

# PiNiZoRo: A GPS-based Exercise Game for Families

Kevin G. Stanley, Ian Livingston, Alan Bandurka, Robert Kapiszka, Regan L. Mandryk

Dept. of Computer Science

University of Saskatchewan

Saskatoon, SK

{first.last}@usask.ca

## ABSTRACT

Obesity is a growing problem among children, due in part to their sedentary lifestyles. Time spent engaged in physical activity is decreasing, while time spent playing computer and video games is on the rise. We leverage children's interest in digital games to encourage families to engage in purposeful walking. We present a GPS-based game, played on a mobile device that uses walking as a primary gameplay mechanic. Our game, PiNiZoRo, includes a fighting game, triggered at points along a real-world route, and a map editor that allows parents and recreation specialists to create custom routes in their neighbourhoods. Results from an initial focus group with parents were positive, as they showed enthusiasm for the concept, implementation, and gameplay.

## Categories and Subject Descriptors

H.5.1 [Information Systems]: Information Interfaces and Presentation – *multimedia information systems*.

## General Terms

Design, Experimentation, Human Factors.

## Keywords

Exercise games, ubiquitous games, GPS, children, families, persuasive games, location-based games.

## 1. INTRODUCTION

Among children, obesity is a growing problem with far reaching consequences to their future health and wellness. Data from the Canadian Population Health Initiative reveal that from 1981 to 1996, overweight and obesity rates tripled among boys aged 7-13 (to 32.6%) and doubled among girls aged 7-13 (to 26.6%), with the greatest increases occurring in the youngest age groups (7-9 year olds) [13]. One explanation for the rise in the prevalence of overweight and obese children is the accompanying decrease in their physical activity levels in the same time frame [13].

The recent decrease in physical activity has been linked to various environmental, social, cultural, and behavioural factors including the increased time spent in sedentary leisure activities such as watching television and playing video games. A 2003 study showed an increased risk of being overweight or obese among 7-

11 year olds who watch television or play video games [15]. Given that 68% of American households play video or computer games [5], the negative potential impact of digital game play on physical activity levels and resulting obesity levels is clear.

Parents have enormous influence over the lifestyles of their children. An accelerometer-based study revealed that children of physically-active mothers are twice as likely to be active, children of physically-active fathers are 3.5 times as likely to be active, and children are 5.8 times as likely to be active if both parents are physically active [12]. Although parents may be concerned about the sedentary lifestyle of their children, recent data from the Entertainment Software Association show that 63% of parents believe that games are a positive part of their children's lives [5].

Our research investigates the use of video game play to motivate physical activities in families. Our solution for parents is a two-pronged approach: first, we integrate video game play into physical activity experiences to draw electronic-age children into being active; second, we design a game where parents exercise together with their children. The video game approach provides parents with a way to engage their children by offering a fun activity that doubles as a mechanism for exercise, promoting healthy habits among the entire family.

Our game – called PiNiZoRo – is a GPS-based exercise game, played on a mobile phone, which uses walking in the real world as a primary gameplay mechanic. Targeted at children aged 4-12, our game includes a fighting minigame, triggered at certain points in the route, which provides a deeper level of play experience to ensure children remain engaged. Finally, the game is designed to allow parents, educators, and recreation specialists to create custom routes in their neighbourhoods.

We tested our game through a pilot study focus group performed with four adult participants, each a parent of a child in our target age group. Participants played the game, and participated in an interview discussing their experience with PiNiZoRo as a potential family activity. Initial results showed that the game has promise, although additional evaluation is still required.

## 2. RELATED WORK

Ubiquitous games have received significant attention in the literature, as have persuasive games aimed at increasing activity. Our particular contribution lies at an intersection between persistent location-based ubiquitous games, and persuasive physical activity or exergames.

One popular class of ubigames is games that respond to a player's location [2]. Persistent location-based games (PLBGs) are distinct from standard ubiquitous games in that locations are tagged with game play elements in perpetuity, which does not expire when a play session or event ends [1]. Coulton et al. describe two simple persistent location based games: MobSpray, a graffiti game and

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

*FuturePlay @ Vancouver Digital Week 2010*, May 6-7, 2010, Vancouver, Canada.

Copyright 2010 ACM

\$5.00.

MobHunt, a treasure hunt in [4]. Li et al. describe a pervasive version of the game Monopoly, where a subdivision is given a new set of property values which players can buy, sell or rent as they walk about the neighbourhood, using traditional Monopoly mechanics [8]. A more general overview of location-based games is given in [7], and ubiquitous games in [10].

