Crushed it!: Interactive Floor Demonstration

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ABSTRACT

We introduce *Crushed It!*, an interactive game on a sensor floor. This floor is combined with a multiple projector system to reduce occlusions from players' interactions with the floor. Individual displays, a HTC Vive to track player position, and smart watches were added to provide an extra layer of interactivity. We created this interactive experience to explore collaboration between people when interacting with large displays. We contribute a novel combination of different technologies for this game system and our studies showed this game is both entertaining and provides players with a motivation to stay physically active.

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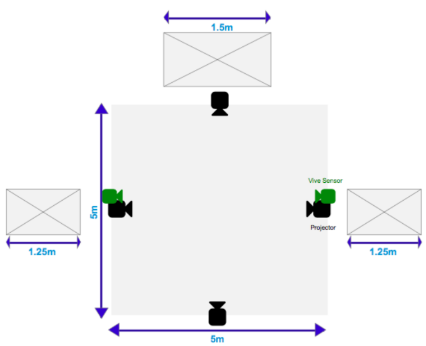

Figure 1: The space requirements of the study

KEYWORDS

Interactive Floor; Collaboration; Gaming; Exergames

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INTRODUCTION

We present our game *Crushed it!* which was developed as part of a larger research project on collaborative interaction. The novelty of this project compared to other projects (like a similar bug smasher game on a technology called playware playground [9] and audience engagement games like Magic Duel [3, 4]) is that it promotes human social interaction and collaboration within a confined interaction space during gameplay.

RESEARCH PROBLEMS AND SOLUTION

We developed the game *Crushed It!* to allow us to study collaborative interactions on large displays and in interactive environments.

From previous research, we know that there is a division of space between people using large displays. Scott et al. describe this division as being territorial [5] with personal territories and shared central spaces. We also know that intent to use space is broadcast socially through body language [6]. This may be possible because of the ascription of personal space and proximity that varies as a function of personal relationship [2]. Other research builds on this idea of personal space [1, 8].

We explored how interactions and personal space are affected by the large interactive floor as opposed to tabletop [5] or large vertical displays [7]. Our installation allows participants to execute collaborative actions and to experience group dynamics while engaging in our game.

We present information on the display, on the floor, and on the watches, and we have studied how changes in the presentation of information (alignment, colour use, divisions) change interpersonal interactions. We will showcase these different modes at interactivity. To increase our ecological validity, we designed our collaboration task to be playful and it is embedded into gameplay. Players of this installation will be asked to interpret game settings and about how players divided up the physical game space.

CRUSHED IT!

The goal of the game is: The players have to crush the 'virtual' bugs projected on the floor ahead of them. Players play competitively to crush bugs and compete to get the highest score. Bugs take

