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KITSUNE

Design Document

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1. ABSTRACT.

The advent of smartphones has brought us to the threshold of an age of truly ubiquitous computing. As the presence of the digital extends into the earliest and latest hours of our waking lives, we in turn imprint virtual projections of ourselves into innumerable layers of digital spaces: the structured and intentional, like social networking sites or game worlds; and the amorphous and often unintentional, like our Google accounts and the haphazard collection of files on our computer desktops. Mobile technology--including internet connectivity, GPS, compass, and accelerometer--now enables us to inform these digital spaces, and the people and systems to which they connect us, in great detail about our physical presence in the real world.

Using this information, pervasive and location-based games aim to create experiences in which players have parallel presences in both real and virtual environments. The interactions that occur between players on these integrated spatial layers result in a unique experience that is simultaneously public and personal, outdoor and virtual, digital and social.

Within the domain of locative media, the Kitsune project aims to create a gaming experience whose dynamics arise both from the permanent features and changing conditions of the natural world, and from the relationships among people as they traverse physical and digital spaces together. With a parallel virtual world based in Japanese folklore, Kitsune is a location-based game for Android phones which uses relational and absolute positioning to overlay the game world on Atlanta's Piedmont Park. Kitsune stages players as virtual hunters and prey in a game of chase and deception that encourages a new type of imaginative, ludic, and kinesthetic engagement with the physical characteristics and social space of the park.

2. INTRODUCTION.

As sociologist Marc Auge asserts in his discussion of 'non-places', industrialized civilization is in danger of losing its sense of place. Media theorist Joshua Meyrowitz attributes much of this loss to the pervasion of technology. Although we have many digital incarnations, most of those virtual spaces have no regard for the physical, real world presence of the flesh-and-blood human they represent. Our ability to succeed in those virtual arenas rarely depends on the circumstances of our physical surroundings: the kid stuck inside while it's pouring outside isn't even aware of the rain, as the sound and imagery on screen drown out the outside world. The student's mp3-playing phone may pause when she receives a call, but it doesn't stop when a real person three feet away tries to talk to her. The man on the park bench looking for a nearby coffee shop using Google Maps can, simply by brushing a finger over the touchscreen, pass effortlessly in a bird's eye across a vast lake.

Kitsune sees both the natural and built elements that define the physical world -- even those that might be disruptive or irrelevant to the typical digital task -- not as distractions that should be made to withdraw behind technology, not as the drab scaffolding that should remain passive and silent behind the LED stages on which our disembodied digital existences play out, but rather as sources of rich interaction to be embraced, to be made co-participants with technology in exploring new relationships with nature and with other people. That lake, which I may have brushed past in Google maps, becomes in Kitsune both a strategic protection against my pursuers and an expanse of water lapping at the base of a dramatic, arching *torii* gate; the park's wooded areas, a safe haven and a peaceful covert of cherry blossoms; the open field, an expanse through which I'll have to sprint with pumping adrenaline to escape capture from the other players: hunters and samurai.

Kitsune is a humble foray into a new paradigm of location-aware technology. I imagine a world in which technology responds to and recognizes built and natural environmental features in ways that foster relationships with what we as humans care about: those with other people and those with our world. I envision technology whose mode of interaction depends on our own interactions with trees, depends on the presence of lakes and hills and fields, depends on whether a person is far or near from you. My objection to our conventional applications of digital technology is not that we don't take location or physical circumstances into account, nor that we fail to use it to connect socially with

one another or convey engaging and emotionally powerful experiences. As anyone but a Luddite will tell you, technology can and does do both. However, it hasn't been used to address both of these needs at the same time, by means of one another. Location and elements of the "real world" are relegated to tasks of pure utility or "wow factor" and lack emotional resonance, while games, even in the ubiquitous age of the iPhone, are largely unconcerned with the real meat of the physical world and facilitate social relationships based only on polygons and text, and not on breathing physical creatures (with exceptions that will be described later).

Designed with the goal of exploring new game-based relationships with real places and real people, Kitsune is a multiplayer, location-based, outdoor game based on Japanese folklore. Android smartphones are used not only to coordinate the players' geographic positions, but also to add a new layer of a virtual world atop our own. A game of capture, strategy, and evasion, it draws from the wealth of legends surrounding the crafty *kitsune*, wise and cunning fox spirits that are known to interfere mischievously with the lives of mortals, especially overly proud samurai. Cloaked in mystery and reverently portrayed as statues at Shinto shrines for countless generations, the character of the kitsune is woven into the cultural tradition of Japan.

Kitsune's gameplay centers on the character of the eponymous fox spirit. During a sacred wedding of the fox spirits, a drunken *tanuki* (raccoon dog) inadvertently scatters the *hoshi no tama,* or star jewels that embody the kitsune's power, which fall to earth. Game play begins when one of the players touches the first pearl, and he or she is assigned the role of the kitsune: his character is possessed by the fox spirit and suddenly grows a tail. The other players are hunters attempting to capture the kitsune-possessed player and expel the troublesome spirit. When a player is possessed by the fox, his goal is to collect as many of the nine celestial pearls as possible, then transport them safely to the Shrine to Inari. The primary means of catching the kitsune is by casting a net over him. A player may cast a net to another hunter by facing in her direction and gesturing with the phone in a throwing motion; the second hunter may cast it to a third in the same fashion, forming a triangular netted area in which the kitsune may be ensnared. The kitsune, however, is not without powers of deceit and destruction that it can use to defeat its pursuers: as it collects the celestial pearls that are strewn throughout the game world, its player gains the ability to create a double of itself to mislead the hunters, fly around temporarily as a terrible fox spirit, offset its own on-screen location, cast lightning bolts, or disappear entirely from the map while in densely wooded areas.

Piedmont Park serves as the setting for the Kitsune project, and its open spaces with hills and trees, its diversity of terrain, its beautiful and irregularly shaped Lake Clara Meer, and its landmarks lend themselves naturally to a wide-ranging game of strategy and chase. The features and terrain of the game world correspond closely with the real terrain of Piedmont: where an oak stands in the real world, a large bonsai -- rendered in the traditional Japanese ink-and-wash style of *sumi-e* -- appears in the game world; where a bridge crosses Lake Clara Meer, a Japanese moon bridge arcs over the water. Likewise, movement of the game character corresponds with the player's movement through the park.

Kitsune explores the duality of spaces and the duality of game roles: a player navigates simultaneously through the park and through the feudal Japan of legend, and she is at once both a parkgoer and a legendary Japanese hunter. If she is the kitsune, she assumes a third role: that of the wily and powerful fox spirit, equipped with a host of magical abilities to deceive her pursuers, but committed to reaching her destination and escaping capture. Unlike most of our public and outdoor uses of technology, Kitsune's digital and physical experiences are parallel and complementary.

