Location-Based Mobile Games

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ABSTRACT
In this paper we describe three implementations of location-based games to be played in large city areas. *Can You See Me Now?* is based on a tag game between online users and 'runners' within the city. *FIASCO* is a game where players perform actions on street corners and document the actions online to interact with other players. *Feeding Yoshi* is an interactive game involving trade and communication with other players. Through this paper, we examine the qualities of the three implementations and discuss the advantages and disadvantages of mobile gaming.

Author Keywords
Online players, GPS, WiFi, mobile devices, location-based play.

ACM Classification Keywords
H.5.3 Group and Organization Interfaces: Organizational design.

INTRODUCTION
Online, collaborative games have gained foothold in mainstream gaming, reducing the status of these games from a novelty to a more common implementation. In introducing such games to the population, constant research has been conducted to make games more engrossing and more interactive. A novel approach to increasing interactivity with these games has been to allow online, computer gamers to interact with players that are not sitting at a computer or terminal. Location-based games are a type of game that allows a player to interact with someone at a computer while they are moving or in a location where it would be difficult to use a full sized computer. One such game, *Can You See Me Now?* (CYSMN), as constructed by S. Benford et al., uses location to have computer players interact with players located around a city [1]. Through development of this interactive game, Benford et al. use the game to study the way players collaborate to accomplish their prescribed tasks and how current technologies impact the way players will perform tasks on location. *FIASCO*, as constructed by M. Chang et al., uses location to have players claim street corners within the city. This interactive game is designed to promote creativity and encourage people to explore different locations [2]. *Feeding Yoshi*, as constructed by M. Bell et al., uses location to create virtual areas where players can interact and gather items. This application was constructed to promote exploration and

teamwork [3].

CYSMN BACKGROUND
CYSMN is an interactive game of tag or catch that is played between individuals sitting at a computer and actual people designated as 'runners' that are scattered throughout a particular location. The location that the runners are traveling in is mirrored on the computer display for those at terminals or computers; thus, the two groups have the ability to play and interact together simultaneously. The objective of the game is for the runners to locate and tag the online virtual players and for the online players to avoid being detected by the runners. In order to complete such tasks, Benford et al. equipped the runners with a jacket system containing an HP Jornada handheld computer that is connected to a wireless network connection through WiFi and a GPS receiver. Online users could be located within the city that the game was conducted in or could be remote users; however, the amount of online players allowed in the game with the runners was limited to fifteen to reduce internet congestion.

Online users playing the game viewed all playing the game as running avatars once they had loaded the preset map. This map replicated the city the runners were in to reduce inconsistencies in avatar locations with avatars in buildings or in water not accessible to runners. Runners viewed the GPS screen that allowed them to track their position and the position of all other players in the game within their vicinity. Runners were equipped with walkie-talkie communication systems to allow them to communicate with one another and relay messages to the technical staff available to assist runners when needed. Online users had the use of text messaging and they could also hear the radio transmissions made by the runners fused into a single audio stream.

CYSMN Research Purpose
In conducting this evaluation, Benford et al. had two goals to accomplish:

- Explore a new artistic form of gaming that could show how future gaming may take place

- Evaluate location-based technology uses in a large scale setting rather than in a closed environment of a classroom or laboratory

CYSMN has been a working project for four years and
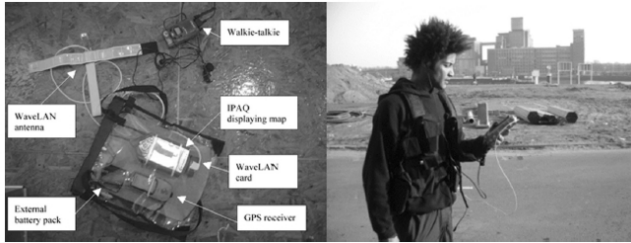
Figure 1: Equipment (left) and runner (right) that participated in CYSMN

Benford et al. use this project to draw on conclusions that can be helpful in evaluating how to deal with location-based games and ideas on the way in which they should be developed.

CYSMN Equipment Setup

Each of the runners was equipped with a jacket holding the GPS and the WiFi transmitter. Figure 1 shows the layout of the contents of the jacket and a runner with the jacket on. The online player's view of the game is indicated within Figure 2. For the online player, all players appear as running avatars. The view of the game is limited for the online player to an overview shot allowing the player a limited view of the locations of players. Only when the player has stopped to type in text does the screen zoom in to only show the chosen avatar. However, as the HP computers carried by the runners have a smaller screen and the runners have to travel the distance shown in the map, the Jornada map has the ability to do close-ups as well as show the overall global map. The Jornada interface shows the map along with the error associated with the GPS receiver, the strength of the connection to the network, and the number of players currently online. Runners have walkie-talkies that they can use to communicate with one another and a separate channel used to contact the technicians, which is not heard by other players.

