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Brennan JONES

Kody DILLMAN

Setareh Aghel MANESH

Ehud SHARLIN

Anthony TANG

Singapore Management University, tonyt@smu.edu.sg

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Designing an Immersive and Entertaining Pervasive Gameplay Experience with Spheros as Game and Interface Elements

Brennan Jones, Kody Dillman, Setareh Aghel Manesh, Ehud Sharlin, Anthony Tang

Department of Computer Science, University of Calgary

{bdgjones, kody.dillman, setareh.aghelmanesh}@ucalgary.ca, ehud@cpsc.ucalgary.ca, tonyt@ucalgary.ca

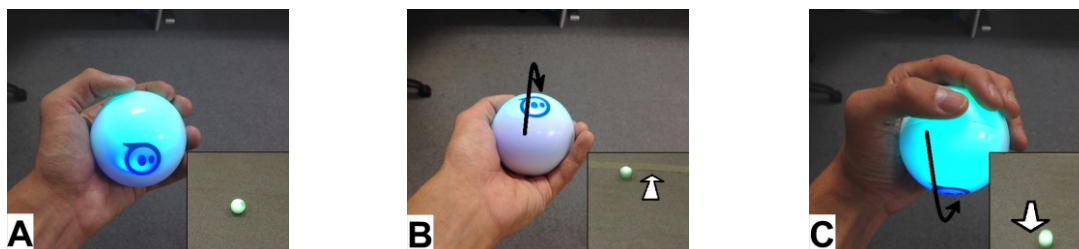


Figure 1: A control scheme that allows a player to roll a Sphero on the floor by tilting another in their hand.

ABSTRACT

The Sphero is a robotic remote-controlled ball capable of rolling around on its own in any direction at multiple speeds. Numerous games have been designed for the Sphero for smartphones and tablets. However, most of these games provide an interface for controlling the Sphero that is far from natural. These games also do not put a strong focus on the physical environment around the Sphero. This work discusses a control scheme used to control a Sphero with another Sphero, and a pervasive game leveraging this scheme that emphasizes physical properties of the environment to create an immersive experience.

Author Keywords

Sphero; robotic ball; pervasive gaming; controllers; natural mappings; immersion; gaming experience

ACM Classification Keywords

H.5.0. Information interfaces and presentation (e.g., HCI): General

INTRODUCTION

Pervasive gaming is a growing form of interactive entertainment that is being further realized through the use

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of robotic toys such as the Sphero. The Sphero is a robotic ball designed by Orbotix that is capable of rolling around in any direction at multiple speeds [1]. It can be controlled using a smartphone or a tablet.

There are several games available for the Sphero for iOS and Android, including augmented reality games, party games, and tabletop games. Most of these games allow players to control a Sphero via their smartphone or tablet by tapping buttons or tilting the device. While the main focus of most of these games is the Sphero, much of the interface is on the smartphone or tablet, and not on the Sphero itself.

CONTROL SCHEME

Previous work by Skalski et al. [4] and Cairns et al. [2] has shown that natural controller mappings lead to more enjoyable and immersive gameplay experiences than unnatural mappings. An example of a “natural” controller mapping, as defined in [4], would be a baseball bat controller used to swing a virtual baseball bat in a video game. In this case, the mapping is from a physical object to a virtual object of the exact same form factor. Players tend to find this control scheme more natural, and thus more enjoyable, than using a traditional game controller.

