GeoWars

A location based game
Game Concept

Synopsis
You: a General holding your position and fending off enemy units using armies funds to build defensive buildings.

Them: enemy forces that attack from land and air and will try to take you out as well as your defensive structures.

Description
GeoWars is a Location-Based Tower Defense (a game where the player must place defensive structures in strategic positions in order to defend its base and destroy all invaders) that uses the users location to determine the games terrain and weather. Therefore the game is actually set where the player is. The players goal is to survive for as long as possible (until the time runs out) and spending as little money as possible. Money can be earn by destroying invading forces units and can be spent (or invested) in defensive structures, such as machineguns nests and laser-guided rocket silos. The invading forces will try to destroy both the players base (which is located in the games map in the same place where the player is located in the real world, meaning that if the player is playing in the corner of Street A with Street B, he will see his base in the exact same corner of the games map) and the defensive structures that hinder their movement.
Key Features

Minimum System Requirements
- Platform: Pocket PC
- 1GHz Snapdragon Processor
- Directx Mobile compliant device
- 20 MB RAM
- Windows Mobile 6.5.x
- Touchscreen
- 4 MB of storage

Supporting Technology
GeoWars uses the following technologies:
- Graphics Engine
  - DirectX Mobile
- User Input
  - .Net Compact Framework 3.5
- GPS Input
  - Windows Mobile Intermediate Driver
- Web Services
  - .Net Compact Framework 3.5
- Audio
  - .Net Compact Framework 3.5
In a not so distant future...

The world is at war. The government needs you, as one of its most prized Generals to defend our country against the invading forces. These forces consist of soldiers, tanks and airplanes, each with their very own weaknesses, strengths and mission objectives. As such, it is crucial that you are able to hold your current sector until the attack is over. In order to do so, and since we’re short on personnel, you were given an experimental tool. This tool is capable of deploying armed and unmanned infrastructures instantly on the terrain. These infrastructures automatically engage any enemy unit in the vicinity. The problem is, it requires expensive resources to do so. And since money is a problem, you’ll have to prove your value to us, by razing enemy units, if you wish to unlock more funds in order to enhance your sectors defense. Remember also to consider the weather in your strategy. Note that the less money you spend, the more pleased we will be with your performance.

Your President

Setting

The game presents a very personalized and familiar battleground, since this battleground is actually a map of the general area of where the player actually is. The weather is also consistent with the real weather where the player is located. The battleground is initially
empty, with just the players base at the center of it. Shortly after, the game begins to be filled with tanks, airplanes and tanks.
Game Mechanics

Sample Game Play

Once the game starts you see yourself in the center of the map. Soon after the game starts enemy forces begin showing up from all around the map’s edges. At this point you have some choices. You could, for an instance, build a defensive rocket tower and place it near you so that your position would be easier to hold, or, if you don’t feel like spending money, you could run away from the enemy forces to gain time. Let’s suppose that you opted for the building option. You spent some of the country’s funds by building that rocket tower, but it was worth it. The enemy airplane that was approaching your position was destroyed rather quickly. Unfortunately while the tower was attacking the aircraft, a tank decided to attack your rocket tower, severely damaging it. You decided to repair that tower, spending a bit money but not as much as you would be spending if you decided to build a new one. Being at full health, the tower easily destroys the enemy tank. Having destroyed two units you noticed that you’ve gained some money for it. However, you didn’t notice the enemy soldier that was approaching your position, stealthily, from behind. Seeing that your newly repaired rocket tower is busy fighting off another tank you decided that gaining some time by running around and luring that soldier closer to the tower is best. As such you begin following the road, moving even closer to your tower, thus increasing the time the soldier would take to get to you. By the time the soldier is pretty close
to you, the other tank is done for and the tower gets to save you easily. You can’t avoid a grin. You definitely are one of the best generals out there. However, the sight of a wave of tanks, airplanes and soldiers quickly wipes that smile away. You still have to hold that sector for at least another 2 minutes. But thanks to the money you’ve previously earned, placing some machine gun nests and rocket silos is a viable option. Hopefully that will be enough to both fend the invaders off and keep you alive until backup arrives.