WiFi connection was setup in the location where the runners were located and the GPS was initialized to connect to the satellites that were the closest, to limit interference.

CYSMN EXPERIMENTAL DESIGN

CYSMN was evaluated through the use of an ethnographic study that was based around two events that were held in Sheffield, UK and Rotterdam, NL. By undertaking an ethnographic study, the effectiveness of the game was analyzed through monitoring human interactions. Actions taken by the runners, service technicians, and the online players were primarily studied. Logs were taken of the conversations that the runners had between one another and the technicians, as well as the text sent between the computer players that were trying to survive. An issue that Benford et al. had with the study of the online players was that players could be playing from anywhere; hence, they
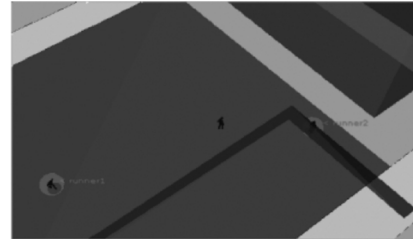
Figure 2: Screenshot of CYSMN as seen by an online player. Each player is represented with an avatar.

were not accessible. To act as a representative of those that were playing online, a computer station was set up within the city that the game was being played in so that they were able to obtain video footage of actual game play. Furthermore, logs of the positions of all of the players, the status of each player, and the state of each of the runners' connections to the WiFi and GPS networks were collected and analyzed.

CYSMN RESULTS AND DISCUSSION

Benford et al. claim that evidence that the initial goal set to create a game system that could be representative of future games is provided by the award of the 2003 Prix Ars Electronica Golden Nica for Interactive Art.

An important issue that arose with their studying of CYSMN was the emergence of uncertainty with the runner equipment. It was found that uncertainties occurred with both the GPS and the WiFi networks. Logs indicated that 90.6% of the WiFi loss intervals were communication errors that lasted between 5 seconds and 10 minutes. These errors generally resulted from the runner moving to an area out of connectivity range. GPS error provided by the GPS receivers ranged from 4m to 106m. GPS receivers were set up to work with satellites that were above 15 degrees in the sky; however, setting the receivers up this way resulted in it taking a longer time to get an initial GPS reading. Blackspots where either of the networks was not functioning could occur at different locations as a runner could have connection to a WiFi point but have no GPS reading, especially between tall buildings.

Hence, the runners can be found in one of four states: connected and tracked, not connected but tracked, connected but not tracked, and neither connected nor tracked. In order for a runner to be both connected and tracked, the runner needs to have both WiFi and GPS connections. If the runner does not have WiFi connection, the runner can still receive GPS data. Hence, the runner cannot relay a message to the other runners of the location of the runner; thus, the runner is tracked but not connected. To be connected but not tracked, the runner can relay messages to where it is located but cannot view its location or the location of other players. Without WiFi and GPS, the runner cannot play the game and must either move to a location where both signals can be found or contact the

technicians for support.

Through both game sessions, Benford et al. found that runners that lost either GPS or WiFi connection would retrace their steps to locate a place where connection was last stabile or contact a technician for assistance. Online gamers would be impacted by the connection uncertainties as runners would disappear off of the map due to connection failure. Also, the runner could reappear and catch the online player without warning as the proximity between the two players was smaller than the threshold set for maximum distance between the players before the online player has been 'seen' by the runner.

CYSMN EVALUATION
From the analysis of CYSMN, Benford et al. have indicated that there are strategies that should be taken by the developers of location-based games. These strategies are based upon reducing the uncertainties that can occur with the group that is at the physical location, such as with the runners. Five strategies are presented to deal with the uncertainties:

- Remove uncertainties by increasing advancements in technology

- Hide the uncertainties from certain players to increase credibility of the game. An example of this would be the masking of the uncertainties from the online players

- Reveal the uncertainties to certain participants that are directly impacted by the uncertainties

- Manage the uncertainties by providing a secondary strategy that will be implemented when the uncertainty occurs, such as a separate way for internet connectivity

- Exploit the uncertainties by requiring that players interact with the uncertainty in the proper manner, such as not entering a zone that does not have connectivity.