Persuasive games are intended to alter people’s behaviors in healthy ways through gameplay. Recently, games intended to increase physical activity have been created and evaluated. *Fish’n’Steps* is a social computer game that links a player’s daily foot step count to the growth and activity of an animated virtual fish, creating competition and collaboration [9]. In *Neat-o-games* players’ activity is monitored through an accelerometer and controls an avatar in a virtual race [6]. In the *Ubifit Garden* players’ physical activity improves their virtual garden, showing their progress on a glanceable display [3]. In *Gemini*, players’ cumulative activity affected their levels in a collaborative chess game played later on a PC [14]. Many pervasive games use a variant of hide and seek or tag as their fundamental play element. Magielse and Markopolous [11], and Vogiazou et al. [16] have both proposed tag-based opportunistic games. Magielse and Markopolous focused their game on children.

### 3. PINIZORO

PiNiZoRo is a location-based game built to encourage families to exercise and explore the outdoors together, by providing additional digitally-mediated play to traditional outings. In the following sections, we describe the game concept, design, and how to edit game maps to create local PiNiZoRo experiences.

#### 3.1 Game Concept

PiNiZoRo is based on a fanciful and family-friendly concept of an ancient shadow conflict between pirates, zombies, ninjas and robots (PiNiZoRo), or according to our game documentation:

*“The secret underworld of pirates, ninjas, robots, and zombies has been hidden from society for hundreds of years. Their epic struggle has been but a whisper on the tongues of bards and madmen. No normal person would have any reason to believe that these creatures of myth even exist. But they do exist... and their violent and terrible war, the Hidden War, is poised to spill into our world, wreaking havoc on society and the world as we know it!”*

*There is one group of mortal men and women who have dedicated their lives to keeping this war hidden from the world. They are the Letalis Vis or simply The Society. However, with the escalation of the Hidden War, the Society has grown weaker, decentralized, and leaderless. Operatives now work independently, documenting their work with detailed maps and notes, in hopes that others will join and take up the mantra: “nos es Letalis Vis Congregatio”, or “We are the Mortal Force Society”.*

Players, expected to be children between 4 and 12 years old, are cast as members of a secret and elite police force tasked with subduing the pirates, zombies, ninjas and robots that have infiltrated their neighborhood. To find and combat these infiltrators, players must follow maps left by others describing a “beat” known to house illegitimate members of the pirate-zombie or ninja-robot alliances. Players are not alone in their quest. A misfit pirate, ninja, zombie and robot aid the player engaging in the actual combat required to subdue the miscreants found along the path.

There are two core gameplay mechanics, a navigation game based on moving through the real world, and a fighting minigame. The



Figure 1: Gameplay screens for map and fighting games

game is expected to be played by children; however, there is also a relatively simple map editor, which allows parents, educators and recreation specialists to create the maps for the children to follow. While the ability to share maps through the internet has been implemented, it was not enabled in our early pilot studies.

#### 3.2 Game Play Module

The play portion of the game is divided into two primary mechanics, following a treasure map-like representation by walking in the real world, and a puzzle-fighting minigame where players attempt to subdue the creatures they have found. Example screens from each play portion are shown in Figure 1.

In the navigation portion of the game, the player is represented by a blue triangle and must move from waypoint to waypoint, represented by pirate-style “X”s. “X”s can indicate either waypoints, changes in the direction of the path, or encounters, where players must play a minigame. While the PiNiZoRo concept allows for many minigames, we have currently only implemented a simple fighting game. To enhance the ambiance, music plays as the player approaches the next encounter waypoint. The fighting minigame is triggered when the player reaches an encounter point.

To subdue the infiltrators found on the map, the player must employ the services of four defectors, one from each of the factions: Nina the Ninja, Bob the Robot, Zoe the Zombie and Pete the Pirate. The fighting game is a timing and puzzle game. Each of the four allies has three possible actions they can perform, associated with a puzzle piece shape. Actions with compatible puzzle-pieces can stack together for combo bonuses. Both player and computer actions stack in the same queue. Unlike puzzle pieces cancel and like puzzle pieces stack together. The queue is flushed if either 5 stacked pieces are placed, or a special “border” piece is played. Every action is executed, but the player with the last action in the queue receives the combo bonuses. The fighting game ends when either the infiltrator or player runs out of health.

#### 3.3 Map Editor Module

The editor is designed to make it easy to build a quest regardless of expertise with mobile technologies. It is accessible for educators, parents and activity coordinators to design maps in their neighborhoods for children. In addition, children could design maps for their friends. Map creation is accomplished by



**Figure 2: Quest and map creation views**

actually walking the desired path. The main quest edit page and primary map editing view are shown in Figure 2.

Walking the desired path has two benefits. First, it allows the user to observe the area from ground level, rather than from a potentially misleading or outdated satellite view. Second, the device has the opportunity to record not only the position of the user, but the local errors in GPS position estimates. Selecting the add encounter command will take the user to a set of cascading tables, typical of the Apple iPhone interface, which allows the user to place the enemy and edit its difficulty and statistics.