Core Game Play / Game Flow

GeoWars gameplay is loosely based on a type of RTS games known as “Tower Wars”. This game type’s mechanics consists of defending the player’s base (or bases) from waves of invading enemy forces. To accomplish this feat, the player has the ability to create a myriad of defensive structures (hence Tower Wars) that destroy, slow down or halt enemy forces. The game’s goal is to survive for as long as possible (or up to a certain time).

Being based on this type of game, GeoWars challenges the player to defend his real position from invading enemy forces. The player not only has the option to spend some of his in-game money to create the aforementioned towers, capable of both defending him and gathering more money, by destroying enemy units, or has the option to flee, by physically moving himself. This way, the player has the ability of playing a location based game without physically moving himself around to do so, although by not doing that the player may find the
game considerably harder, since he is limiting his tactical and defensive options.

While the predefined timer that measures how much time is left in the game is still counting down, the player must avoid having his life points depleted. These life points may be depleted by machine gun fire or rockets, or even by invading forces actually coming to the players position “stomping” him (each of these “hazards” deal different damage to the player). Also note that each enemy unit has different characteristics, such as armor, damage, rate of fire, ammunition type, movement capability, and the likes. For an instance, while a tank may only move through roads and streets, an airplane can move rather freely through the entire games scenario. All of these units are influenced by the weather of the place the game is being played.

The final score is determined by both the remaining player’s life and the amount of money that remains unspent.

Money

Money is a core component of GeoWars. In fact, not only does it influence how many and which defensive structures may the player build, it also determines how high is the player’s score. Money may be spent in the creation of new defensive towers or in the repairing of the current ones. As such, the more money a player has, the more chances and options he does have to withstand the in-game assault. Money can be harvested by destroying enemy units (via previously created towers) or overtime. The remaining money that the player ends up having at the end on a game helps determine the final score.
**Time**

Time is the essence of this game. In fact, most aspects of the game revolve around it. Each game has a timer that determines how much time the player must keep himself alive, and the passing of time also grants the player money. Unfortunately, as time passes by, more and more enemy units are also bound to converge to the players position, so managing time correctly not only may grant the player’s survival, it is the key to achieving higher scores.

**Towers**

Towers are the only way the player may fight back against the invading enemy forces. They also allow for the player to gain extra money, since they are capable of destroying enemy units, and the player is rewarded with money for each kill. These towers can be built (for a price) anywhere in the map, so as long as they don’t obstruct roads. There are many different towers, each unique in its firepower, reloading time, armor and purchase cost. Towers eventually get damaged and can be repaired. Also note that while the more towers built mean a better defended player, that also usually mean less score, as the money spent in building that many towers may turn out to not result in net gain.

**Enemies**

Enemies come in various flavors, from tanks to soldiers. Each unique in its movement capabilities, range, firepower as well as other characteristics. These enemy units are to be avoided, as they may impose a losing condition to the player, since they are the only way a player may lose his life, and hence, lose the game. They can be destroyed by any type of damage, and when destroyed the provide the player a rewarding blast as well as an equally rewarding money boost.
Some enemies can only move around certain areas of the map, and are prone to being affected by the location’s weather.

**Map**

The map represents both the battleground for the player’s battle and the physical location of the player. Therefore, if you are playing at, say, Hyde Park, the battleground for your game will be the very same Hyde Park. This makes the game very dynamic and grants a different gameplay every time the game is played. The map also conditions where the enemy units may come from and where they may go (if they are tanks or soldiers for an instance, they may only move around streets and roads). Obviously, the game difficulty is very much related with its map. A more street-dense map may provide enemy units more points from where they may attack, and less places the player may lay his defense.

**Weather**

Also based on the player’s location, the weather plays a subtle, yet important role in the game, as it may affect the enemy units movement speed and damage per hit. While a clear weather provides no penalties for enemy units, a rainy weather imposes penalties to both the movement speed and damage of each enemy unit, due to reduced visibility and moist in the atmosphere.

**Player**

The player’s location is clearly marked in the game map. It is the player’s goal to protect his position by populating the map with defensive towers and also by moving around the game map by moving
around the real world. The tactical advantages of playing a location-based game by actually moving around the real world are obvious. For an instance, if the player is to enter a shopping center or a parking lot, enemy tanks and soldiers will have a hard time to close in on him. The player may also lay some defensive towers in a particular place and stand among that tower nest to serve as bait and to lure enemy forces away from a weakened tower or just to get the enemy forces in a situation where they get in a crossfire. Obviously, if the player feels like it, he may stay put and play the game without moving. This choice, however, cripples both the player and his tactical options during the game, possible rendering the act of winning the game a virtually insurmountable task.