The basic actions of Kitsune -- navigation and coordination to cast the net -- comprise a fundamentally different mode of interaction from the traditional video game. Although gesture-driven input, like Nintendo's Wii-mote, hints at this feeling of agency, actually using one's body to navigate a large outdoor space introduces an entirely new flavor of immersion. One of the three characteristic pleasures of digital media described by Janet Murray, the quality of immersion is often strongest in games with deep, vast worlds that offer the potential for rich, long-term social interaction, like in MMORPG's. But such games lack the the physicial experience, the human encounter, the racing heartbeat, and the palpable, sweat-inducing sunlight. Kitsune is an attempt to explore a new form of immersion that's on the cusp of emerging, thanks to ubiquitous and mobile computing: copresent, parallel immersion, in which we interact on digital and physical levels in harmony rather than contradiction.

3. Existing field

3.1 Location-based and pervasive gaming

Before describing the design process of Kitsune, it is worth examining how the field of location-based gaming (and its overlapping counterparts, pervasive and ubiquitous gaming) has addressed one's relationship with the physical environment thus far. Though still a nascent field, it has been regarded with lofty expectations. In 2007, Jane McGonigal outlined fifteen principles of ubiquitous games, among them the interplay of the virtual and the real, and the ambiguity of their thresholds; the growth and potential enormity of player communities; and the emergence of compelling new relationships among people in public spaces, which she terms "collective magical thinking" (Borries 237).

The most influential pervasive games have used a variety of methods to enable interaction with the physical world, ranging from the cell-phone-assisted gameplay of *PacManhattan*, to the mix of augmented reality and computer play of *Can You See Me Now*. Although the location-based RPG *Mogi* pioneered the pervasive game format on a commercial cell phone carrier, it failed due to prohibitively expensive data plans. Few attempts have been made since to duplicate this effort.

This is unfortunate, as the four years since *Mogi* have marked the arrival of a new generation of handsets--most prominent among them, Apple's iPhone and Android-based handsets like the HTC G1. This generation has introduced a rich palette for interaction design, from the accelerometer and touchscreen to the GPS and compass.

As anyone familiar with the inundating offerings of the iPhone's App Store can attest, developers have used these tools to enhance our interactions with the physical world: fiducial scanning or computer vision-based programs by which to pricecheck or record; GPS tools to find the nearest coffee shop or historical landmark; and casual games that use the proximity of other players to generate gameplay.

Nonetheless, few games currently available for the iPhone or Android platforms have exploited the exciting instruments at their disposal to address the principles addressed by McGonigal, or for their most exciting potential: a redefinition of our relationship with

the physical world.

3.2 Antecedents

Although the history of location-based gaming is short, and that of smartphone-based games is even shorter, a number of antecedents inform our theoretical focus and design decisions.

Two of the earliest pervasive games were Blast Theory's *Can You See Me Now* (CYSMN) and *BotFighters*, both of which staged gameplay in real urban spaces. In CYSMN, players on computers competed in a game of evasion with a team of real world on-foot pursuers. The real world team were able to see the position of the online players by handheld GPS-enabled devices. *BotFighters* was an SMS-based player-vs-player shooter that brought the action of CounterStrike into the real world, adding the suspense of combat to an ordinary setting.

GeoGames used the relational position of players to recreate traditional board or paper-based games like Tic-Tac-Toe. The designers identified a danger common to location-based games: unless short breaks are inserted into the game flow, the experience of devolves into a pure race (Borries 302). *GeoGames* used such pauses to introduce location-specific content, such as information related to a tourist area. Some of the most popular pervasive games involve large scale versions of a traditional scavenger hunt. In geocaching, players can use any GPS device to navigate to the latitude and longitude of a hidden prize, then use the web to communicate their success and mark the location of treasures deposited for other players.

The multiplayer GPS-based RPG *Mogi*, which was launched in Tokyo in 2005, is perhaps the most direct predecessor to this project. *Mogi* allowed interaction through handsets that provided a simple map that served as a radar for spotting nearby players and items. As players navigated through the real world, their avatars moved in parallel in a fictional world whose elements directly corresponded with the real world: for example, if a player entered the real-life Ueno Park, his avatar entered a dense forest. *Mogi* encouraged players to collaborate not only with other mobile users, but also with stationary players playing through its web-based interface.

Kitsune integrates and repurpose elements of each of these games. Like *BotFighters*, it

attempts to bring play into the real world, but it focuses on the mechanics of calculated, strategic coordination of players' relative positions, the navigation throughout the park to collect items, and changing roles. Thus, as in *GeoGames* the players will navigate from one space to the next, often in punctuated bursts of speed, but Kitsune will pace gameplay by incorporating multiple sub-goals and multiple means to capture or deceive one's opponent, so that the experience does not devolve into a series of races.

Like *Mogi*, the game features a fictional map whose features directly correspond with elements of the real world. On this map, players will see their position in relation to other players. *Mogi*, much like geocaching, fostered collaboration in pursuit of items, but this game will demand a closer coordination of efforts: the goal will not simply be collecting items, but rather working as a team to outmaneuver another player.

Kitsune is unique among these antecedents in that it operates on a current generation cellular network and mobile hardware, and it uses not only GPS positioning but also directional bearing. This comparatively granular mode of wide-area interaction will enable more emergent gameplay, as strategies will depend not only on one's coordinates in the eyes of an orbiting satellite, but also on one's direction.

4. DESIGN

4.1 Theoretical parameters

Since its inception, the underlying goal of the Kitsune project has been to explore new ways to establish relationships among people and the worlds they occupy and traverse, by means of the *relational*, social positioning of players in space; and by the *absolute*, persistent, evolving character of the spaces in which play unfolds. These parameters emerged from an understanding of the relationship of the concepts of space and place, as derived from the disciplines of HCI, architecture, philosophy.

Well-designed spaces facilitate social interaction on dynamic, adaptable levels. They allow for diverse positioning among individuals and invite an unpredictable variety of uses. In its social dimension, space may be understood as a stage for relational positioning. This relational positioning will translate into the project's core game mechanics, in the forms of both collaboration and competition.