#### 4. PILOT STUDY

To test PiNiZoRo's potential we recruited four participants (parents of children 5-10, 3 male, 1 female), for a pilot focus group study. Prior to performing any experimental task, participants received verbal instructions about the game and the experimental tasks. Participants were then provided with an iPhone running PiNiZoRo. An experimenter remained with the participant throughout the tasks to ensure that tasks were completed consistently between users. Participants performed two tasks: play a pre-made PiNiZoRo beat-map on the university campus, and use the map editor to create a new custom map.

After the tasks were complete participants participated in a short (15 minute) interview, designed to explore their experience with and opinion of PiNiZoRo, and the role of games and exercise in their daily lives.

All participants felt that exercise is important for their children. Walking was listed as a common activity that participants do with their children, though often with a specific goal in mind, like walking to the store. As such all participants felt that a game incorporated walking as a mechanism of interaction could be successful. One participant suggested that other potential physical activities are too complex:

*“Coordinating all 4 of us to do the same activity is hard, but walking or bike riding is certainly feasible.”*

Participants also felt that the iPhone is a good platform for family games. The use of GPS as a game mechanic is also viewed as novel and fun one participant said:

*“It makes the real world interactive as opposed to something that’s just there.”*

Two participants compared the use of GPS to geo-caching, citing it as an example of the success of GPS in games. Participants expressed the value of using a game as a motivational tool.

*“Sometimes you do stuff like make a game along the way, they get tired along the way, of course, they get tired so it’s better if they are distracted”*

*“It gives purpose to walking, which might be good for kids: It makes it feel like an adventure in a sense.”*

Participants felt that the activities offered by PiNiZoRo would function well as an exercise game for children and parents. The achievement of reaching a waypoint or winning a battle was considered to be the most satisfying part of the game.

*“I kind of liked the anticipation of wondering what’s going to happen at the next waypoint.”*

However, participants agreed that additional minigames would be required to engage children in the long-term. Three participants felt that the minigames would not be required to engage younger children – that the traveling from waypoint to waypoint would be sufficient. However, the same participants also felt that the traveling would be insufficient for older children, thus more minigames would be required.

*“Compared to typical exercise games I like the idea that it’s outside, and that you can go for a walk, and that it’s in the real world, and that it’s something that you can do as a family and that it’s not so consuming like a normal video game would be where all your focus is paid to the video games itself, here you can [go] in and out of the video game as you need too, which is nice.”*

One participant enjoyed how well the physical activity was integrated into the gameplay, saying:

*“I think the exercise is really well hidden, and I can see kids just tearing around from location to location trying to get to the next minigame.”*

All participants felt that the map editor was an important part of the game, although some participants wanted to build maps from home, rather than walk the map before playing the game.

*“I liked kind of creating my own map, that was kind of neat to be creative and give them names, you know, and think how my own story would go.”*

Overall, participants were enthusiastic about PiNiZoRo's potential. The differences the game offers over traditional exercise games, the activities, and that it is played outdoors made our game very appealing.

#### 5. DISCUSSION AND FUTURE WORK

PiNiZoRo is unique because of the balance of goals and objectives it represents. Exergames suffer a design challenge in that exercise is not always considered to be an inherently fun activity. Many sports have exercise as a byproduct of the activity rather than the goal; similarly, PiNiZoRo has walking as a byproduct of enjoyable gameplay. Walking is integral to the gameplay, but is made more fun through the scenario, the hunt for waypoints, and the triggered minigames.

Many families already walk together, and parents often create adventures for their children on these walks using tools like identifying flora and fauna, or playing games like ‘I spy with my

little eye.’ Our game may appeal to these families, but we are targeting families who may need more motivation to go for a walk together. Some children may respond better to the motivation of the digital aspects of game play, and some parents may be pushed to go on these adventures by their children. We hope that a game such as PiNiZoRo could be a scaffold for families to learn to enjoy physical activity-based outings without the need for accompanying digital media.

Parents in our pilot focus group appreciated our game for its use of digital technology to support purposeful walking. The design of our map editor constantly renews this purpose as new routes can be created users. In this way, PiNiZoRo supports leveling as more challenging routes can be created and played. To create a new quest, our implementation requires users to walk a route. Although we implemented a map editor that could be used from a stationary point (like a parent’s home), we require users to walk their routes so that quests are reliable. There are two main advantages to walking the route: the GPS records not only the position, but the reliability of that position based on the surrounding environment; and it allows the creator to observe the area from ground level, rather than from a potentially outdated satellite view.

