

Pervasive Gaming System with Motion-Sensing Interface for Urban Context: City-Hunters

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ABSTRACT

In this paper, we explore the possibility to use the mobile phone as a platform for pervasive gaming in urban context. The project is a multi-player mobile gaming application that aims to produce an immersive, augmented reality experience through integration of virtual with real world by using a combination of geo-positioning and tilt sensing. Players' actual positions and surroundings are used as the battlefield and the mobile phone as your weapon. The game play directly responds to the player's movement and their surrounding urban context to create a more realistic, physically involving experience.

The objective of the game is to eliminate the opponent by firing and striking them with virtual projectiles by aiming the actual phone at the remote opponent far out of sight. Data collected from the tilt angle and orientation of the phone can be used to calculate a 3D trajectory of the virtual projectile in the real city to determine its effect on the opponent and the city.

Categories and Subject Descriptors

J.7 [Computer Applications]: Computers in Other Systems – Consumer Products

General Terms

Design, Experimentation

Keywords

Mobile Phone, Pervasive Gaming, Augmented Reality, Motion-sensitive Interface

1. CONCEPT

The project aims to achieve seamless integration of the real and the virtual domain by creating a virtual battle field in the real world, supplemented by immersive and intuitive interface to enhance the experience.

We attempt to extend the virtual world of gaming through context-sensitive feedback, which allows players to interact with both the physical and virtual objects within that space. The participants will, between the two of them, experience and share an altered sense of situation, time and place; suddenly a peaceful city becomes a warzone. In this situation, the same physical space is converted into having dual correlations depending on the observer thus in effect, creating a “parallel universe” for the players; the real, peaceful city and a virtual city that is constantly at war.

Also, the need for the players to constantly look up to check their surroundings leads them to become more aware of the existing urban fabric. This will lead to the player making new discoveries or continually rediscover overlooked parts of the city to appreciate it further.

In terms of user interface, instead of pressing buttons while staring into a screen, the game uses the phone and the players themselves as the interfaces. Players will need to physically move considerable distances to control the positions of their characters, and will need to delicately orientate and aim their mobile phones as if they were real cannons.



Figure 1: Shooting over a building

2. BACKGROUND AND INSPIRATION

Computation power and features in mobile phones are advancing rapidly and their “rapidly growing user base, combined with the increasing availability and range of data services on cellular networks, will undoubtedly result in the cellular phone becoming the main computing device.” [1] If mobile phones are set to be the most viable pervasive computing devices, they will certainly be used for entertainment purposes, for pervasive gaming.

Pervasive games provide a new generation of gaming experience that is context-sensitive and actively responds to the physical environment of the players. They use “information and communication technology to overcome the boundaries of conventional games, creating new enhanced gaming environments, making the real environment an intrinsic component of the overall game.”[2]

The idea of using accelerometer as the user interface was inspired by Nintendo Wii console's controller, the “Wiimote,” [3] which resembles a remote and has 3-axis accelerometer and gyroscopes to detect motion. It can be swung like a sword or used as a fishing rod in games which enhances the immersive experience by increasing the player's physical involvement as well as mental.

The game mechanics are based on the classic genre of artillery games where players control pieces of artillery, like cannons, in a 2D terrain. The players take turns at firing cannons at each other and “can only destroy their enemy by correctly determining certain firing parameters which affect the trajectory of their projectiles.” [4] Interestingly, artillery games were an extension of one of the original use of computers; to “calculate the trajectories of rockets and other related military-based calculations.”[5] Therefore our game is true to the roots of its

genre, and is the ultimate simulation; simulating both the projectile trajectory and its effect to your physical context.

3. USER SCENARIO

It is 2pm on a Saturday afternoon at an outdoor cafe when Tom decides to play a game of City-Hunters while having his Cappuccino. Using his mobile phone, he logs on the City-Hunters network and notices his friend Jerry is online and challenges him to play a game of City-Hunters. Jerry, who happened to be walking by few blocks away at the time, is alerted to Tom's challenge then accepts it. After Jerry's acceptance, the screen switches to the main game screen, which provides the players with aerial view of the city with graphical representations of themselves in their current locations. (see figure 2)

At the start of a new game, each player is given 100 hit points which is deducted every time the players are hit by their opponent's projectiles, depending on their proximity from the landing point. Player's own hit points and the opponent's hit points are displayed as bars on the bottom and top of the screen, respectively.



Figure 2: A Typical Game Screen

This game begins with Jerry's turn, where he is given 30 seconds to carry out his firing sequence while Tom awaits. He notes Tom's position in the city by checking the overhead map on the mobile phone screen and points his phone at Tom's direction. Then, trying to avoid hitting a high building in front of him, he decides to set a steep angle at 80 degrees. Finally, he estimates the fire power required to make the projectile land at the desired location and presses the "fire button" on the mobile phone.

The cannon ball's trajectory is animated on the screen, with audio feedback. Jerry's instincts prove reasonably accurate and the cannon fire lands only 10 metres away from Tom, deducting 20 hit points.

When Jerry's firing animation ends, Tom's turn begins, where carries out the same aiming procedures as Jerry to set his direction, angle and power and fires his cannon. Tom's shot is perfectly orchestrated and, in the animation, the cannon ball heads directly towards Jerry. Luckily for Jerry, Tom's firing angle was too low therefore it is blocked by the high building standing in front of Jerry. This demolishes the building in the virtual city, meaning if another shot were to be taken at exactly same position, direction, angle and power, Tom would be able to shoot through the physical building. Although Tom failed to damage Jerry, he is awarded extra points for destroying a high building.

Now Jerry feels much more vulnerable and decides to move away from his position. He hastily runs at another building to take cover and quickly fires a shot at Tom before his 30 second timer is expired. Because Jerry did not have enough time to carefully calculate the angle and power, the cannon ball falls harmlessly in the park, nowhere near Tom.

The exchange of cannon fire continues until one player's hit points fall under zero. When this happens, the game exits to the summary screen which displays the player's career total score and their ranking against all other players who has plays City-Hunters.

4. REALISATION

4.1 The Client

We predicted that technologies like Global Positioning System (GPS) and magnetometer/accelerometers will be relatively common capabilities of mobile phones in the future. Our project uses a relatively high-end phone with Bluetooth, J2ME 1.1 and GPRS data connection capability. External GPS receiver and a 3-axis accelerometer/magnetometer are both connected through Bluetooth connection to add these not yet widely available functionalities to out phone.

The accelerometer is attached to the front of the mobile phone so that they will essentially act as a single, integrated device. A 2-axis magnetometer is included in the accelerometer and is used as a digital compass, providing the physical orientation of the phone, while the 3-axis accelerometer senses the static acceleration due to gravity which can be used to calculate the tilt angle of the phone.

The client mainly works as a terminal for the server and provides a graphical and audio feedback to the user, and is responsible for collecting position and motion data and transferring it to the server. The server takes the major role in of data processing and storage. The client and the server are connected by data connection through Internet (either Wi-Fi or GPRS) with the server always on standby for responding to requests from clients. When a firing event occurs, the client sends the firing parameters to the server, which then responds with the result of the 3D trajectory calculation according to on your firing parameters and the urban context.

4.2 The Server

The information of players and their actions are received by the server and processed then distributed back to the clients. This ensures that the positions, scores and hit points of the clients are synchronized while also allowing extensive databases such as aerial maps and 3D height maps to be stored and processed on the server where storage is not a major concern.

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