In addition, well-designed spaces are also characterized by persistence and evolution. Here, persistence does not merely imply that a place will last indefinitely; rather, it suggests that it extends through time by reflecting, absorbing, or evoking memories and sentiments, offering a sacred ring in which something meaningful occurred or may yet occur. Likewise, the trait of evolution represents another facet of the same property, but it suggests that as a space absorbs memories, it also adapts to them and evolves in accordance with use. The dual processes of persisting and evolving contribute to a sense of permanence and stability, the two properties identified by Yi Fu Tuan as being essential to the concept of place. But although Tuan places value on the accretion of subjective experience and the emotional evolution of space, he says little of the role of public spatial affordances in evolving physically—changing in reflection of the lives and desires of its inhabitants. Although societies desire places that reflect and nurture their own evolution, the twin constraints of propriety (inhibitions against social embarassment) and preservation (the condemnation of vandalism) render it difficult to satisfy this need publicly. Instead, fulfillment of this need is often relegated to the home, where we have the freedom to customize (painting walls, decorating), memorialize (photography, mementos), and enshrine (as in many homes in Confucian societies). In modern public places, communal bulletin boards, wishing fountains, Shinto prayer cards, and graffiti speak in various ways to this need, but trees have also long served a

similar function. Their presence is persistent, always contributing sound and shade, but they grow and adapt to the seasons and the passage of time. They are responsive to human life. They can be carved into, pruned, climbed; they can have flowers planted around them, Christmas lights or prayer cards strewn on their branches; they can be tended or neglected; and they can serve as the axes around which rituals are performed.

In contrast to the intimacy of subjective experience, which Tuan argues designers cannot predict or plan for, these repositories of meaning may be intentionally designed. In comparison with the physical built environment, digital media is less vulnerable to the constraints of propriety and preservation. Thus, digital repositories can be designed more readily. In our game, these repositories will embody the absolute, evolving character of place--the striated layer that underlies the smooth relational layer.

4.2 Folklore and corollary game dynamics

The rich folklore of Japan inspires both the subject matter and the game mechanics of Kitsune. Below is a list of the traits of the kitsune that are evident in the game:

Mischievousness. Kitsune have a playful nature, and are eager to fool overly proud samurai. In the game, the kitsune's sudden possession of one of the hunters exhibits his mischievousness. As the kitsune, a player may proceed quickly to his destination, or he may use the various skills and abilities granted by the eight pearls to prolong the fun and tease his pursuers.

Deceit and illusion. Kitsune can deceive mortals by many means, but especially by shapeshifting and illusion. In the game, the kitsune will be able to create an illusory double of itself, and also to offset its on-screen position, temporarily disorienting the other players. However, kitsune have difficulty hiding their tails when they are in human form. The player who is the kitsune is identified by a tail.

Mystique, sacredness, and service to the Shinto god Inari. The kitsune are powerful creatures, reverently portrayed as statues at shrines. In the game, delivering all nine pearls safely at Shrine of Inari is the goal of the kitsune.

Faithful guardians. Those who help the kitsune are faithfully protected and blessed. In the game, collecting and delivering the celestial pearls will result in the good fortune of the kitsune, resulting in the player's rising station in life, from a humble peasant to a samurai.

Number of tails corresponds to age, magical powers, and wisdom (9 maximum): In Japanese folklore, Kitsune with 9 tails are often portrayed as having white or golden fur. In the game, as the kitsune collects pearls and becomes more powerful, his number of tails and fur color will change accordingly.

Inability to hide tail. Japanese lore recounts stories of kitsune possessing humans, but giving away their true by being unable to hide their tail. In the game, the player whose hunter character is possessed by the kitsune will be identified by a tail.

Kitsune-bi. Many legendary kitsune are capable of spewing lightning or fire from their mouths or tales. In the game, collecting blue pearls gives the kitsune character the ability to cause a surge of lightning to strike the ground, and shock those casting nets or reveal hidden hunters.

Hoshi no tama. These star jewels or pearls, which may be carried on the tail or in the mouth of kitsune, may contain the spirit of the kitsune. In Kitsune, the *hoshi no tama* have fallen to the earth during the wedding of a kitsune, scattered accidentally by a drunken *tanuki* (raccoon dog). The game begins when one of the players collects the first pearl.

Kitsune-ken ("fox fist"): A Japanese game based on rock-paper-scissors: "the headman beats the hunter, whom he outranks; the hunter beats the fox, whom he shoots; the fox beats the headman, whom he bewitches"

Other aspects of the kitsune folklore have potential for interesting gameplay, but are currently absent from the game's design, include:

- The kitsune's fear and hatred of dogs, even while in human form.
- The kitsune's tendency to impersonate mysterious women, especially at night.
- The kitsune's unsurpassed wisdom, yet imperfect understanding of human morality. For example, kitsune may reward one reverent family by stealing from another.
- Natural phenomena that signal the presence of kitsunes -- for example, a sunshower is said to accompany the wedding of two kitsune, whose wrath will fall on any uninvited guests to the ceremony.

4.3 Paper Prototype Play-Testing

In addition to my research into Japanese legends, much of the early progression of the design emerged out of play-testing using paper prototypes. With a pizza box and X-acto knife, I created a game board, covered it with grid paper, and colored the areas of the paper according to the terrain of Piedmont Park. I created movable markers for objects that might be seen while in the park (bench, squirrels, etc.), three hunters, the fox, and the goal marker (the kitsune statue).

Although a paper version of a location-based game can only convey so much of the actual experience, I identified a few fundamental gameplay issues based on discussions with the play-testers, which I compiled into the notes below:

> **It's critical that the game play adapt to the circumstances of weather, time, and cell/GPS signal.** Rather than design around the inconveniences of mobile technology, the game should embrace them as integral mechanics of the game. If it rains, the game play adapts. If the GPS signal evaporates, the hunters instead rely on manual, old-school, map-based navigation. Because the game is based loosely on the metaphor of the fox hunt, it might be appropriate to acknowledge the role of natural intervention, which sometimes favors the hunters, sometimes the fox.
>
> **The hunters must always have some sort of reference point to guess at the kitsune's location**–even if that reference point is tenuous or altogether wrong. If a hunter doesn't know who the kitsune is (because

he didn't see who was picked as the kitsune at the beginning of the game), or where he is (because the kitsune's position is offset), then the player has no basis for choosing which direction to set off in–and will probably just stand there, confused.

So we thought of two possibilities. The first idea is that because the kitsune uses the special power of the gorinto markers to offset his own location displayed on the hunters' phones, the hunters should see some indication that the displayed fox is in fact "fake." So the fake fox should appear translucent, like a ghost. The hunters still won't know exactly where the real fox is, but they'll have a reasonable reference point and will be able to approach the hunt with more confidence. (The original idea consisted of simply offsetting the fox's displayed position, without any indication to the hunters that the displayed fox's location was wrong and was intended to mislead them.)

The other possibility is that instead of his position being simply offset, the kitsune instead will spawn two or three doppelgangers: fake foxes that set off in separate directions to mislead the hunters. In this case, the hunters will still have a strong reference point: they'll see multiple foxes appear, which isn't normally possible, and they'll know only one is the real fox.

The game should be paced according to 1) reasonable expectations for cell phone usage and 2) the typical pace at which a person might enjoy a public park. In my initial stab at game rules, it was conceivable that a game could reach a point of stalemate. So to keep up the pace, it will be important to make the kitsune's destination change every few minutes. If reaching a certain goal seems impossible, and capturing the fox seems equally impossible, then the goal will suddenly move to another location of the park, and the hunt will be "refreshed."

