It's hard, it is fun: Throwing balls inside the home

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Abstract
A major drawback of conventional interfaces for computer and console games is the lack of physical stimulation. Traditional ball games do offer that, but, though diverse in nature, they do not offer the same flexibility, interactivity, and the wide variety of game types that computer games do. Splashball aims to combine the best of both worlds, i.e. a physically stimulating interface to computer games. Splashball uses the impact of real balls on a wall as a point and click interface. In this paper we present the rationale behind Splashball, and the main results of a test with gamers, and discuss how this matches with ideas on why physical computer games are motivating and fun.

Keywords
Sensor technology, pervasive games, physical interfaces, game playability evaluation, motivation

ACM Classification Keywords
H.1.2 User/Machine Systems, H.R.2 User Interfaces.

Introduction
Children used to play outside a lot more, e.g. in the backyard or on some other playground. Nowadays many children spend significant amounts of time sitting down behind PCs, game consoles and televisions. As a

result more and more children are not getting enough physical exercise while physical inactivity is seen as a major contributing factor to weight problems of an increasing number of children. Interest in how to make electronic toys and games more physical is growing – see also Nintendo's Wii. And modern electronics in combination with more traditional game elements can offer interesting options: more flexibility in game flow, less static game situations, personalization of game elements, and different game levels.

Previous studies [e.g. 3] have learned that children love game interfaces and designs that stimulate them to become more physically active, and not just outdoors: being allowed to run and jump indoors is seen as big fun. Furthermore, these studies also showed that actually playing together is highly appreciated by children. These notions, in addition to other 'heuristics', were adopted as starting point for the development of Splashball (see also [1] for an overview of what makes games fun). In the next paragraph, the Splashball setup will be presented. Then, the evaluation of the Splashball games will be discussed.

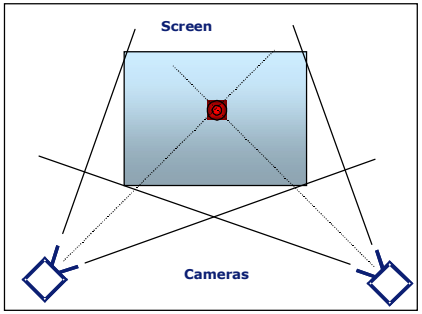

Figure 1. Orientation of the cameras with respect to the screen.

Splashball setup

The Splashball platform uses the impact of balls on a wall as a form of point and click interface. The basic set-up of Splashball consists of a beamer and a means of impact localization. The beamer is used to project a playing field, i.e. the game, onto the wall. This is the output screen of a PC that runs the application software. To detect the impact of a ball against the wall, a motion sensor is mounted on the wall plate that receives the impact. To determine the location of the impact two cameras are mounted near the two bottom corners of the wall at a grazing angle with respect to the wall (Figure 1). The centers of the field of vision of the cameras cross near the center of the projected playing field on the wall. The cameras and motion sensor are connected to a second PC running the detection software. The detection of an impact triggers the image processing sub system to determine the location of the ball during impact by analyzing the successive frames in the image buffer at around the time of the impact trigger. More details about the setup are provided in [2].

Several games were developed for this platform. In the first game a mouse would pop up from within a giant piece of cheese. Hitting the mouse wearing a shirt of a particular color would gain a point for the player associated with that color. The object of the second game was to prevent a man from carrying a bucket of paint of a particular color across the screen by hitting it. Men that reach the other side of the screen would pour the paint into a funnel until one of the players collected a certain amount of paint. The third game featured a rabbit that was to be chased into a rabbit hole of a particular color by hitting the screen opposite from the direction the player wanted the rabbit to run, i.e. chasing the rabbit in the right direction. A fourth game featured dolphins and a sea landscape. In this game, fish that are either red or green jump out of the water. If a fish is hit a dolphin jumps out of the water to catch it and eat it (see Figure 2). The player with the corresponding color of the fish hit gets a point.

Evaluation

The games were tested with adolescents between the age of 12 and 16. In total, 38 high school students participated: 20 girls and 18 boys, in same sex pairs. Participants were positioned 2 to 2.5 meters from the

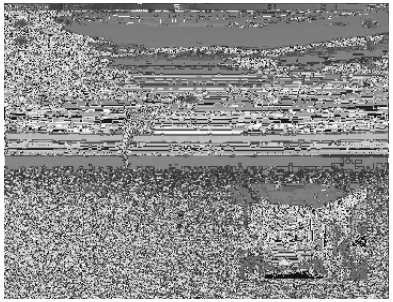

Figure 2. The screen of the dolphin game. The small insert shows the room in which Splashball was setup, and a gamer trying to hit a fish.

wall, enabling them to see the full projection and standing close enough to hit the wall with some accuracy. They played each game at least once for a total test duration of 1-1,5 hours. During game play the participants were observed and afterwards they were interviewed. The setup of the test is discussed in more detail in [2].

Main results

The vast majority of the participants rated Splashball as good fun. What they liked about the games was throwing balls against a wall, in particular inside a home. Also, being able to play a game without being bound to a chair and a keyboard, and being (physically) active, was seen as fun. They also liked that it was something new, and different from other games, and that it was designed for multiple players, actually being in the same room together.

The main complaint was the fact that impact detection and impact localization were not always accurate, although the participants acknowledged the fact that the games were under development. The participants also considered the current games to be a bit slow-paced, and they suggested that the games could be made more complex, with more variation, challenge, and unexpected events. The test results are discussed in more detail in [2].

Discussion and conclusion

The comments and suggestions of the participants in this test were useful feedback. The impact detection and localization were improved substantially since these tests were conducted. Overall, the test results indicated that Splashball is enjoyable and that it can stimulate children to be physically active. Based on the observation data and the interview results, it can be concluded that the competitive aspect – one of the core sources of fun [1], was indeed a strong motivator. Also other aspects of Splashball are motivating, and a source of fun: the social aspect [1] – with *direct* contact with peers, doing something together; trying to master a seemingly easy, but still difficult to master physical skill [1] (hitting a target with a ball); it is a novel application, that allows one to engage in something that is normally strictly forbidden (throwing balls inside); gamers can use their own creativity, to come up with rules how to play, experiment with how to play (e.g. throwing in different ways, helping or hindering the co-player to add extra challenge). Most importantly, it is about being physically active, without the boring routines often associated with physical activity (e.g. repetitiveness of most fitness exercises). And the flexibility of the technology will ensure that games do not have to become boring after a while.

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