
P(A)INBALL: A pinball machine that hurts

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Abstract

In this paper, we describe the concept, implementation and user interaction of a mixed reality pinball game, called *Painball*, which inflicts discomfort on its users, as part of the game mechanism. We created a pinball machine consisting of an original pinball cabinet to be operated via its original controls and enhanced with virtual and tangible devices that allow for carefully designed uncomfortable, sometimes physically painful, interactions. Users can decide how much pain to endure intended as such to allow us to study the role of enduring discomfort as tests of courage in social interactions mediated via technology.

Author Keywords

Uncomfortable interactions; tangible user interfaces.

ACM Classification Keywords

H.5.2. User Interfaces: Haptic I/O

Introduction

“A life without pain has no meaning”, German philosopher Schopenhauer once said, whose philosophy regarded the suffering of the body as evolving to the central locus of meaning of human existence [7].

Pain has not only been a topic for philosophers, see e.g. “Dukkha” (suffering, pain) in Buddhist tradition

[7], but plays an important role in day-to-day human-human interactions. On the one hand, pain can be used as a tool of power when inflicted involuntarily on others, on the other hand, the voluntary suffering of discomfort or pain in front of others can be regarded as a sign of strength. In fact, many (sub-)cultures use painful initiation rituals to introduce new members to their communities. This ranges from rituals of tribes such as wearing a glove filled with painful insect stings of bullet ants (by the Brazilian Satere-Mawe) or the torturous ordeals of the Okipa ceremony (by the native American people of Mandans) [6] to freshman initiation at universities. Tests of courage often include physical actions and pain or injuries. A tendency was found that adolescent males are more attracted to compare each other in rituals involving pain [6].

In the field of Human-Computer Interaction (HCI) user experiences have so far mostly focused on useful or joyful interactions. Only recently dark themes have inspired new modes of technology-interaction coming from more experimental approaches or performing arts. In a recent publication Benford et al. [1] have started to explore the role of discomfort in HCI. They “argue that uncomfortable interactions – carefully and ethically managed – are an important tool in a designer’s armory that can help realize positive long-term values related to entertainment, enlightenment and sociality.” Taking their work as a starting point we designed and implemented a pinball machine that carefully combines pleasure and suffering to create a powerful gaming experience with a social component. The device combines virtual elements as well as mechanical input devices and tangible output devices.

In this paper, after embedding our work into a broader context of existing work, we describe *Painball* in terms of the design concept, implementation and user interactions. Last, we give an outlook on planned user studies and further developments.

Related Work

Benford et al. [1] recently started to investigate uncomfortable interactions as part of designing cultural experiences in which these interactions support the realization of entertainment, enlightenment or sociality.

In entertainment, physical discomfort (e.g. a sudden drop in a rollercoaster ride) and/or psychological discomfort (e.g. anticipation of danger in a horror story) is often employed as a means to enhance thrill and suspense to make the experience intense and memorable. In game design punishment for losing or doing badly, e.g. in the form of paying virtual money or removing game tokens is often employed. Some games use pain for punishment, e.g. a version of the mau-mau card game where losers are pinched or hit on the hand, or the Lightning Reaction Electric Shock game [5], where the loser of each round receives an electric shock. Similarly, in Tekken Torture Tournament, a media installation by the artists Stern and Allen in 2001, participants played the martial arts computer game Tekken Tournament and were equipped with a special bracelet that induced an electric shock if a player’s virtual character was hit in the game [4].

In the area of (interactive) art discomfort, besides being entertaining, is also used to stimulate reflection and enlightenment [1]. For instance, Domestic Tension is a provocative media installation by Iraqi artist Bilal addressing the dichotomy of virtuality and reality. Viewers can log into the project’s website, observe the

artist 24 hours a day and shoot him with an internet-connected controllable paint gun system. The artist's objective was to raise awareness of the lack of privacy and the issue of a virtual war that can turn into a real experience [4]. Another influential work related to ours is the „artwork, formerly known as PainStation“ by Morawe and Reiff [8]. This computer game installation featured a simple Pong game for two players, who had to rest their non-playing hand on a dedicated rest place, which was heated, electro-shocked or hit with a motor-driven whip based on the game logic.