Game Modes

Quick Game
A quick game is a game that considers the players current location and weather as the base for the game to be played. The game will have minimum configurable parameters so as to allow the player to jump right into the game.

Load Game
This option requires that the user logs in the game in order to obtain a list of previously configured games. These games, which were created at the online game portal, configure a whole game, defining its difficulty and where the game takes place. This makes possible for the player to play a game that is location based, but doesn’t rely on the player's current location, making it possible for the player to not only
play a fully configurable game but also allows for it to be played in locations that are deemed unplayable or where the GPS signal is absent. Additionally, the loaded game’s scores are recorded online.

**Game Options**

<table>
<thead>
<tr>
<th>Option</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound</td>
<td>On/Off</td>
</tr>
<tr>
<td>Difficulty</td>
<td>Easy/Medium/Hard</td>
</tr>
<tr>
<td>General Moves</td>
<td>On/Off</td>
</tr>
<tr>
<td>Use Weather</td>
<td>On/Off</td>
</tr>
</tbody>
</table>

**Player Design / Characters**

**Player**

Whereabouts unknown

The player is a top general, renowned for his military feats, with the mission to defend sectors from an enemy invasion. The ability to withstand such assault depends only of his tactical knowledge, so, if his life is lost, that sector is doomed. Luckily, the general is agile enough to run and shelter himself, or lure enemies, keeping himself from harm’s way.

**Towers**

Government classified project

Little is known about these towers. They started off as being advanced automated targeting systems for missiles and machine guns so as to
be installed on airplanes and tanks, but ended proving to be very capable of actively working on their own. Furthermore, they can be deployed nearly instantly on top of buildings providing a great defensive support if placed correctly. If only they were a little bit cheaper...

**Enemy Forces**

**Homeland Unknown**

Little is known about their origins, their motives or their numbers, but their technology rivals the best there is. They are capable of attacking from both air and land, and will attempt to neutralize any resistance on the field, be it automated or human. Still, they are vulnerable to current technology, so keeping them at bay is not an insurmountable task. They also possess technology very valuable that, if salvaged, may provide being useful.

**Combat**

Combat in GeoWars revolves around hit points. If the player loses his hit points, he loses the game. However, as long as he keeps his hit points positive, he may not kill a single enemy unit, if he is capable of surviving the predefined time. Everything in the game has hit points, from tanks to towers, and from bullets and rockets. Since every object in game is destructible this means that the tide of the battle can turn very easily for both sides. If the enemy overwhelms the player with many tanks or other units, these units may incur in a situation of friendly fire, and thus actually destroying each other without meaning to do so. In fact, the more units present in the battlefield, the more coordination is required both for the enemy and for the player. The
player may position the towers in a way that it creates a crossfire
situation for each unit that passes by. However, if the shots miss the
unit in the crossfire, these shots may hit other towers, and thus
actually become more of a nuisance than a helping hand. So, as it is
plain to see, GeoWars combat system requires some notion of tactic in
order to maximize the player’s actions. Playing the game in a sloppy
kind of a way will probably result in loss for the player. Also note that
every ammunition available for the player is also available for the
enemy’s forces, as a way to balance the fight. Each ammunition has its
downsides and its features. For an instance, machine gun fire is fast,
both in speed and reload time, but if the enemy unit is moving in a
perpendicular route to the chasing bullet, the bullet may miss and hit
another target (that might even be friendly). On the other hand, a
rocket will be homming to its target and if it makes contact with the
target it will deal some considerable damage, but if something comes
between the target and the missile (which is easy to happen since the
rocket is rather slow) or if the missile is intercepted by, say, machine
gun fire or even another rocket it will be destroyed.

In combat, the main edge the player has is the ability to channel
every force to his position, and, as so, being able to funnel the
enemy’s attack to a desired area, both for evasion and ambush
purposes. Another edge the player has is the ability to promptly repair
an already built tower, which is always cheaper than actually paying
for a new one (obviously, the more damage the tower has, the more
resources it needs to be rebuilt, and thus, money). The diversity of
units for both sides also plays an important role, especially regarding
tactical opportunities. For an instance, if the player is in a map where
there is only an attack point for land units such as tanks and soldiers
to enter, enforcing that entry point with multiple towers sounds like
the way to go. But the player must also keep in mind the possibility of airplanes to take him by surprise through an undefended sector. As such, knowledge is in fact power, since the further the player’s insight regarding enemy unit’s strong and weak points grows deeper, so will his sense of effectively creating new tactical approaches to them in each situation.