The other method for keeping a lively pace will be to encourage a regular stream of clues from the kitsune. These clues can be either photographs or audio recordings. The kitsune will have motivation to do this because each clue will grant him an additional minute on the

timer. He will have to reach his destination before the timer runs out, but he has the ability to extend the timer by putting himself at greater risk of being discovered.

To prevent a hunter from simply trailing on the heals of the kitsune for the whole game, there should be virtual barriers. This dynamic is intrinsic to the idea of the *foxhole* — areas that the fox can jump into to evade the immediate danger, but at risk of being cornered or surrounded. To account for the possibility that a hunter with Olympian sprinting prowess is breathing down the kitsune's neck the entire game, it will be important that certain areas be off-limits to the hunters- for example, the heavily wooded areas ("forests"). If the hunter encroaches into this space, he may be disqualified from the game. Likewise, the hunters should also be able to construct barriers which the kitsune must circumvent. They will be able not only to capture the kitsune with the three-person (triangular) net; they can also block his or her progress by casting a two-person (i.e., linear) net which will remain in that position for the duration of the game.

Thinking about tying the game experience with nature, and of being true to the fox hunt, has also brought to my attention the need to do deeper research on the folklore behind the kitsune. I am deeply interested in making the spirit of this "kitsune" character as alive and palpable, and as true to its forebear in Japanese lore, as possible.

The main refinements that emerged from this initial play-testing include the presence of multiple scattered destinations (pearls) to make the game's flow more dynamic and unpredictable, and the inclusion of references points designed to inform the player when the kitsune is trying to deceive him. Features that I envision appearing in a future, much refined incarnation of the prototype include the presence of barriers by means of different map terrain, and game conditions that respond to the weather (such as the rice paddies flooding, and becoming uncrossable to all but the flying kitsune, when it's raining).

4.4 Application screens

On opening Kitsune, the game client will check in with the server and if necessary download any missing graphics assets to the SD card (Figure 1). Although developers of smaller Android apps typically bundle their assets with the application itself to be stored on the device's ROM, Kitsune's relatively high requirements necessitated a workaround that makes use of the SD card, which offers a much higher capacity than the ROM.

Figure 1.

Figure 2.

After the assets have finished loading, the user sees the main log-in screen of Kitsune (Figure 2). If he's already logged in from a previous session, he will be able to click the "Play" button; otherwise, he'll need to log in first by clicking the "CLICK HERE TO LOG IN" text at the bottom of the screen.

Clicking the text will open the log-in screen (figure 3), prompting the user for her username and password, or giving the option (at the bottom of the screen) to register a

new account. After filling out the text boxes and clicking "log in," the client will verify the credentials with the game server. If the username exists and the password was entered correctly, it will sign her in (figure 4). As long as the password doesn't change on the server's database, she will remain signed in unless the user manually chooses a different account.

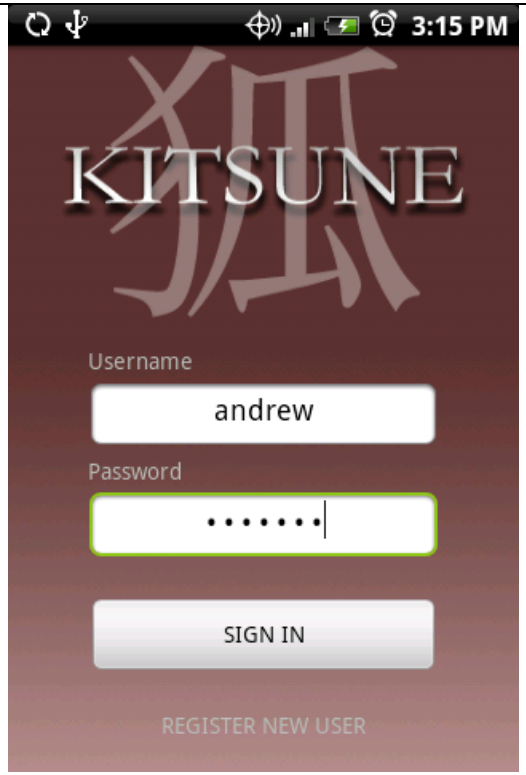

Figure 3.

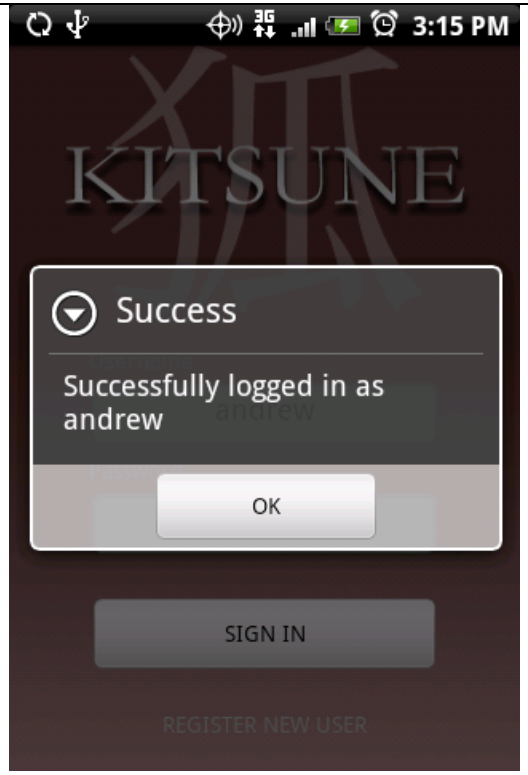

Figure 4.

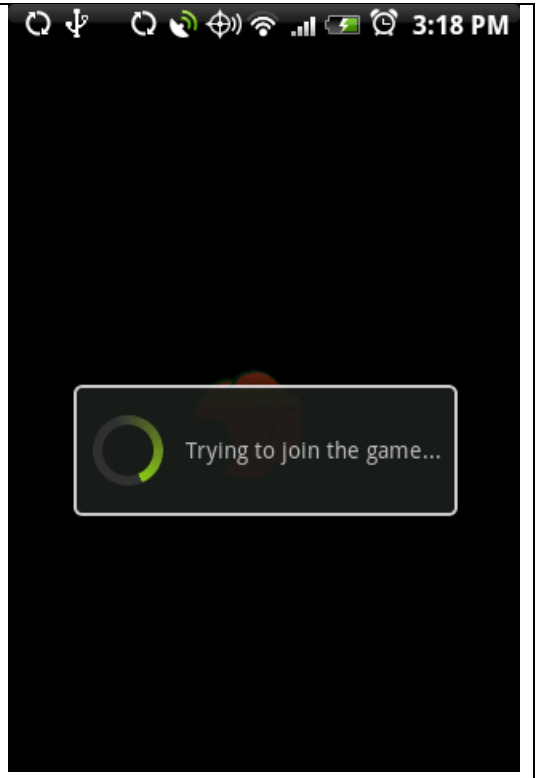

Figure 5.