Besides entertainment and reflective purposes, Benford et al. [1] discuss the role of discomfort in social interactions, in particular to achieve bonding between people (mainly through rites of passage, as already mentioned in our introduction). We would like to extend this with looking at how enduring pain voluntarily, e.g. as part of a game, is used by people as a tool to express their courage in front of others and the effects on the audience while watching a player suffer.

Painball Concept & Gaming Content

In the Painball project we aim to combine elements of sociality and entertainment to reach a balanced amount of pleasure and discomfort experienced in a group of players and bystanders. This will allow us to study how uncomfortable, sometimes painful, technology can mediate social experiences in game play, e.g. boasting by players, who endure the pain, and pain empathy or Schadenfreude by spectators watching others suffer. While we took inspiration from Painstation for painful interactions, we did not intent to use pain as a means of punishment for failure but as an opportunity to win a pinball game. We aim for a social setting, in which

testing one's courage in front of others or challenging each other is the main goal.

Discomfort in Painball is mainly realized in the sense of visceral and social discomfort. Visceral or physical sensations are created through heat plates and electric shocks. In addition to tactile sensations as the primary source of physical discomfort we aim to stimulate other senses, e.g. through visual discomfort created by manipulating visual cues (e.g. focal length, eye separation in stereoscopic rendering) or acoustic displeasure by generating uncomfortable sounds. Social discomfort will be implemented, e.g., by creating content that may trigger pain empathy [3]. To allow for emphatic responses by the player the game features a vulnerable protagonist (e.g. a small child) who is endangered during gameplay. The moments when discomfort is inflicted on players during the game is coupled to the game's story line to make it understandable and allow for a state of flow where players may even enjoy the inflicted discomfort as part of the thrill or game challenge.

The play field has a dark theme to fit the uncomfortable interactions during the game. Therefore, we built a graveyard scene (see Fig. 1) with a witch, bats, spiders and nature elements. In the section user interactions we describe examples of how some objects represent traditional pinball elements and the user interaction.

Technical Implementation

Focus of the implementation was to create a multi-modal UI demonstrator that can be easily used to prototype new interaction techniques by adding IO devices in this case for creating discomfort.



Figure 1. Pinball cabinet with playfield (lower display) and panel for extended gameplay (upper display)

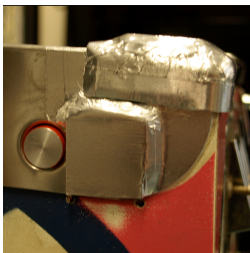


Figure 2. Peltier elements and aluminum flipper buttons

The case and playfield

To create a realistic experience of playing pinball, we used an old non-functional pinball machine as a case for our discomfort-inflicting tangible interface (Fig. 1). We replaced the electronic core and mechanic table with a custom-built computer including an integrated PC board and several input interfaces. The original playfield of the pinball was replaced and extended by three displays: (1) a 40" LED display mounted horizontally into the main housing, which shows the pinball map; (2) a 27" information panel in the top case for extended game content and (3) an 10" TFT replacing the original DMD display to show the scores.

Virtual playfield objects

Pinball games have a set of typical game items such as ramps, bumpers, targets etc. These items are represented on the playfield (i.e. LED display) in form of virtual objects and characters.

Input devices

Currently, interfaces are provided for input devices such as the Microsoft Kinect, and an eye-tracking system with integrated 3D shutter glasses and 6DOF head tracking. An Arduino micro controller is used to connect the original pinball input devices such as the flipper buttons and the plunger to the computer. This enables the user to control Painball by means of the original pinball machine interface. Possible extensions include a brain-computer interface, multi-touch and the Wii balance board. However, adding these needs careful consideration for integration into the gameplay to avoid overwhelming the user.

Output devices

For a multimodal and tangible experience we employed

haptic as well as audio-visual feedback. An Arduino board was connected to provide an extension for sensors and actuators. The original plastic flipper buttons were substituted by aluminum buttons (Fig. 2) and connected to a current stimulation device controlled by the Arduino. This provides a tangible electric shock during the game. While uncomfortable, we would like to emphasize that the electric current sent out from the device is harmless to people. Under development is an extension of this interface using gloves worn by the player to conduct the electricity in a way that the player experiences a tingling sensation on the hands. In addition, we integrated a set of Peltier devices (Fig. 2) into the hand rest to produce hot and cold sensations. This thermoelectric heat pump is a solid-state device that creates a heat flux between the junctions of two materials depending on the direction of the current. Furthermore rubber arrows are shot via a USB device to distract the user.