**Player Units**

**Towers Overview**

- Machine Gun Tower
- Missile Tower
- Passive Tower
- Interceptor Tower
## Towers

<table>
<thead>
<tr>
<th>Name</th>
<th>Range</th>
<th>Health</th>
<th>Muzzle velocity</th>
<th>Homming</th>
<th>Projectile damage</th>
<th>Fire rate</th>
<th>Cost</th>
<th>Number of Projectiles per shot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine Gun</td>
<td>Medium</td>
<td>100</td>
<td>Moderate</td>
<td>No</td>
<td>3</td>
<td>Moderate</td>
<td>100</td>
<td>1</td>
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<tr>
<td>Missile</td>
<td>Very Long</td>
<td>150</td>
<td>Low</td>
<td>Yes</td>
<td>10</td>
<td>Low</td>
<td>200</td>
<td>1</td>
</tr>
<tr>
<td>Interceptor</td>
<td>Long</td>
<td>50</td>
<td>High</td>
<td>No</td>
<td>1</td>
<td>High</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>Static</td>
<td>Very Short</td>
<td>25</td>
<td>Moderate</td>
<td>No</td>
<td>5</td>
<td>High</td>
<td>250</td>
<td>8</td>
</tr>
</tbody>
</table>
Towers Examples

Machine Gun

- A tower with a full automatic machine gun. The machine gun will lock onto a target and keep firing at it until that target is destroyed. The machine gun is an affordable and very average weapon, mostly effective at medium range and when engaging enemies that are moving towards it or away from it. When engaging targets very far away that are moving perpendicularly to it, most shot if not all will miss. Therefore, placing many of these as scattered as possible maximizes their overall effectiveness.

Missile

- There isn’t much to say about this tower. It fires a homming missile that, while being slow, will most certainly hit its target. Unless something else happens to come across its path. Since it is quite slow it is probably used best in combination with another more rapid firing tower. Also, as said before, in a cluttered battlefield many missiles may not hit their target, actually even being destroyed in the crossfire (be it friendly or not). Even so, it is an effective weapon, able to engage any target anywhere on the map.

Passive

- The passive tower is mounted with a large particle emitter connected to a timer which basically emits particles in all directions from time to time. Although these particles have a short life, they do pack quite a punch to any unit standing near it. This tower has the shortest range of all towers, but also has
the ability to deal the most damage per time. However, it will also harm any other adjacent towers, so it should be used with caution. Due to its short range it is best placed near choke points, such as cross roads and the likes. Also it is not very self-defendable, as it is not able to defend itself against long range attacking foes.

Interceptor

- This is probably to most interesting tower yet. It will primarily target airborne missiles (yes, even other tower’s) attempting to destroy them in mid-flight. Due to its high speed in both bullet speed and in firing rate it is able to so quickly. Alas, the damage dealt by its bullets is somewhat mediocre, and so, even though its fire rate is excellent it won’t deal much damage to enemy units. Even so, since it will only engage those units directly if there are no airborne missiles it pays up for its price.

**Enemy Units**

**Units Overview**

- Tank
- Soldier
- Airplane
- Boat
## Enemy Units

<table>
<thead>
<tr>
<th>Name</th>
<th>Range</th>
<th>Health</th>
<th>Muzzle velocity</th>
<th>Homming</th>
<th>Projectile damage</th>
<th>Fire rate</th>
<th>Cost</th>
<th>Number of Projectiles per shot</th>
<th>Movement speed</th>
<th>Type of ammunition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tank</td>
<td>Long</td>
<td>20</td>
<td>Moderate</td>
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<td>4</td>
<td>Moderate</td>
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<td>1</td>
<td>Slow</td>
<td>Shell</td>
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<tr>
<td>Aircraft</td>
<td>Medium</td>
<td>10</td>
<td>Moderate</td>
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<td>5</td>
<td>Low</td>
<td>N.A.</td>
<td>2</td>
<td>Fast</td>
<td>Missile</td>
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<tr>
<td>Soldier</td>
<td>Short</td>
<td>5</td>
<td>High</td>
<td>No</td>
<td>3</td>
<td>High</td>
<td>N.A.</td>
<td>1</td>
<td>Moderate</td>
<td>Bullet</td>
</tr>
<tr>
<td>Boat</td>
<td>Very Long</td>
<td>50</td>
<td>High</td>
<td>Yes</td>
<td>15</td>
<td>Very Low</td>
<td>N.A.</td>
<td>1</td>
<td>Static</td>
<td>Missile</td>
</tr>
</tbody>
</table>
Enemy Examples