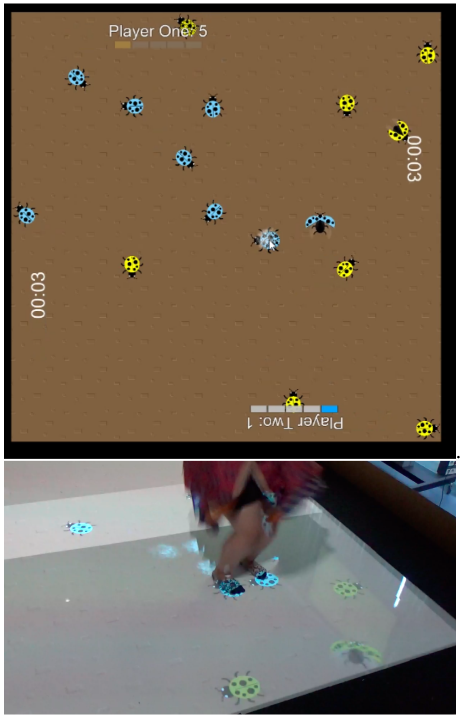

Figure 2: The projected image on the computer and in play

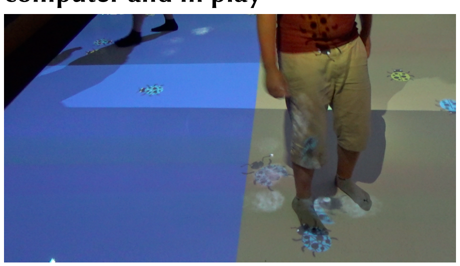

Figure 3: A pair of participants playing the game

two individual hits to be defeated, the first cracks the bug (the player has yet to receive points), the second crushes it (players receive points). Players are informed that it is indeed possible to crush a bug the other player has already stepped on once; thus, the player receives the points despite their opponents initial effort (a practice known from Massively Online Battle Arena (MOBA) games as *kill-stealing*). This rule was designed to promote competition between players. To keep players close in point proximity (to maintain player motivation), we allowed the losing player to execute a 'power jump' for every five bugs killed. The 'power jump' kills all bugs in the players immediate surrounding area of two game units (approximately 20 cm) in all directions. The player with the most points at the end of the three-minute round is declared the winner.

GAME IMPLEMENTATION

The game was programmed in *Unity 2017.3.1F1* on *Microsoft Windows*. The game feels to the participants like a Wack-a-Mole-style game. However, our game tracks the user's step input and jump input via a capacitive sensor floor of $25m^2$ size (SensFloor, Future-Shape GmbH, Germany). The floor itself is set up with a square-shaped sensor design. The floor communicates through both a *Future-Shape Transponder* (a proprietary receiver) and a *Raspberry Pi* hub. The game uses the *HTC Vive* virtual reality headset to track the users position based on the position of their head. The Vive is attached via screw-mounted sensors to a helmet worn by the participant. The Vive sensor is generally placed above the floor under the projector and able to capture the participant on any quadrant of the floor.

The game combines different spaces: the real world, the virtual space above the floor (known as the light box), and the floor itself. The representation of the floor is translated from each bug as one quarter game unit. The bugs appear in the real world as approximately 10 cm in size (4 inches). To maintain the accuracy of the floor positioning, the bugs land only overlaying the centre of a sensor in the floor. Between floors, the bug appears as though it is 'flying' and cannot be caught; thus, assuring the user is constantly stepping on a sensor when making a selection.

To limit the occlusion of the information on the projected floor display, the projectors (BenQ) overlay the scene with redundancy. Although some vulnerabilities still exist, the occlusion is compensated for by the third projector (Canon).

In addition to the floor display, two *LG* monitors (width approximately 120cm) and a main *Iiyama* touch display (width approximately 150cm) which receives touch information via USB input. These peripheral displays distribute user interface information via networked settings over a wireless hotspot. The user interface runs on both Windows and iOS.

Two *Android Wear* watches, *Asus ZenWatch3* are used to provide individual displays. Finally the watches are connected via a wireless hotspot.

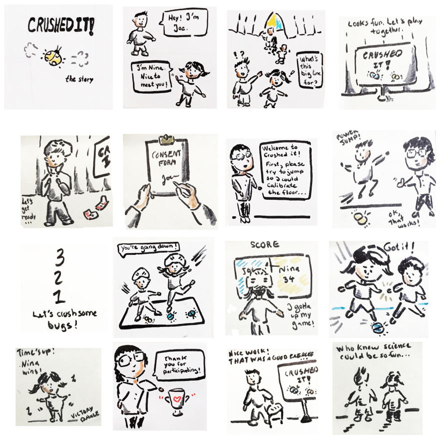

Figure 3: The envisioned experience of the attendees

EXPERIENCE

Overall players will experience a single round of the game. Players will be in pairs and have a chance to get an introductory pitch for the game and a post-game debriefing. We would like for players to walk away with 1) an experience of interactive technology, 2) understanding of our research, 3) new connections with other attendees made while playing and interacting with the game. Please see both figure **??** and the supplementary documents for many more details on how we plan to shape the experience.

We believe this work is relevant to CHI because it demonstrates a unique interactive physical game environment based on a strong research rationale. We will demonstrate to attendees our findings on collaboration through play at the conference.

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