Our current implementation appeals to children who like twitch-based games, because the only minigame we have implemented is a puzzle-fighter. To accommodate children with different play styles, we are currently implementing a clue-gathering minigame. We plan to create additional minigames to make the game more appealing for older children and for long-term play. In addition, we plan to conduct initial tests with children and large-scale tests with families and schools.

## 6. CONCLUSIONS

Obesity rates are rising among children, due in part to their sedentary lifestyles. Time spent engaged in physical activity is decreasing, while time spent playing computer and video games is on the rise. We have created a GPS-based game, played on a mobile device that uses walking as a primary gameplay mechanic. Parents can support purposeful walking in their families by creating custom quests for their kids in their own neighbourhoods. In a pilot focus group, parents showed enthusiasm for the concept, implementation, and gameplay.

## 7. ACKNOWLEDGMENTS

The authors would like to acknowledge the Natural Sciences and Engineering Research Council and University of Saskatchewan USTEP program for research funding and Andre Doucette for his iPhone development environment expertise.

## 8. REFERENCES

[1] Bell, M., Chalmers, M., Barkhuus, L., Hall, M., Sherwood, S., Tennent, P., Brown, B., Rowland, D., and Benford, S. (2006). Interweaving mobile games with everyday life. *Proc. of CHI '06*, 417-426.

[2] Björk, S., Falk, J., Hansson, R., and Ljungstrand, P. (2001). Pirates! - Using the physical world as a game board. *Proc. of Interact 2001*, 423-430.

[3] Consolvo, S., McDonald, D.W., Toscos, T., Chen, M.Y., Froehlich, J., Harrison, B., Klasnja, P., LaMarca, A., LeGrand, L., Libby, R., Smith, I. and Landay, J.A. (2008). Activity Sensing in the Wild: A Field Trial of UbiFit Garden. *Proc. of CHI'08*, 1797-1806.

[4] P. Coulton, O. Rashid, W. Bamford, “Experiencing Touch in Mobile Mixed Reality Games,” *International Conference in Computer Game Design and Technology*, 2006, 8 pages.

[5] Entertainment Software Research Association. 2009. Essential Facts about the Computer and Video Games Industry (retrieved March 2010).

[6] Kazakos, K., Fujiki, Y., Puri, C., Bhuddaraju, P., Pavlidis, I., and Levine, J. (2008). NEAT-o-Games: Exertion Interface Interwoven in Daily Life. in *Workshop on Exertion Interfaces at CHI 2008*, 1-3.

[7] Schlideder, C., Kiefer, P., Matyas, S., “Geogames: Designing Location-Based Games from Classic Board Games,” *IEEE Intelligent Systems*, 21(5), 2006, pp. 40-46.

[8] Li, M., O’Grady, M.J., O’Hare, G.M.P., “Geo-gaming: The Mobile Monopoly Experience,” *Proc. WEBIST 2008*, 4 pages.

[9] Lin, J.J., Mamykina, L., Lindtner, S., Delajoux, G. and Strub, H.B. (2006). Fish'n'Steps: Encouraging Physical Activity with an Interactive Computer Game. in *Proc. of the Intl. Conf. on Ubiquitous Computing (UbiComp)*, 261-278.

[10] Magerkurth, C., Cheok, A.D., Mandryk, R.L., and Nilsen, T. (2005). Pervasive Games: Bringing Computer Entertainment Back to the Real World. in *ACM Computers in Entertainment* 3(3), 19 pages.

[11] Magielse, R. and Markopoulos, P., “Heatbeat: An Outdoor Pervasive Game for Children,” *Proc. CHI '09*, pp. 2181-2184.

[12] Moore, L.L., Lombardi, D.A., White, M.J., Campbell, J.L., Oliveria, S.A., & Ellison, R.C. 1991. Influence of parents' physical activity levels on activity levels of young children. *Journal of Pediatrics*, 118(2), 215-219.

[13] Raine, K.D. 2004. Overweight and Obesity in Canada: A Population Health Perspective. Report. Canadian Population Health Initiative, 1-96.

[14] Stanley, K.G., Pinelle, D., Bandurka, A., McDine, D., and Mandryk, R.L. (2008). Integrating Cumulative Context into Computer Games. *Proc. of Future Play 2008*, 248-251.

[15] Tremblay, M.S., & Willms, J.D. 2003. Is the Canadian Childhood Obesity Epidemic Related to Physical Inactivity? *International Journal of Obesity & Related Metabolic Disorders*, 27(9), 1100-1105.

[16] Vogiazou, Y.; Raijmakers, B.; Geelhoed, E.; Reid, J. and Eisenstadt, M., “Design for emergence: experiments with a mixed reality urban playground game,” *Pers. Ubiq. Comp.* 11(1), pp. 45-58.