FIASCO BACKGROUND
FIASCO, designed by Michele Chang and Elizabeth Goodman, is a game for playing in a large city by many unfamiliar people, involving both physical and internet activity. The game is designed to promote creativity and spontaneity in the lives of people who are trapped within the confines of boring capitalism. As a research tool, Chang and Goodman state that FIASCO "highlights relationships amongst a critical mass of players in order to understand the pressures that a game system exerts on the real world and vice versa."

FIASCO How to Play
The object of FIASCO is to claim street corners as one's own turf. A player can claim a street corner by performing actions, or "stunts," and photographing them for evidence. The photographs are uploaded to the FIASCO website and associated with the street corner at which they took place. Other players rate the photographs, and the highest rated stunt for a particular street corner wins that location – until someone else's stunt at the same location is rated higher. Stunts are based on three elements, called an object, an action, and a theme. An object is an item in the city, such as a street sign or a coffee cup; an action is some creative response to the situation performed by a player; a theme is some concept related to the situation, such as "happy hour." For FIASCO, Chang and Goodman recorded objects, actions, and themes, which are randomly selected by players to be used in their stunts.

FIASCO Historical Influence
Chang and Goodman created FIASCO based on the ideas and actions of a group from the 1950s, who called themselves the Situationists. They saw that people in a city were suffocating and their creativity was being squelched. The members of this group wandered the city streets based on certain rules they had previously made, performing stunts similar in essence to those now performed in FIASCO. Chang and Goodman also based the game on interactions they observed between previously unfamiliar people, such as in urban pick-up games of softball, and imagined the notion of stunts based on their observations of common New York City situations.

FIASCO Design
Chang and Goodman considered developing FIASCO for players to use portable devices in the game. Such devices would likely have Global Positioning System (GPS) capability to pinpoint a street corner location on the game's map, as well as access to the FIASCO server for uploading pictures of stunts when they are performed. Such devices would be helpful in making players' interactions with each other more frequent and responses to stunts timelier in relation to its performance. However, there would also be technological and economical concerns, severely limiting the range of possible participants. In addition, Chang and Goodman wanted to place the actions at the forefront of attention, rather than making the game device-centered.

FIASCO Prototype Test
Chang and Goodman tested FIASCO using a small group of acquaintances. Despite this initial game being artificial, they observed that the players performed more creative actions than they would have outside the confines of the game, thus meeting a primary goal of the development. FIASCO had not been fully implemented as a public game at the time of its paper being published, but plans were being made for its implementation in New York City starting in May 2004.

FIASCO Concerns
The nature of having predetermined objects, actions, and themes for the creation of stunts limits the creativity that

FIASCO is designed to promote. However, some measure of rules or control over the nature of stunts is necessary to protect both people involved in the game, and innocent passersby. Chang and Goodman neglect to discuss this design conflict.

Figure 3: Map screen on the PDA for Feeding Yoshi

FEEDING YOSHI BACKGROUND

Feeding Yoshi is a mobile game played on a PDA that makes use of GPA and WiFi technologies. The game is played in real time by individuals that can join up in any size group, but preferably by groups of four. The objective of the game is to as score as many points as possible by feeding Yoshies found throughout the world. Yoshies and their food which are located in places called plantations are generated by the game when a wireless access point in located. Plantations have certain fruits and also if a barren plantation is found you can plant a seed of your favorite Yoshies fruit for availability. To play the game you must locate Yoshies and plantations, store fruit the Yoshies will eat and walk to the location to feed them. Fruit can be traded by being near someone else playing the game thanks to the PDA constantly transmitting a signal; this is encouraged because extra points are generated from trade, as indicated in Figure 3. Scores are updated on a website regularly and automatically by the PDA.

FEEDING YOSHI EXPERIMENTAL DESIGN

The game system was tested by assigning PDAs to individuals in three US cities with teams of four. One city had two teams and all individuals in teams were located near each other so trading and team effort could be maximized. The game was originally designed for only five days but because a number of participates couldn't play the game during work hours the following weekend was included for a total of seven days. Data was gathered and charted based on the maximum time people played in one seating per a day and the total amount of time spent per a day by each team. Players were also asked to make video diaries each day explaining ways they have been playing the game, along with strategies their team had been using to increase their scores.

FEEDING YOSHI RESULTS

Players generally found the game very enjoyable with a few complaining that it got repetitive after a few days. Some other concerns people had were that they felt awkward walking back and forth on a street when they had found a plantation and Yoshi near each other. Some were nervous in busy locations with cameras, fearing that local authorities might believe they were participating in some illegal activity.