After signing in, the player will return to the main screen, and the "Play" button will be enabled. Upon clicking this button, the game will begin, and her character will be placed in the game world. The game will present a notification that it's trying to log in (figure 5); as soon as the application has successfully set the player's status to "active" on the game server, game play can begin. On exiting this screen, the player's status will be set to "inactive" on the server, and her player will disappear from the screens of other active players.

4.5 Game rules, mechanics, and objectives

Players see the game world from a bird's eye view, always centered on where their character is (unless that player is controlling the flying fox spirit). They can see other players on screen if they are in range of the viewport; and they can determine the direction and proximity of off-screen players by means of indicator dots at the edges of the screen. Green indicator dots represent hunters (figure 6), and a red indicator dot represents the kitsune. Indicator dots also display the distance of the object or player, measured in meters.

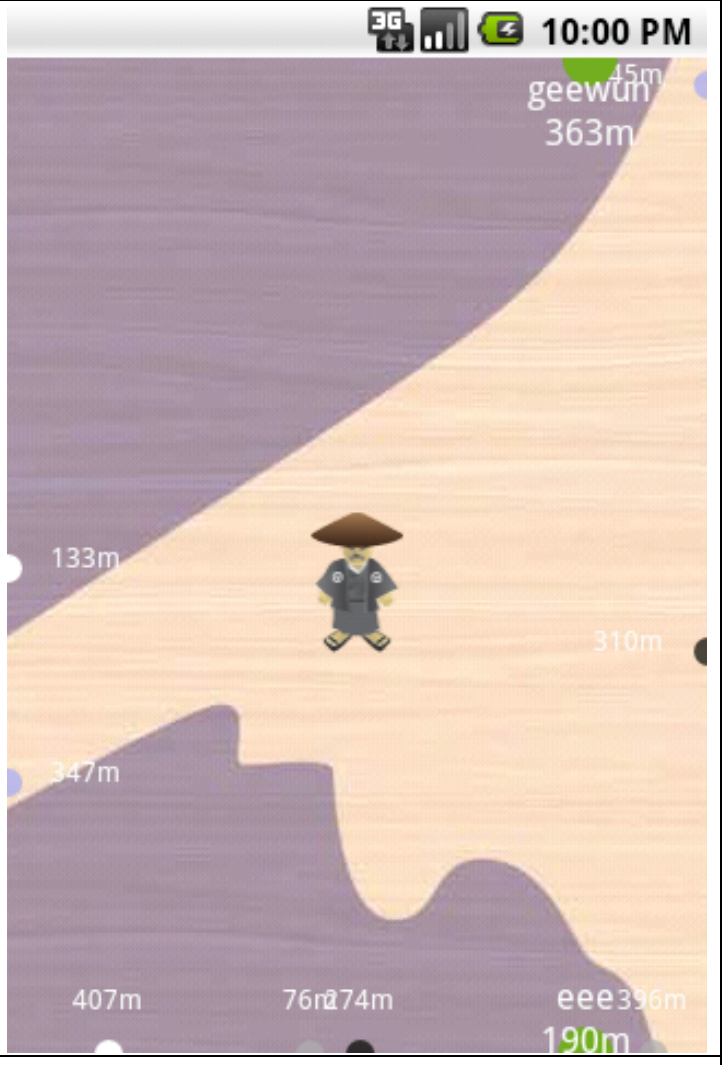

Figure 6. The indicator of a hunter to the northeast of the Kitsune, out of range of the viewport. *(The fox icon is a placeholder for the graphic of a hunter with a fox tail.)*

Play begins when at least four players activate the game on their phones within the boundaries of Piedmont Park. As the game begins, nine *hoshi no tama* (celestial pearls) fall to the earth and appear on the game map (figure 9).

The first player to touch a pearl by walking to its location in the real world is possessed by the fox spirit. As the kitsune, his goal is to collect the remaining pearls and return them to the Shrine to Inari without being caught by the other players. The other players—the "hunters"—must work together to capture the kitsune before he reaches his goal.

The hunters have various means to capture the kitsune, and the kitsune has a variety of magical powers with which to frustrate their efforts.

Hunters have the ability to cast a net to each other. A hunter casts a virtual ray by pointing his phone in the direction of a fellow hunter and pressing the phone's touchscreen (Figure 7). When the three hunters have cast rays in one another's direction, they form a triangular net (Figure 8).

The strength of the net depends on the hunters' proximity to one another. If the players are far apart -- more than 100 feet, for example -- the net is tenous, and they must keep the kitsune under the net for a very long period of time to catch him. If the players are close to one another, they have a better hold on the net and only have to keep the kitsune trapped under the net for a brief amount of time.

Hunters also have the ability to collect the pearls preemptively to prevent the kitsune from growing in power. They may lie in wait in certain areas. If they stand in a wooded area on the game map and keep the phone motionless for at least 10 seconds (as detected by the accelerometer), they will be undetectable by the kitsune until they move the phone or cast a net, or until the kitsune player spots them in real life. While they are lying in wait, the indicator on the kitsune's screen becomes a gray question mark, but the player's character itself will not be visible even if he is within the viewport.

The player who touches the first pearl becomes possessed by the kitsune, and gains his first ability: the ability to fly in the form of a mighty, dragonlike fox spirit (figure 10) throughout the game map, temporarily independent of the player's position in the

physical world. But because his powers are weak from the loss of his hoshi no tama, he is only able to remain in this world in this form for a brief amount of time. The kitsune player may activate flying fox mode by double-tapping his character.

While in flying fox mode, the kitsune player has the opportunity to scout for nearby hunters and pearls. He can also try to free himself from the net by flying directly over one of the hunters holding the net, causing a terrible gust of wind and causing the hunter to lose his grasp of the net.

While controlling the flying fox in this mode, the kitsune player will slowly see the flying fox fading away. When his spirit has nearly disappeared, the kitsune will possess the body of the closest hunter to remain in this world. If the kitsune player is currently hovering near the character of another player when he fades, that player will become the kitsune; and the previous kitsune player will assume the role of a hunter.

The remaining eight pearls grant the following abilities:

- The two remaining white pearls increase the amount of time during which the player can fly around as the fox spirit.

- Silver pearls (figure 9) grant the ability to disappear completely from the screen for a brief period of time, even while moving. The first silver pearl enables this power, and the second increases the amount of time during which the kitsune can remain invisible. The kitsune may succeed in reaching his goal by using these brief periods of invisibility strategically (for example, when standing in a crowd of bystanders), possibly choosing to set off in a different direction in order to mislead his pursuers. The kitsune may go invisible by pressing and holding the touchscreen over his character.