Tank

- A slow moving bunker would be the best definition for this unit. It has a good armor and moderate attacking capabilities. Its long range makes up for its crippled speed. Also, since it does fire shell ammunitions, it is not prone to be intercepted by other projectiles. However, since it is slow, both in its movement speed and its shell speed, it is easily outmaneuvered by the player, or flanked by Towers. Still, it is a force to be reckoned with. Also, this vehicle is only capable of moving around the battlefield through streets and roads, making its path and course of action rather predictable. It will prefer to engage defensive infrastructures while moving closer to the player’s position.

Aircraft

- The aircraft is a sneaky enemy unit, capable of striking from everywhere and at any target. Even though it is a rather fragile unit, and prone to be taken down by rapid close-range fire or a homming missile it is fast enough to be capable to cause some damage until destroyed. In fact, it fires not only one, but two closely positioned homming missiles that make the player, if targeted, an almost sure dead target. The missiles are, since they are twin missiles, difficult to intercept, as only one of them will actually be destroyed per hit. Since it is an aircraft, it may show up coming from anywhere in the map and can wander around and change directions when it feels like it.

Soldier
• The foot soldier is the most fragile and has the least damage dealing weapon and the shortest range of all units. However, it is quite fast and small sized making it hard to hit if not from a close firing position. Even if it does need to fire from a very short range, if it does so it will effectively deal a considerable amount of damage due to its rapid firing weapon. Even when firing at towers it will not stop moving until it reaches the player. When close enough to the player it will effectively engage the player, dealing a huge damage in a very small amount of time. This unit is best countered with fast, close range fire. Luckily, the soldier can only move around roads and streets, making it more predictable than other units.

Boat

• The cruiser is the most fearsome unit present in this army. It is capable of effectively engaging any unit in the map with tremendous firepower. Thanks to its thick armor, it will probably stick around time enough to deal serious damage to any unit it sets its eyes on. Even so, this powerful Argonaut has its flaws. Mainly, it will only show up in water (obviously), meaning that not only is it possible that it may not show in every battlefield, its position is also predictable. Furthermore, as it is static, it is susceptible to crossfire, so, with enough firepower, it may be quickly taken down. To top it all, it slow firing tactical missile (that surely will do some damage if it does land) is very easily intercepted.
Physics
The game’s physics consists basically about three things:

- Collisions,
- Homming objects,
- Rotating objects considering their heading.

A collision is, as the name implies, the ability to determine if an object is starting to intercept another object. This is done using a bounding box approach. So, each object has a dynamic bounding box, that gives each object the ability of not only determining if an object has collided with it, but also to filter by type of object and act differently according to each object that has collided with it. This makes the addition of newer objects easy and customizable. The reaction to a collision might be an explosion (as when a missile hits its target) or the negation of building a tower (it is not possible to build a tower atop of another object). As such, collisions do play a major role in a top down, 2D real time strategy game, as it gives the game the ability of correctly positioning units without them being atop of another and also of effectively determining if a projectile has hit its target.

Regarding homming objects, such as missiles, their behavior is also just as the name implies. A homming device, once having its target acquired, will follow it to the best of its skills so as to hit it and, in this game’s case, destroy the target. As such, each homming projectile at each game cycle will update its current speed vector considering his position and the targets position, further normalizing said vector and then multiplying it by the module of the projectile speed. This
guarantees that the projectile will follow the target regardless of the target’s speed or position.

The rotation of objects considering their heading doesn’t add much to the gameplay itself, but does help to keep the physics as real as possible. So, if a homming missile is following, say, a tank, the tip of the missile will be facing the heading of its speed vector. Likewise, a cannon that is targeting something will be rotating so as to keep pointing directly at its target at all times. This allows the player to effectively visualize which unit is being targeted by each.