User Interaction Design

To give the user a realistic experience of playing an enhanced pinball game, the user starts a game with real coins detected by a small infrared sensor inside the coin slot. Next, the user can begin the game, just like real pinball machines, by launching a (virtual) ball into the case using the manual plunger. The virtual ball will then interact with the virtual objects in the horizontal play field. As with traditional pinball the primary user objective is to score as many points as possible by hitting targets, bumpers, ramps etc. on the playfield, which may unlock special game features if hit in a certain order. We will briefly discuss a few examples below to illustrate interactions in the game using some of the named IO-devices.



Figure 3. Left: Headstones acting as targets. Right: Protagonist girl looking at graveyard.

Targets & bumpers

A central piece of the playfield is a cemetery with a number of tombstones that act as targets. To reach these, the user first has to hit the gate of the cemetery a number of times. When the user hits the target headstones (Fig. 3), spiders will crawl out of the tombs towards the player, who feels the tingling sensation of electric shocks. In addition, trees act as bumpers. When hit several times, a colony of bats comes to life creating a high-pitched sound and triggering the rubber arrows to represent the bats flying towards the user.

Ramps

Two ramps are situated at each side of the cemetery to lead up to a platform in the back of the play field. The ramps look like traditional metal pinball ramps.

Virtual characters

The protagonist is a small girl (Fig. 3) sleepwalking on the cemetery and needs to be brought back to bed safely by the successful gameplay of the user. The antagonist is a witch standing on the platform. She is

engaged when the user shoots the ball up the ramps to hit her. Based on the number of hits throughout the game, the witch creates the following magic spells: (1) sending flashes represented by electric shocks, (2) setting trees on fire triggering the Peltier elements to heat up, (3) creating fog around the ball, whenever the user looks at the ball as identified by the eye tracker.

Extended gameplay

The upper screen of the cabinet is currently used to show an introduction to the story and additional animations of the little girl. It is envisioned to use it for extended gameplay in the future.

Ethical Considerations

Although certain social effects, such as boasting in front of bystanders as well as experiencing Schadenfreude only work if enduring the discomfort is truly a challenge, we would like to emphasize that all output is carefully designed to ensure player safety. E.g. the electric shock level provides merely discomfort but the applied current is not harmful. Furthermore, we built in a safety mechanism to avoid the Peltier elements from overheating even if the software crashed. Before playing players will be informed about the effects, and asked to give their consent. Of course, they can easily stop or avoid any discomforting effect, e.g. by removing their hands or looking away, which will merely result in losing points or the game ball.

Future Work

Extensions

Some extensions to the interface are currently under development such as vibrational feedback for a Wii balance board or a vibrational vest worn by the user and rendering the fog with negative parallax causing

it to pop out from the display. Excessive parallaxes can cause discomfort, but are subject to large individual differences currently posing a challenge to the development (see [2]).

We also intend to develop Painball for two players. Each player can then set the pain level intended to endure, before starting a game, which will affect the number of points (the higher the pain level the more points) that can be achieved.

User Studies

We are planning to conduct a first exploratory usability test using qualitative methods (i.e. thinking aloud, interviews and observations) to evaluate the effects of the coherence of input and output devices and gameplay. Based on the results we will tweak the overall storyline and gameplay.

Subsequently, we will use the Painball as a means to study player behavior in experimental set-ups collecting quantitative data (e.g. through questionnaires or bio signals). In particular, we would like to study differences in social (with bystanders) or individual settings, gender differences in game play (e.g. with respect to enduring discomfort to show courage) and effects of pain empathy and Schadenfreude (e.g. experienced by bystanders).

Conclusions

We presented our ongoing work on the design and implementation of a pinball game that combines virtual and tangible elements to create uncomfortable interactions embedded into the game mechanics of the pinball game. Ultimately, through careful balance between discomfort and pleasure as well as social

aspects of challenging other players or showing off, a state of flow should be created with the game. Embedded into the broader research of uncomfortable interactions, introduced by Benford et al [1], the Painball is intended as a means to explore the role of courage, boasting and Schadenfreude in social interactions mediated via technology.

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