Location-aware Real Time Strategy Games
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Contents

1 Introduction: Real Time Strategy games

Ever since the first operating system for handheld devices, the spreading of smartphones has intensifed every year.In 2012, the number of smartphones in the world has reached one billion, according to Bloomberg[51]

The rapid expansion of mobile computing presents new challenges and opportunities for both the user and the developer. The ease of use and the presence of touchscreens, GPS receivers, gyroscopes, accelerometers and, since recently, even barometers gives way to new approaches in developing games.

In this paper, we will define a number of computer game genres, classify some of the most popular location-aware games and game platforms and propoe an introduction of a genre that has a long legacy among computer games, but is not yet known to the location-aware mobile context. The new genre is that of 'Real Time Strategy'(RTS)[12][4][30][33] games. We will do that with a subgenre of RTS, called Real Time Tactics(RTT)[13][42].

1.1 What is Real Time Strategy?

RTS games are defined as real-time (continuous time) competitive games, in which several players fight against each other, either in a skirmish or team versus team. The purpose is to defeat the opponents by taking real-time decisions on managing resources and troops. The focus is, therefore, on three key elements: **managing resource gathering**, **building a base to provide troops** and **battle tactics**.[12][4][30][33]

This project will focus on a subgenre of RTS, Real Time Tactics(RTT) - which, instead of managing all three aspects of RTS, focuses on **battle tactics**.

Because it is essentially a simplified approach to RTS[42], RTT can provide a good proof of concept and at the same time simple and enjoyable playability. The advantage of having a RTT GPS-enabled game versus RTS is that it greatly reduces the play time, requires less skills and has the potential of being less stressful than RTS.

1.2 Real Time Strateg versus Turn Based Strategy

Turn Based Strategy games[15][31](such as chess and board games, for example) allow the player to take his time and plan every move. Implicitly, the duration of the game is greater. This type of game is not in the scope of this project, yet it deserves mentioning, as there are many such games for mobile devices. Some notable implementations are the ones of Scotland Yard, Catan and Monopoly.

In particular, there are two implementations for Scotland Yard upon which a comparison has been made on whether it is better to port a board game in a real-time(continuous-time) or turn-based mobile GPS-based game[50]. These two implementations are Mobilis XHunt(turn based) and MisterX Mobile(real-time). The comparison has been made on 10 aspects: Fun, Smooth Progression, Dynamic Gameplay, Ease of play, Stressless Gameplay, Communication, Strategy, Clear Rules, Low Risk, Education. The conclusion was that there was no favorite between the two, but it has been concluded that these 10 aspects have different weights for the player and that Fun, Smooth Progression and Dynamic Gameplay have a higher individual weight to players than the rest.[50, p. 5]

Based on the knowledge gathered from the above-mentioned comparison, the aim of this project will be to maximize the interactivity and dynamics of the RTS game.

2 Location-Based Augmented Reality Games

Ever since the first operating system for handheld devices, the spreading of smartphones has intensified every year.

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since recently, even barometers gives way to new approaches in developing games.

Although it is one of the oldest additions to the smartphone, the GPS-enabled smartphone is still not ubiquitous. As of now, each company's flagship and most of their mid-level smartphones are GPS-enabled. This makes way to the propagation of GPS gaming. Although the concept is old, very few attempts have been made in this direction and this branch of game development may be considered to still be in one of its early stages of maturity.

This paper is a proposal for extending the genre of mobile real-time multiplayer location-based games.

2.1   Location-based games

Location-based games[9] take advantage of the mobile devices' built-in receivers for global positioning. They provide the user's location with an accuracy ranging from a few to a couple dozen meters. Because the most mobile devices in the world today rely on the Global Positioning System(only recently support for GLONASS has been added to smartphones), we can use the term GPS-games.

GPS-games came up long before this feature has become ubiquitous in mobile phones and tablets. One of the first widespread GPS-games is Geocaching. It is composed of two parts:

a. Placing physical caches at various locations that can be considered interesting or worth visiting and publishing their GPS positions (eg. on websites).

b. Searching for various caches by using a GPS device.

Along with the evolution of smartphones came that of the mobile games. GPS games come in a lot of flavors, from GPS-based tours, adventure and investigation games to various race games - single and multi player and massively multiplayer online games.