Scoring also became a problem because one group fell behind in the beginning of the trial, and felt defeated as there was not enough time to try and beat the other teams. Some ideas on possibly having short-term scoring and an overall team scoring were discussed.

Lastly, a key problem that was noticed was that individuals in larger urbanized cities had an advantage due to the many available wireless access points, allowing them to find more Yoshies and plantations in a smaller area. A possible solution suggested was to have plantations be exhaustible, or place a limit on the number of Yoshies in a given area.
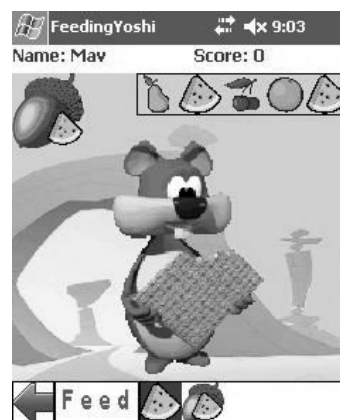

Figure 4: Yoshi on the screen with his fruit of choice

FEEDING YOSHI REDESIGN

With the good overall results from the participants, it was sensed that the core of the game worked very well but that the structure of the game might need to be redesigned. Some of this comes from the aforementioned problems, but there were also complaints and noticeable playing flaws. A key complaint was about playing within cars or trains. Since many mobile games are usually played during time spent traveling over long trips, it would seem that the game should be able to be played during these travels; however, most of the participants complained about the short range of the detection between the PDA and the access points. This is a major concern since the technology used to locate and determine the type of access point is currently limited by the size constraints of the PDA.

In addition, it was stated that structure of the game seemed to focus more on hard 'graft' then either skill or luck. The exhaustible plantations would help with this design

problem, to prevent someone from constantly feeding the same Yoshi from a nearby plantation for points. Another suggestion is to give the game a time limit per day. This gives more of a level playing field, since a number of participates complained that their day jobs kept them from devoting as much time to the game as other people.

CONCLUSION

Location-based games have potential for introducing new users and players to a different facet of gaming. Players will take the game outside rather than keep the player inside with a computer screen or television. Three implementations of location-based gaming have been described in this paper, each taking a different approach. Benford et al. used the approach in CYSMN of having the runners travel with a GPS in order to locate the online players that were able to view a layout of the city. Furthermore, WiFi was an integral part of the method to allow the players to interact and keep track of one another's progress. Issues that arose with using methods that require constant connection is keeping the connection live; participants found blackout spots caused inconsistencies in play and in the online users' ability to keep track of runners. In contrast, FIASCO utilized neither GPS nor WiFi. Thus, players were not in touch with one another while they were on the street. Players had to return to a computer in order for them to interact and reveal progress. A benefit of not using WiFi and the GPS is the reduction in technological issues and it made the game more action centered rather than device centered. As with CYSMN, Feeding Yoshi used both WiFi and GPS to enable the players to keep in touch with one another. However, unlike CYSMN,

Feeding Yoshi did not have issues with WiFi and GPS outages; hence, CYSMN may have been conducted in areas where the satellite ranges were not adequate and the WiFi locations were too spread apart for complete access. However, the five strategies for uncertainties outlined by Benford et al. still apply in developing location-based games such as Feeding Yoshi. Feeding Yoshi did not have to deal with these issues due to the parameters provided in the implementation and the locations where the game was conducted.

Location-based games are a unique form of gaming that allows interactivity and a wider range of creativity. Games such as CYSMN, FIASCO, and Feeding Yoshi allow for greater freedom of movement and physical player interaction. An increase in location-based games may change the way that games are played in the future.

REFERENCES

1. Benford, S., Crabtree, A., Flintham, M., Drozd, A., Anastasi, R., Paxton, M. Can You See Me Now? *ACM Trans. on CHI*, ACM Press (2006), 13-1, 100-133.

2. Chang, M., Goodman, E. FIASCO: Game Interface for Location-Based Play. *Proc. Of DIS'04*, ACM Press (2004), 329-332.

3. Bell, M., Chalmers, M., Barkhuus, L., Hall, M., Sherwood, S., Tennent, P., Brown, B., Rowland, D., Benford, S., Capra, M., Hampshire, A. Interweaving Mobile Games With Everyday Life. *Proc. Of ACM CHI 2006*. ACM Press (2006), 1, 417-426.