

Swan Boat: Pervasive Social Game to Enhance Treadmill Running

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ABSTRACT

We designed and implemented a pervasive game called Swan Boat that targets the bland and tedious nature of running on a treadmill, making it fun through social interaction and immersive game play. We developed Swan Boat on top of PSD, a platform for pervasive games, and using the Interactive Treadmill hardware. We conducted a user study to evaluate our game.

Keywords

Pervasive games, Fitness games, Interactive Treadmill, Sensor-Bracelet, PSD, Swan Boat

1. INTRODUCTION

Regular aerobic exercise is important in losing weight and staying healthy. Despite understanding the need for exercise, many people do not exercise regularly as it can be boring and difficult. Running on a treadmill, a common exercise in fitness centers is the most prominent example of tedious aerobic exercise. Although convenient, running on a treadmill can be monotonous, repetitive and isolated work.

We designed and implemented Swan Boat, a multiplayer racing game to help motivate the sedentary public to exercise by running. Swan Boat makes tedious and isolated treadmill running fun and appealing through social interaction and immersive game play that engages the whole body. We implemented Swan Boat using Interactive Treadmill and Personal Space Director (PSD)[1], a game platform supporting the development and operation of pervasive games.



Figure 1. Swan Boat

2. SWAN BOAT

Swan Boat is a fitness racing game where teams of runners compete against each other by collaboratively controlling the speed and direction of their boat. Our target exercise, running, is utilized as the main game interaction to control the boat and is realized by using the treadmill as the interface. Two or more players form a team, cooperating and synchronizing their movements at a fine-grained level, i.e. pace and speed of their

running and with arm gestures. The game is analogous to a swan-boat steered by two children in a pond or a boat race in which team members row in sync with each other to the sound of a drum.

Swan Boat enhances treadmill running by leveraging rich social interaction among players. Players meet other runners of various skill levels and styles in Internet virtual communities and form teams that compete over the network, allowing solo players at home or in fitness centers to easily find teammates and opponents. The competition between teams motivates players to run enthusiastically to achieve victory.

The difference in speed between team members determines the direction of their boat, so if a team wants to steer their boat to port, the member in charge of that direction should run faster than her teammate. To finish a winding course quickly, a player must coordinate the steering of the boat with her teammate, excitedly yelling “faster!” and “slow down!”, and adjusting her pace according to her teammate’s. This kind of close communication and synchronized interaction immerses the players in the game experience.

Runners are further immersed in the game when obtaining game items as the runners actually “feel” the resulting effects. For example, if a team fails to avoid a rock item, the system raises the incline of their treadmills to simulate their boat being weighed down by the rock. Gestures also enrich immersive and fun game play. Flapping one’s arms is an effective response to being weighed down by a rock. Prompt flapping lifts the boat so that it skims over the surface of the water. The reduced friction compensates for the drag due to the rock, allowing the team to regain speed. Coordinated punching gestures can also be used to attack a nearby opponent’s boat, hindering their movement.

3. IMPLEMENTATION

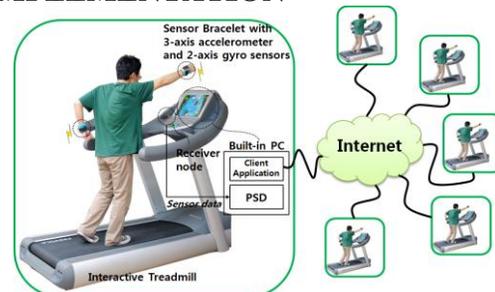


Figure 2. Overview of the system

We implemented a multiplayer version of Swan Boat. Figure 2 shows our implementation of the Swan Boat system, including a game server and multiple clients. The Swan Boat client consists of four main components: an Interactive Treadmill, Sensor-Bracelets, Player Space Director (a game platform for pervasive games), and the Swan Boat game application.

3.1 Swan Boat Game Server

The server maintains global game states that consist of each boat's speed, direction and position in the game map, as well as event occurrences, e.g. collisions with obstacles, acquisition of items, attacking, etc. These states are updated with game inputs from each game client. The up-to-date global game states are periodically sent to the clients to synchronize their game states.

3.2 Interactive Treadmill

We developed an application-controllable Interactive Treadmill to develop and deploy treadmill-enhancing games. Interactive Treadmill is a new type of treadmill that automatically adjusts its speed to the runner's pace using an ultrasonic sensor at the front of the treadmill. When the user runs faster, approaching the sensor, the Interactive Treadmill speeds up. When the user runs slower, it slows down. The user thus controls the speed of the Interactive Treadmill simply by running.

Interactive Treadmill periodically sends the runner's information, including current speed, mileage, total calories burned and current incline, to PSD. It also actuates its physical components such as incline and belt motor according to messages from PSD. The Interactive Treadmill is equipped with a socket interface to communicate with external applications and provides a rich environment for gaming, including a built-in PC, 17-inch touch screen, and stereo speakers.



Figure 3. Interactive Treadmill Figure 4. Sensor-Bracelet

3.3 Sensor-Bracelet

We also developed a custom-designed wearable device, Sensor-Bracelet, which can be equipped with various sensors. It is worn on each of a player's hands to detect gestural game inputs such as punching, shaking, and flapping. Each Sensor-Bracelet is equipped with a 3-axis accelerometer and a 2-axis gyro sensor. It supports Bluetooth and Zigbee as wireless communication interfaces. An additional base sensor receiver node receives sensor data from Sensor-Bracelets and transfers the data to PSD using a serial or USB interface.

3.4 PSD, Player Space Director

PSD is a game platform to support contextual interactions and facilitate the development and operation of diverse pervasive games. It supports game designers in defining a rich set of

pervasive game interactions. PSD further manages the player's space by:

- interpreting pervasive game interactions, recognizing player's gestures, actions, and surrounding contexts and abstracting them as meaningful game state and input,
- communicating with the game logic,
- abstracting and managing a large number of heterogeneous sensors/actuators in pervasive game spaces,
- delivering feedback from the game logic to the player.

Using PSD, we were able to easily experiment with a number of gaming interactions, e.g., punching, swinging, clapping, flapping, waving, kicking, running, jumping, rowing, etc. We identified gestures with hands and arms as most appropriate and fun for Swan Boat since the arms are free while running. We elaborated on several gesture-based interactions, i.e., punching, flapping, and shaking, and included them in the game.

3.5 Swan Boat Client Application

The Swan Boat client application provides the team game view to the player. It sends the game input from PSD, including running speed and detected gestures, to the game server to update the game state. It also reflects the updated global game state from the server to the game view, and shows the results to the player.

4. USER EXPERIENCE

We conducted a 2-week preliminary user study of Swan Boat with 11 university students and 6 professors. Swan Boat is more fun than just running according to our interviews. Many participants were surprised at how fast time seemed to pass while playing Swan Boat. One said that he would go to the fitness center more often if he could play Swan Boat. Many participants liked the arm gestures, especially the punching. One stated that if buttons replaced arm gestures, it would not be as fun. Several participants stated that they ran much faster than usual to win the race. Participants who did not run hard and even walked when not playing Swan Boat, ran enthusiastically when playing.

5. CONCLUSION & FUTURE WORK

We developed a pervasive game for treadmill running, Swan Boat, and demonstrated its enjoyment and exercise potential through a preliminary user study. In future work, we plan to incorporate safety measures into the game design. We believe that this project can be a meaningful work in the successful integration between real world tasks and game experience.

6. ACKNOWLEDGMENT

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7. REFERENCES

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