2.2   Types of GPS-based games

There is a number of GPS-enabled games and game authoring tools that are available for iOS and Android devices. The ones studied for this paper are : ARIS[2], Tourality[37], Wherigo[43], conTAGion[5], Shadow Cities[35], SCVNGR[34], Please Stay Calm[27], Parallel Mafia [26], Parallel Kingdom[25], Tripventure[38], Warfinger[39], Totem[36], Portal Hunt[28], aMazing[1], Ingress[16], MobileWar[19], Mister X Mobile[18], Mobilis XHunt[20], Own This World[24], MapAttack[17].

For better understanding the classification done below, we will first define each type of game:

a. **Adventure/Investigation Game** - Game in which the player plays the role of a character in a story. The primordial characteristics of this genre is that it is focused on immersion in the story, puzzle solving and investigation, rather than on physical skills. Also, the tendency of this genre is towards single player experience, though occasionally multiplayer is also implemented[6] (eg. the ARIS-based game 'Mentira').

b. **Massively Multiplayer Online Game** - This type of game is designed to support large numbers of players (even in the number of millions in some cases) that play and interact in a persistent virtual world. This type of game allows both cooperative and competitive gameplay and is exclusively based on multiplayer.[10] Subgenres include MMO Role Playing Games and MMO Shooters.

c. **Casual Game** - Analogous to the MMO, the Casual Game is targeted at mass at a mass audience and can incorporate any type of game type. The particularity of this genre is that it aims at having simple rules, simple gameplay and requiring no specialized skills.[8]

d. **Racing Game** - It's a genre defining a broad range of games. In the case of computer games, it describes mostly motorized vehicle racing. In the mobile context, it mostly describes racing on foot against time or through a number of checkpoints.[11]

e. **Shooter Game** - This one's a subgenre of action games. It focuses on first or third person experience, speed, aiming and reaction time. Usually the weapon is ranged, although close-combat weapons are included in most games.[14]

We will now classify the games/platforms based on the genres they best fall in:

a. **Adventure/Investigation Games**

   (a) ARIS
   (b) Wherigo
   (c) Tripventure
   (d) Tidy City

b. **Massively Multiplayer Online Games**

   (a) Shadow Cities
   (b) Please Stay Calm
   (c) conTAGion
   (d) Parallel Mafia
   (e) Parallel Kingdom
   (f) Portal Hunt
   (g) Ingress

c. **Casual Games**

   (a) SCVNGR
   (b) Warfinger
   (c) aMazing
   (d) Own This World
   (e) MapAttack

d. **Racing Games**

   (a) Tourality

e. **Shooter Games**

   (a) MobileWar

A special category is represented by Mister X Mobile[18] and Mobilis XHunt[20], which both bring a board game (Scotland Yard) to the mobile environment. While the former adapts the board game to real-time gameplay(placing it closer to the 'Multiplayer Racing Games', with elements from 'Real Time Strategy Games'), the latter falls in the definition of 'Turn Based Strategy' games.

3   Real Time Strategy Games

This proposal is for the research and development of GPS-enabled Real Time Strategy games. They are to be augmented reality games for single player or multiplayer competitive 'free for all'/'skirmish' and 'team versus team' games. This category of games offers opportunities to also enhance the experience for all the previously existing types of GPS-enabled mobile games.
For this project, the proposed games are :

a. **Territory Takeover**

b. **The War Game**

1. The **Territory Takeover** game is a multiplayer, team versus team competitive game. The players or game author define an area of play, which will be divided into multiple divisions. Each division will be marked by a 'flag' (a GPS marker). To capture the area division, a team must capture its flag. The game ends when all flags have been captured and the winner is the team with most captured flags. Each flag may be given a time that a player must spend next to it in order to capture it. Once a flag (and implicitly the territory) is captured, it remains so until the end of the game. The winner can be decided on flag counting or, alternatively, each flag may receive a number of points, according to the size of the territory marked by it and the difficulty of the terrain.

This game can be enhanced with the use of virtual tools or weapons. For the purpose of this project, the following tools/weapons have been considered :

  a. The **Immobilizer** is an ability that can be used by each player to block an opponent from moving. The 'attacker' 'activates' the ability and a circle around him is drawn to show the range in which he can shoot. If an opponent enters the range area, the 'attacker' will select him on the map and shoot. The 'victim' will receive a notification that he is immobilized. A circle or rectangle will be defined around him and he will not be allowed to move outside of it for a given time, say 30 seconds or 1 minute. If he does, he gets disqualified and kicked out of the game. An alternate solution would be that the team loses points, for the case that this is the scoring methodology implemented.

  b. **Demobilizer** is an ability that an immobilized player can use. For this project, it will only work on the person that uses the ability. The effect is that a person that is immobilized gets the waiting time halved.