- Black pearls grant the kitsune the ability to create a double of himself. The first black pearl gives this ability, and the two successive black pearls increase the amount of time during which the double will last. The kitsune gains the ability to create an illusory double of itself. The player presses and holds the touchscreen anywhere on the visible map to choose where to spawn the doppelganger. When it appears, it moves in the opposite direction of himself. Although the false kitsune appears on the screen as a second red indicator while off screen, players

may see through the illusion when it appears in the viewport, because the player will have a black tail and will slowly be fading away.

- Blue pearls grant the kitsune the ability to cast lightning bolts upon nearby players, causing their net to break and their phone to vibrate, and temporarily revealing any hidden hunters nearby. Lightning may be cast by double-tapping anywhere outside of the screen, while not in flying fox mode.

On arriving at the Shrine of Inari (on the bridge crossing Lake Clara Meer) and pressing and holding the touchscreen atop the fox statue, the kitsune spirit will depart the player's body and disappear. The kitsune has succeeded, and in turn he blesses the hunter that helped him; that player's avatar will now represent his good fortune, as the humble hunter becomes a samurai (figure 11).

Figure 7. Player 1 casts net to player 2.

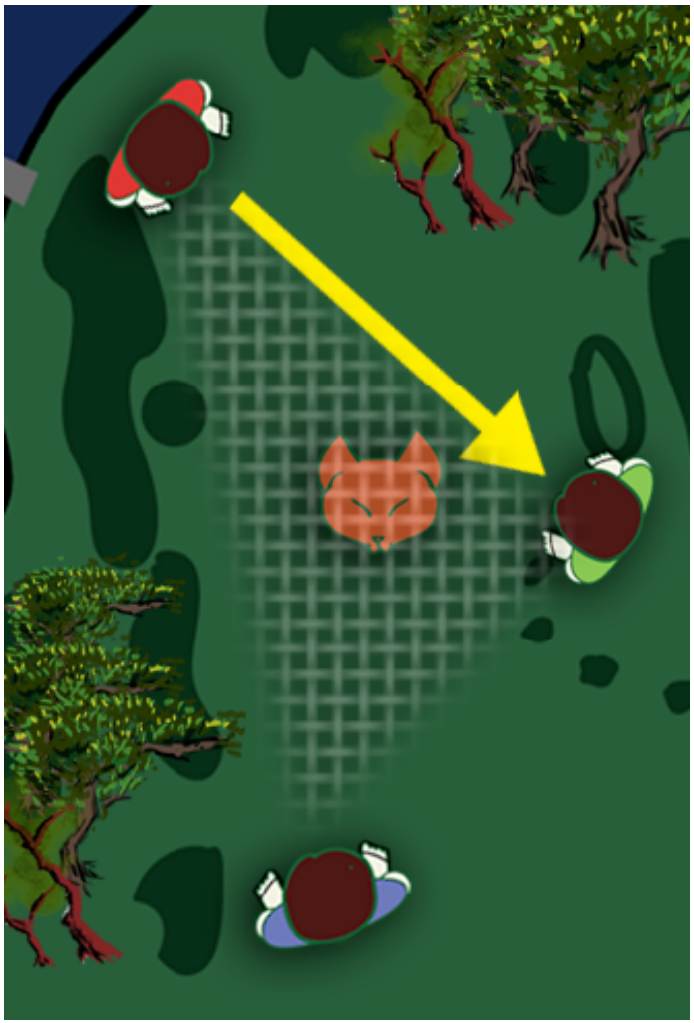

Figure 8. Player 2 casts net to player 3, forming a triangular area around the kitsune.

			
Figure 9. A white *hoshi no tama*, or celestial pearl. This pearl grants the kitsune player the ability to fly freely for a limited period of time as the fox spirit.	Figure 10. The flying fox spirit. Having collected a white pearl, the kitsune player can temporarily fly around and disrupt the casting of nets.	Figure 11. Players who succeed in obtaining all the pearls and returning the kitsune successfully to the shrine are rewarded permanently with a samurai avatar.	Figure 12. A compass that overlays the screen to provide directional orientation.

	
Figure 12. Satellite view of piedmont (scaled down from 10000x10000 pixels)	Figure 13. Scaled to 8000x6400 pixels in game.

5. IMPLEMENTATION.

5.1 Technical Architecture

In addition to the mobile internet connectivity and GPS provided by cellular carriers, the technical architecture of Kitsune depends on two components: the Android application, written in Java and targeted at a minimum SDK level of 3 (i.e., Android OS 1.5, "Cupcake" or higher); and the game server, a Linux virtual machine running Apache, MySQL, and PHP (see figure 14).

Despite the astonishing processing power crammed into the small Android handsets, Kitsune's many processes push the devices to their limits in terms of computation and battery life.

Although I can't address the issue of battery life through code without reducing the frequency of requests to the GPS receiver, I have optimized the performance of the game by means of extensive multi-threading. The graphics renderer, user interface, server communicator, background bitmap loader, physics updater, and event announcer all reside in separate threads.

The game's most important PHP script, `game_data_update.php`, serves as the central, synchronizing link among each player's phone. Every 2 seconds, each client queries the server by means of this script, which returns data in the form of XML. After receiving this data, the server communicator thread parses the document to determine what changes need to be made to the state of the game and to the position and status of players and items. However, collision detections and tweening are performed at the level of the client application, as both must be evaluated instantaneously for smooth animations.