Altogether these game features attempt to simulate a coherent physics system with the sole purpose of providing a better and more relatable gaming experience.
Artificial Intelligence Design

Overview

AI of an enemy unit

Enemy AI

Like their tower counterparts, enemy units are effectively capable of acquiring targets and firing at them. The only particular difference is that most of these units are mobile and will attempt to approach a target, considering some restraints. For an instance, a tank (or a soldier, since their behavior isn’t different at all) may appear on the top left corner. At that point the tank will attempt to acquire a tower of
some type (once again prioritizing the targets) while moving towards the player, carefully following only streets and roads. If the player is not on a street or road, the tank will try to get to the section of a road closest to the player. This way, the tank is capable of razing defensive structures while attempting to approach its primary target (the player). Once the distance to the player has been reduced to a certain point (not always possible of course) the tank will engage the player. Of course the same thing cannot be said about an aircraft. An aircraft will fire and close in on the chosen target, be it a tower (if available) or the player. Since it is an airborne vehicle, it is not bound to the constraints imposed by the battlefield. Finally, a boat will work pretty much like a tower, since it is not capable of moving around (and it is only capable of showing up on water courses of any kind).
Tower AI
Tower units are not controllable by the player. In fact, the player can only chose where to deploy the tower and when to repair them. Besides that, the process of acquiring a target and effectively engaging it is completely automatic. All towers, with the exception of the passive tower require the acquisition of a target prior to firing. This particular tower doesn’t require any target to be acquired since it will fire in predetermined directions at predetermined intervals. The acquisition of a target varies slightly from tower to tower, depending on the type of each, but consists of target prioritizing. This means that a tower has a priority list of types of units to engage. For an instance, a tower may prefer attacking tanks first, then airplanes, then boats, then soldiers. This means that even if there are multiple soldiers around the map, if there is at least one tank or one aircraft or one boat, the tower will prefer to target one of them, effectively ignoring any other type of foe until that type is destroyed. Also, when targeting multiple targets of the same time, the tower will chose the oldest one in the battlefield, the one more prone to be dealing damage. Considering the previous example if the tower had to choose between firing to tank A or tank B, it would choose the one that has been around for the longest. The action of firing upon a target doesn’t consider the target speed or heading, meaning that non-homming projectiles may not hit their target. If the target is destroyed, the tower will attempt to reacquire a new target, once again considering its list of priorities of viable targets.

Player commands
Overview
The player can interact with the game in various ways. From touching the interface controls present in the game to moving around.
**Move**
The player can move his General by moving around in the real world. The game will map the movement to the player to the general’s position, so as to attempt to keep the general coincident with the representation of the player’s real global position in the map.

**Select Tower to deploy**
The player can select from any of the four towers one at a time to build. He can do so by clicking on any of the tower buttons placed in the bottom of the UI and then clicking where would he like the tower to be placed. If the selected area is a valid area, the tower will be deployed.

**Pause the game**
The game can be paused anytime by the player by clicking on the bottom-rightmost icon.
Player Interface

UI Overview

In game UI

Geo Wars has an in game UI laid out as follows: statistics of the ongoing game are presented in the top most portion of the device’s screen. That’s where the remaining time, money and the player’s health is displayed.

User options via touch screen are handled in the bottom portion of the screen. There, the player can choose which tower does he want to place, and can pause the game. This way, the player when tapping the buttons won’t cover the rest of the screen, being able to see the
current action and most importantly, the statistics bar at the top of the screen. Also at the bottom, close to the Pause button is the “current weather” icon, that depicts what is the current weather, so that the player knows what he is up against.

As such, the following items are present in the game’s interface:

Money: Represents the amount of money the player has available to build towers.

Time: Displays how many seconds until the game ends

Life: Shows the remaining life of the player.

M button: Selects a machinegun tower to be deployed.

R button: Selects a rocket tower to be deployed.

S button: Selects a static tower to be deployed.

I button: Selects an interceptor tower to be deployed.

Weather: Depicts the current weather and so, the penalties / bonuses that are to be applied.

Pause button: A button that when pressed, pauses the game and sends the player back to the main menu.

**Menus**

Menus are the game’s means to navigate through the options available for the player to tweak and adjust his game to his liking.