Both the abilities have a common cooldown timer. That means that if a player immobilizes somebody and is immediately immoblized himself, he won't be able to use the demobilizer because of the cooldown following the usage of the immobilizer.

2. The War Game is inspired by Real Time Strategy Games and Airsoft. Two teams are formed. An area of play is delimited on the map. Each player can choose between a number of characters. For the purpose of this project, four characters are proposed: Defender, Marine, Sniper and Heavy Trooper. Each of the four characters has special abilities and characteristics :

  a. The **Defender** has the ability to generate shields for short periods of time. Members of the team can hide behind those shields for defence. The Defender may also act as a Medic and heal or revive members of the team. He has low health, long ability cooldowns and a sidearm with short range, small damage and fast cooldowns .

  b. The **Marine** has a weapon that can shoot a medium range with medium damage and fast cooldowns. He has medium health.

  c. The **Sniper** has two weapons : the sniper rifle that can shoot at distant ranges and deal large damage to single targets and the sidearm, which is the same as the Defender's. His health is low, just like the Defender's. The sniper shot may penetrate the Defender's shield and cause reduced damage to one target.

  d. The **Heavy Trooper** has three weapons : the bazooka, the sidearm and mines. The bazooka is a mid-range weapon with splash damage - it therefore can be fired against compact groups, such as the ones that might be hiding behind a shield. The bazooka cannot deal damage through the shield, but it may be shot next to it, causing damage from the side. The damage to each target varies from moderate to small, depending how far they are from the center of the 'projectile explosion'. The mines can be placed randomly on the map and their 'explosions' will not affect the members of the Heavy Trooper's team. Also they cannot be triggered by the members of his team. The damage dealt will be moderate, with splash damage, just like the bazooka projectile. The bazooka and the mines have long cooldowns, therefore the sidearm is added. The Heavy Trooper has high health.

This game has some advantages and drawbacks:
Advantages: It does not require specialized gear and setting, nor does it need long amounts of time to be played. It can be enjoyed with a bunch of friends on a sunny weekend afternoon.
Drawbacks: It highly depends on GPS accuracy. This issue may affect gameplay. It also does not feel as 'real' as real-life games, nor PC games.

4 Requirements

The two above-mentioned games will use a common framework that will enable multiplayer interaction for both 'free for all'/'skirmish' and 'team versus team' approaches. They will require a server to centralize player information such as GPS data and the virtual 'health' attribute. Because the games proposed are fast-paced, they require quick response times from the server, client and and the communication protocol between them.

4.1 Client

The following technologies have been considered for developing the frontend for the application : Android, XCode(for Apple iOS) and multiplatoform APIs such as PhoneGap/Cordova and Titanium. The multiplatform APIs offer the benefit of the 'code once, deploy everywhere' philosophy, at the cost of performance[29][21]. In this case, this approach is disadvantageous. Therefore, the choice of native app development makes more sense for this situation.

The client will be developed with Android, due to its accessibility and versatility and the fact that it's ubiquitous and open source.

4.2 Server

The games that are to be implemented will actively rely on communication with a centralized server. This implies a constant Internet connection on each mobile device. Also, they require fast, low latency message exchanges. The server should be able to handle this for players in the numbers of a few dozens.

The server will be written using NodeJS[22][23]. NodeJS is a javascript framework based on the Google V8 Engine that is designed for web server functionality. Yet, due to the fact that it is a framework and not a standalone server, one can take advantage of the 'Event Loop' functionality to write various other types of servers. This particular feat is beneficial to the purpose of this project. It is also faster than Apache for general purpose, fast message exchange scenarios[3].

4.3 Communication Protocols

During a game, active communication must be performed between the mobile devices and the server in order to multicast all player positions and intentions to all players. There are two aspects to this approach:

   a. The game is created on the server, in a so-called 'Lobby' which all the players join.

   b. The game is created on the server and once the game starts, all players send their positions to the server. The server is then responsible to multicasting the positions to all the players.