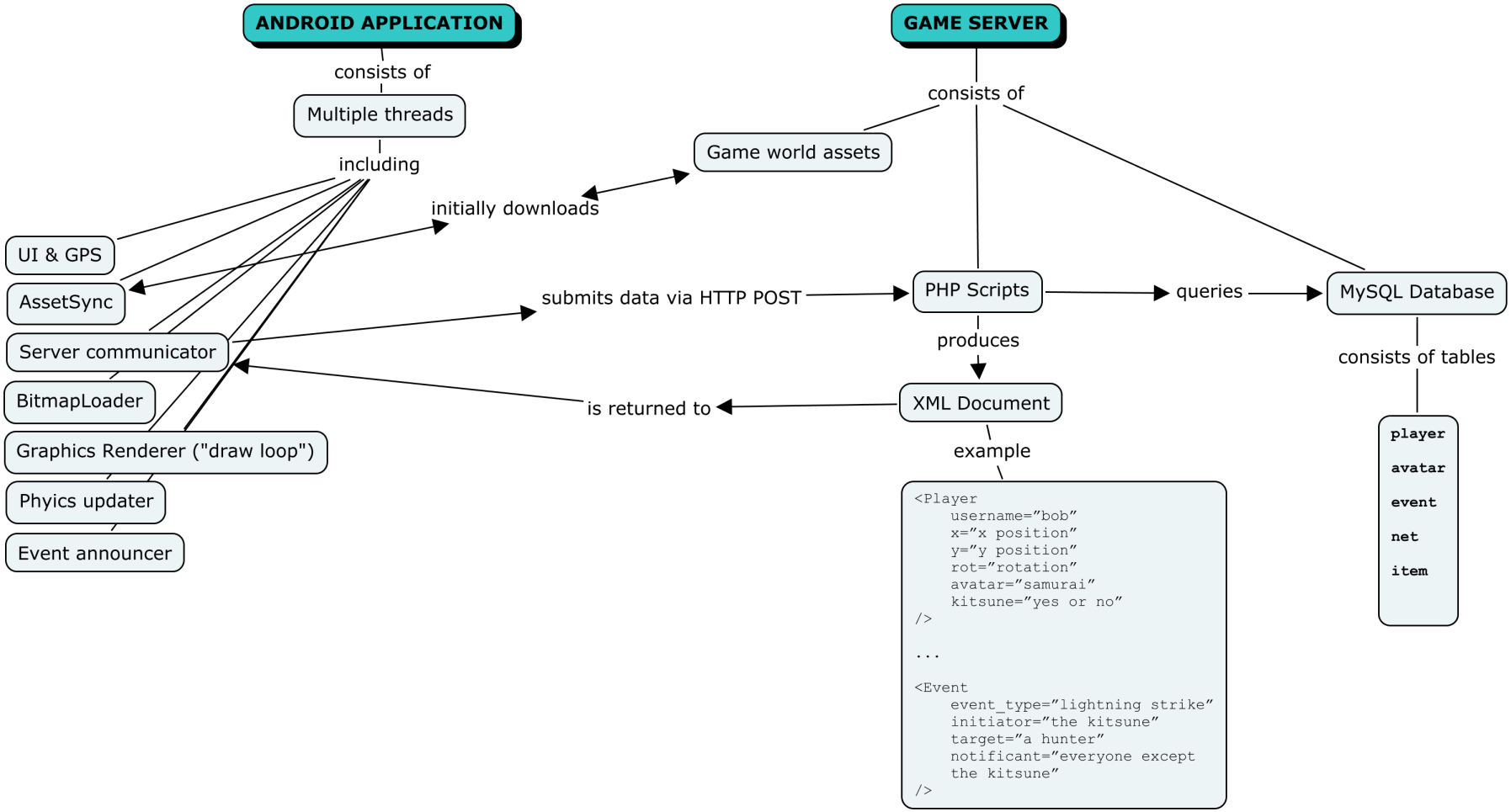

Figure 14. The technical architecture of Kitsune.

5.2 Testing of Game Mechanics

During an on-site test of the GPS and net-casting, the overcast drizzly weather fortunately didn't result in diminished GPS accuracy, which remained at between 6 and 10 meters. Nonetheless, graceful treatment of potentially poor GPS conditions remains a challenge yet to be addressed.

The three photos and screenshot below were taken during this test. I tested the casting of the net and GPS positioning on three different Android phones (HTC Dream / G1, HTC Droid Eris, and Motorola Droid).

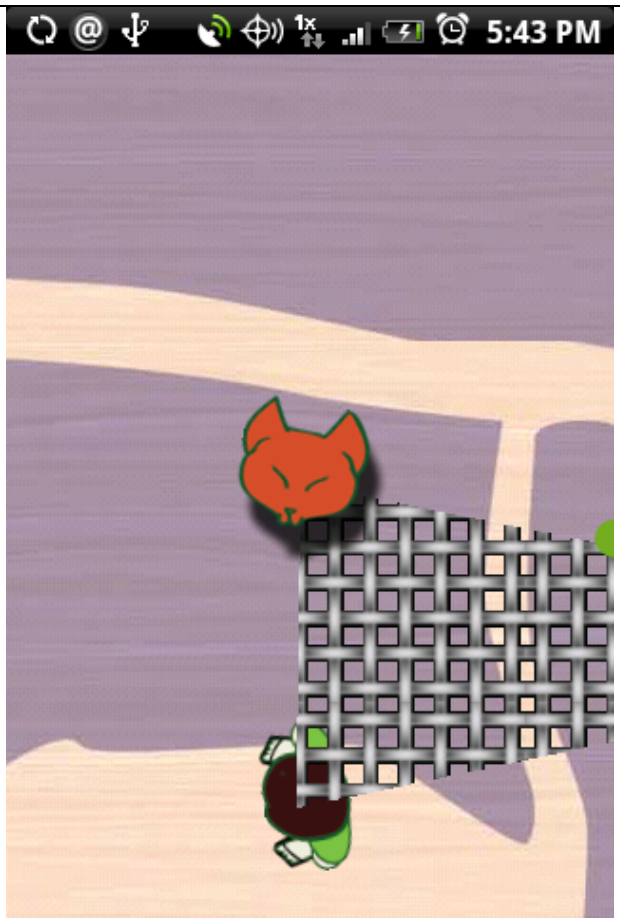

Figure 15. Net casting.

This screenshot was taken during an on-site test of casting the net among three players. At the bottom of the screen is Player 1 (myself), in the parking lot behind Willie's Mexicana Grill on Piedmont Ave. The parking lot and paths are defined by the tan area. As we moved around the park, the net stretched accordingly.

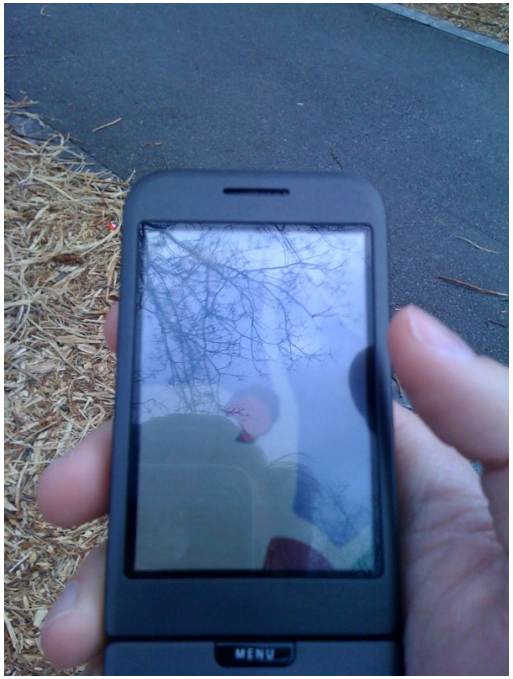		
Figure 16. These photos show the phone, which positioned me on the map accurately according to what area of the park I was in.	Figure 17. Path and patch of grass corresponding with terrain and shapes in game world.	Figure 18. Lake Clara Meer and the crescent dock on its western side.