- Main menu
- Settings menu
- Load Game
Art Assets

Overview
Geo Wars uses different types of file formats for multimedia support. For images the supported formats are several, although the preferred one is the 8bits PNG. Due to Direct3D mobile limitations, animated textures were converted from animated gifs to “sprite stripes” PNGs. A sprite stripe is an image where all frames that form a gif are placed next to each other. All textures were also converted to resolutions of the type $2^n \times 2^m$. This is required by Direct3D mobile, since it only operates with textures with dimensions of base 2.

Tower Models
- Machine Gun Tower
- Rocket Tower
• Interceptor Tower

• Passive Tower

**Enemy Models**

• Tank

• Soldier

• Boat

• Aircraft (sprite strip)
Environment Models

- Bag of money

- Player (sprite strip)

- Explosion (sprite strip)

Projectile Models

- Bullet

- Rocket
Sounds and Music

Sound Assets

Overview
The supported audio file format is the .WAV. Different bitrates and frequencies were used.

Sound Effects
- Explosion
Technical Analysis

Experimental Features

Location-Based Services
This game is one of the few that uses the player’s position in the real world not only to generate distinct gaming content (in this case, battlefield maps) but also as a means of input by the player.

Weather Services
The usage of real life weather as a way of affecting the gameplay not only adds to the realism but also to the enrichment of the overall gaming experience. This feature is also highly experimental, as there aren’t many games around that use the real world weather as an element.

Unique Experience
Since the game relies upon location and weather services, the gaming experience is completely unique, not only from player to player, but from game to game. With the added fact that most events in game are random, the uniqueness of each and every game is assured.

Artificial Intelligence
The fact that the AI takes into account each battlefield in their movement options also provides a unique and custom experience. The artificial intelligence is also diverse enough to provide some surprises to the player and to prove to be a real challenge in the game.
Major Development Tasks

Identifying Map components
The development of an algorithm capable of downloading, analyzing and parsing the map downloaded in accordance with the players position allows the game to identify different types of terrain (be it water, parks, buildings and roads) in order to provide a true location based game.

Weather data
Converting latitude and longitude coordinates into the weather of the city and country the player is at was needed to provide the game with an even more unique and personalized experience.

Basic Game Engine
Considering the complexity of this game, it was need to, based on the Direct3D mobile API, to build a minimally functional game engine to provide the very basics of animating a sprite, to support sprite picking, and so on, and to ensure proper memory management of the application.

Risks

Direct3D mobile
Considering that the game uses this API, it means that not only specific graphic drivers are required for this game to be played, the game itself is limited by this API. As such, high resolution textures that
are not of base 2 dimensions cannot be used. The inability of properly using the alpha channel of an image (as for Direct3D the image’s alpha either is opaque or completely transparent) can also limit some of the graphic options. Furthermore, the need of an explicit memory management for textures, sprites and devices imposed by Direct3D also proves to be cumbersome. The lack of capability of correctly instantiating sprites also makes this program somewhat needlessly memory hungry.

**AI**
Being a location based game; each game’s conditions are unique. As such, and since the AI relies heavily upon algorithms such as A* for movement, the AI can be rendered useless or buggy under certain unpredicted conditions.

**Network**
If the player has a slow device or network connection or if the GPS satellite connection is intermittent the game may be rendered unplayable or very buggy. Although some features in the game do try to make the game playable whether there is only GPS or only a data connection available, in some circumstances these solution prove to be worthless.

**Game Balance**
Being a location based game, and as such a unique game is created each time, it is difficult to guarantee proper game balance. A game in some place may be too easy to play, but in some other place it may be nigh impossible to complete.
**Test plan**

After the implementation of this game’s concept, the game is to be published in a mobile developer’s forum in order to gather feedback on both its features and the quality of the implementation of the concept. As such, and after gathering enough feedback, the game’s concept is subject to change as features are added, altered or removed. A gameplay video of the game is also to be uploaded to YouTube, in order to provide users a preview of the game and to serve as a tool to evaluate what are the type of users that are interested in these types of games (as YouTube provides some statistics for this effect). Additionally, the game is to be live field-tested by some testers so as to provide feedback in first hand and to witness usability issues or inconsistencies in the game. All of this feedback will allow to improve the game to fill the needs of the location-based games’ players.