The Sphero device is typically controlled through an on-screen gamepad with “accelerate” and “turn” controls. Yet this style of control is very far from Skalski’s “natural” mapping. The control scheme that we introduce here for the Sphero (the roller) employs a second, paired Sphero (the controller) that a player holds in their hand. We define the *starting position* of the controller, as shown in Figure 1(a), as the position with the tail light pointed toward the player and the lit-up hemisphere pointed up. From the starting position, the player tilts the controller in any direction to

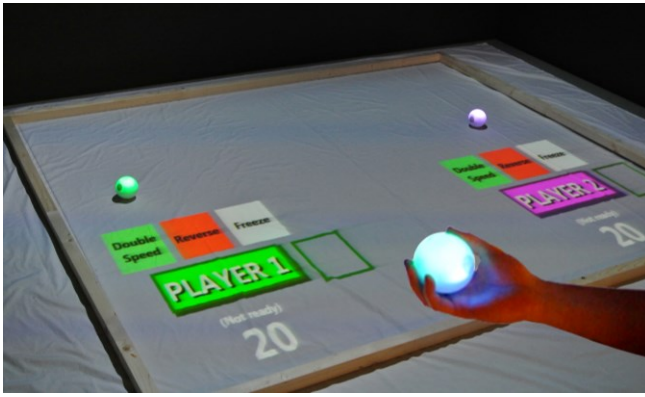


Figure 2: Sphero Sumo's play arena with the rollers in their starting positions.

move the roller in that direction relative to the player's initial position (Figures 1(b) and 1(c)). The degree to which the controller is tilted in any given direction, starting at 15 degrees and up to 100 degrees, positively and linearly affects the roller's speed in that direction. When the controller is tilted less than 15 degrees from its starting position, the roller does not move. This is to allow the player to easily stop the roller by holding the controller steady at its starting position. The roller's speed maxes out when the controller is tilted past 100 degrees.

Our design rationale is that the controller provides a natural and intuitive mapping to the roller because both objects have the exact same form factor. Although the movements of the controller and the roller are not the same (the roller is rolling while the controller is simply tilted), the directions of their movements are.

SPHERO SUMO

We designed a two-player game, called *Sphero Sumo* that leverages this control scheme. *Sphero Sumo* is a fighting game that requires two players to each control a Sphero in an arena and square off against each other. The rules of this game are simple: players one and two constantly hit each other to take health points from one another. The last player with health remaining wins.

The game's graphical interface is projected onto the floor, as shown in Figure 2. Each player starts with 20 health points. Players' rollers do damage to each other through collisions with their opponents. At the point of a collision between two rollers, the roller that is moving faster "wins" the collision, while the roller that is moving slower "loses" the collision and loses three health points.

Players must also avoid hitting walls; hitting a wall causes a player to lose one health point. A player's health is displayed both as a number on the scoreboard and through the roller as a steady transition in the brightness of the ball, with bright meaning at full health and dim meaning almost dead. Whenever a player's roller is involved in a collision,

either with the wall or with another roller, that player's controller vibrates and flashes, and their roller also flashes. The game also utilizes special attacks by allowing a player to slap their controller once to load an attack and then again to use that attack.

EFFECTS OF PHYSICAL PROPERTIES ON PLAYER EXPERIENCES

The experience of a game can be made more enriching and immersive by emphasizing physical aspects of it [3]. The physical domain of a game can include both tangible interfaces and real-world properties that are also game elements or representations of game state. In contemporary video games, the game logic, game state (e.g., score), and game world all exist in what Magerkurth et al. [3] define as the "virtual domain." They are all within the computer and are not existent or represented in the physical world. Many traditional Sphero games for iOS and Android go beyond the virtual domain by including Spheros as physical game elements in order to increase immersion and enjoyability. *Sphero Sumo* does this as well, but takes it a step further by also including physical arena bounds, a physical stage, and a projector. The projector plays two roles: (1) augment additional information such as score values and player statuses onto the game arena, and (2) provide lighting to the game arena that is similar to stage lighting in a theatre, thus drawing focus (and emphasis) on the game stage.

FUTURE WORK

In the future, we plan on running user studies that compare the control scheme we presented to controlling a Sphero with a smartphone to see if our control scheme is perceived as more natural or more enjoyable than the smartphone. We are also interested in comparing *Sphero Sumo* to a similar fighting game played without Spheros but with only virtual game elements to see if emphasizing physical aspects of the game in this case affects the perceived immersiveness of the game.

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