5.3 Live Play-Test

After implementing the kitsune powers and refining the net-casting, I conducted a live play-test with five participants. It was a sunny day, the GPS signal was optimal, and we played several rounds of the game successfully.

We identified several challenges and shortcomings of the prototype; the most glaring of these:

- The bright sunlight, and the constant movement required by the game play, makes it difficult to tell what's going on. Therefore a stream of haptic feedback from a vibrating phone, as well as a variety of easily understood audio cues, will be crucial to keeping the players informed about what's happening in the game world.
- Constantly using the GPS radio drains the battery too fast to be able to play more than a few rounds of the game without the phones dying. Even though all the phones were fully charged before the day of the play test, each came close to dying after about two hours of total play time.

I issued a questionnaire to each of the participants, with the following questions:

1) Is the game fun? Why or why not?

In response to this question, all play-testers indicated that while playing Kitsune, they explored parts of the park with which they were previously unfamiliar: large sections of Piedmont like the picnic and grilling area east of the lake, but also small inconspicuous spots like a ring of bushes and flowers where a pearl is housed.

Excerpts from the responses to this question:

> *"[Kitsune] hearkens back to the childhood fun of hide and seek. I found myself laughing and gasping for breath in the very same way when I reached a pearl after a headlong sprint. It's fun because you play face-to-face, toe-to-toe with friends! Not their avatars, not their keyboard and mouse, but with *them*"*

"It's like hide-and-seek for grown ups, with more strategy and without the shame!"

2) Is the game balanced?

One respondent noted that the game was imbalanced in favor of the hunters, perhaps an inherent fact of any real-world game of one against many. The respondent also noted, however, that the conditions of the park -- for example, crowds during a festival or special event -- might tilt the odds in favor of the fox.

Another respondent noted that giving power-ups only to the kitsune evens the field, as the kitsune faces three opponents at once. However, others suggested adding power-ups for the hunters, adding alternative ways to catch the fox, and limiting the range and life of the nets.

3) Describe the experience and whether it's different from the normal experience of the park.

Each play-tester reported a greater willingness to do things and go places they might not otherwise. One noted that this boldness wasn't necessarily a result of role-playing, but rather of the excitement of the game: "*trying to capture a fox leads me to run through crowds in front of speeding bicycles! And trying to snag pearls leads me to sneak around and explore physical locations I might not have been drawn to without the game leading me on.*"

Another tester mentioned having gained a better awareness of the layout and terrain of the park. Others commented on the game's inevitable side effect of sunburn, and its potential, unusual among video games, to be played with one's dog.

Seeing us running around with our phones apparently in search of something (the pearls), one bystander asked what we were doing, and the tester explained the game.

More granular and prolonged play-testing will be necessary to hone game mechanics like the kitsune powers and the exact placement of the pearls.

The response of play-testers suggests that even before final refinements have been made to the game, Kitsune conveys an experience that is fundamentally different from the conventional visit to a park. It conveys many of those qualities described by Jane McGonigal as being essential to ubiquitous gaming, particularly the engagement with other people in public places, and a playful spirit of "collective magical thinking."

Moreover, Kitsune appends a new set of characteristics to McGonigal's list. It serves not as a simple catalyst for live-action role-play, but rather as a means to experience parallel copresence, the sense of inhabiting both a real space and its fictional counterpart in near real time. This sense of copresence is a phenomenon not only of the imagination but also of the body, requiring players to sprint, to hurdle, to sweat, to balance their phone, to hide behind trees or bushes, or to gesture in a net-casting motion, performing these actions in conjunction with one's game character. The imaginative, social, spatial, and kinesthetic qualities of Kitsune suggest that ubiquitous gaming can establish a direct relationship with one's avatar, with other people, and with the real physical environment.

6. DELIVERABLES

On April 22, 2010, I will submit the following deliverables to my committee:

- A PHP/MySQL webserver that handles communication among the players.
- A functioning prototype of the Android game client, tested in Android 1.5, 1.6, and 2.0.1 on three different device types, that properly displays the position and orientation of each player on the map. With a decent GPS signal in Piedmont Park, the map corresponds properly with the player's physical location.
- An infrastructure for synchronizing game world assets with the authoritative assets on the server.
- The ability to display players (and when out of the viewport, their peripheral indicators) on screen.
- The ability to cast a net from one player to another, forming an initial net line; the ability of the second player to receive this net and cast the net to the third player; the ability of the third player to receive the net, forming a triangular area;

and the ability of each player to receive updates from the server about the status and position of the net.
- The ability to detect collision between objects, including whether the kitsune is currently within the boundaries of the triangular net.
- The ability of the kitsune player to enter "flying fox mode" and navigate freely around the screen until the flying fox fades out, after collecting a white pearl.
- The kitsune's ability to disappear after collecting a silver pearl
- The kitsune's ability to create an illusory double of itself, after collecting a black pearl.
- The kitsune's ability to create bolts of lightning, after collecting a blue pearl.
- Graphics for the hunters; flying fox spirit; samurai; pearls; trees; kitsune; and the game world containing accurate shapes and outlines of the terrain, lake, and paths of Piedmont Park, created by tracing high resolution satellite imagery of the park and calibrating the X and Y coordinates of the gamespace to the latitudinal and longitudinal boundaries of the park.

Additional features that I envision for Kitsune, but whose implementation is likely beyond the scope of this project, include:

- Actually requiring hunters to face one another and gesture with the phone (as detected by the accelerometer) in order to cast the net successfully. (The current implementation imposes less stringent requirements on a hunter: she simply presses and holds the touchscreen, and a net is then cast to the closest hunter regardless of their orientation to each other).
- Weather-based game dynamics (if it's raining, the rice paddies flood, so a hunter won't be able to follow beyond a certain point).
- The ability to "lose one's avatar" (as in the case of a flooded rice paddy, a player can lose his avatar by venturing somewhere that the game character won't follow; the player is then forced to return to his avatar to retrieve him).
- The ability to contribute user-generated content to the game world.

7. CONCLUSION.

Kitsune actively engages the question of how best to integrate parallel experiences in real and virtual worlds, encouraging a new and closer type of relationship with other players and with the natural world while satisfying our desire for digital immersion.

The responses to the play test suggest that despite the imperfections of the prototype, Kitsune truly does catalyze a unique social, visual, and kinesthetic engagement with the physical environment. Though it certainly falls short of being the defining paragon for the future of locative gaming, it is my hope that the failures and successes of the Kitsune prototype and the methodology of its creation will be of use to digital designers; that the preservation of our bond with the physical world is not forgotten from their agenda; and that in spite of its disruptive intrusion into the physical world, digital media is also used for its very real potential to nurture new roots that put our bodies in the sunshine, and our feet on the earth.

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