This is, of course, a subset of the tasks that must be performed by the server. There will be other information that must be exchanged periodically, such as the player's health and quantities of various other attributes that will be added during development and/or proposed during trying out the game. In the general idea of communication protocol usage, the list of choices has been narrowed down to three:

   a. WebRTC - A protocol that is to be part of the HTML 5 standard. It will be based on the RTP(Reliable Transport Protocol), which is the base for VoIP protocols and is itself based on UDP. It promises to be a very fast standard protocol, appropriate for audio and video streaming and massive multiplayer games.[40] It is still in draft format and there are no official implementations for it. Implementing the protocol itself is outside the scope of this project.

   b. WebSockets - A protocol that is part of the HTML 5 standard. It is a low latency TCP-based protocol that promises to replace http in several types of web applications.[41]

   c. RTP - The protocol on which VoIP and WebRTC are based. It is based on UDP and it is designed for real-time streaming of data.[32]

From these three protocols, a choice will be made between WebSockets and RTP. WebRTC is to be left as an option until its official release and implementation for both NodeJS and Android.

4.4 Game Elements

Both games share a number of common features:

 a. a number of players that are visible on the map

 b. a number of teams, represented by different colors(in the case of free-for-all(skirmish) play, the number of teams equals the number of players)

 c. a number of items that each player can use

 d. item properties, such as range and cooldown times

 e. player health

The 'War Game' also introduces a number of characters to the game. Each character type has a different health value and different tools, with specific properties.

The server must provide a 'game lobby', to which the players connect and prepare for starting the game. This includes character choice for the 'War Game' and a 'Ready' button. When all players declare themselves to be 'ready', a countdown starts and then the game begins.

5 Implementation

Implementation will mean developing a server and a client application from scratch, covering all the functionality needed for the games to work according to the description in section 'Real Time Strategy Games'.

5.1 Schedule

This project, consisting of one server and one client application, is to be developed in four steps:

 a. **Development** - During the first iteration of development, the most basic features of the game are to be implemented: basic server functionality that would allow the game to work, basic client functionality and the 'War Game' without all features.(2 months)

 b. **Testing and Evaluation** - During this phase, the game and its functionality will be live-tested for feasibility and quality. New ideas will be sought and documented. Most importantly, player feedback will be gathered.(1 month)

 c. **Development** - During the second iteration of development, the 'War Game' will be completed and, using its framework, the 'Territory Takeover' game will be implemented. Bugs will be removed and tweaks will be made to the framework and the game concepts to match the player feedback.(2 months)

 d. **Evaluation and Completion** - During the second evaluation phase, both games will be tested for playability, player feedback will be gathered and the Dissertation Paper will be completed.(1 month)

5.2 Authoring Tool

As it is not the focus of this project, the Authoring Tool will comprise the most basic elements necessary for setting up the game(such as defining obstacles and probably the border of the gameplay area). Future work might include modifying and/or adding new character attributes, multiple obstacle types and probably extending the RTT games to full-fledged RTS.

6 Documentation on the Games

Extensive documentation has been found from research done on education-oriented GPS-games.[48][46][47][44][45][49], describing concepts and approaches in developing platforms and games to this end[47], porting them to different locations[44], comparing them and discussing their functionality[49][48][46] or discussing their effect and usefulness[48]. Unfortunately for the direction of this particular project, this documentation focuses exclusively on GPS-enabled Adventure Games.

The lack of documentation for the other games, except their websites has left trying them out one by one as the only option to understand their components and functionality. Additional information was retrieved from video descriptions, examples and reviews of the games.

During the preparation of this proposal paper no games or documentation have been found on GPS-enabled Real Time Strategy games. From the searches performed, no location-aware mobile games have been found to fall in the genre of RTS. However, one has been found in the genre of 'Shooter Games' - MobileWar.

The purpose of this project is to create a framework on which the GPS-enabled Real Time Strategy games 'Territory Takeover' and 'The War Game' will be implemented as proof of concept. This framework is to be extended during future work. The names of the games themselves are chosen only by their descriptive nature and are prone to change during the steps of development and evaluation.

7 Application of the Games

The two games are proposed with group teambuilding and recreation in mind. Both games require team strategy and cooperation. Territory Takeover allows for both team versus team and free for all gameplay, allowing for both small and large groups to play. The War Game is to be a fast paced game spanning a time interval in the range of a few tens of minutes. Although it is a RTS Game and not a Shooter Game, the 'War Game' can be seen as a more casual approach to Airsoft. Where it lacks the realism of Airsoft or the immersion of classical computer Real Time Strategy games, it gains in the intensity of real-life experience and teamwork, without requiring specialized equipment(Airsoft[7]) or highly developed skills(computer Real Time Strategy games).

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