defended from the other team.

http://en.wikipedia.org/wiki/Capture_the_flag

This project requires the student to design and develop an augmented reality game for a GPS-enabled mobile device (preferably Windows Phone 7). The details of the gameplay are open to negotiation, but a suggestion is that a number of flags (or capture points) are distributed in GPS locations around the campus. The players are required to visit the location for a specified time period to capture the location. The players accumulate score based on number of capture points held and time they are uncontested for. The status of the capture points should be persistent, with the game's progress being able to be tracked over multiple (perhaps unlimited) days.

The project involves databases for storing flag locations and capture logs etc.

Project Code: DJP3

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