Figure 1: The Move it Move it Microwave

*Both authors contributed equally to this research.

The Move it Move it Microwave - A Multiplayer Microwave for Playful Interactions

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ABSTRACT

Play is a vital part of human nature. Games are designed to harness this instinct, but playfulness can be found outside of games in our everyday life. Human Computer Interaction (HCI) has long focused on devices and interfaces facilitating either productive work or play, but only recently has the community seen the opportunities to include elements of playfulness in everyday life. Based on the concept of Homo Ludens, the Man of Play, the concept of ludic design, with a focus on playfulness, has been introduced. This paper covers the design process and learnings from the making of The Move it Move it Microwave, a multiplayer dance controlled microwave designed for the purpose of playfulness in the home environment. In short tests the device showed potential in providing a playful experience, and opens up the discussion about several topics around playfulness in the home.

CCS CONCEPTS

• **Human-centered computing** → *Interaction devices*; *Gestural input*; Collaborative and social computing devices.

KEYWORDS

HCI, playful interactions, ludic design

INTRODUCTION

Play is an important part of our lives. Play takes place in all ages, all cultures, throughout all of human history and further back. Playfulness in HCI is often discussed in the context of games, but playfulness can permeate other parts of our lives than games. Playfulness in design can be used to simply make an interaction more pleasurable, but also for providing an engaging way for a user to understand

something in their environment. Some examples of these are gamification applications for reducing energy consumption and exergames, games designed to encourage exercise. Playful interactions can also provide a way to socialize with those around us, by giving us a platform where bonding can happen.

This paper details the design process of the two-player dance controlled microwave called The Move it Move it Microwave, and the experience of using a collaborative, playful interface to perform everyday activities. Through the re-design of an everyday object, we hope to create a playful interaction which can be used to conceptualize power consumption in the house hold. Therefore, the research aims to answer the following questions:

What features can be applied to a household device to encourage playfulness?

How can a playful interaction be used to conceptualize energy consumption?

RELATED WORKS

This research is related to topics around playfulness in the design and HCI field.

Playfulness and Homo Ludens

In his 1938 book *Homo Ludens - A Study of the Play-Element in Culture*, historian Johan Huizinga defines some essential characteristics of play, which can be summarized as [7, p.9-13]:

- Play is free.
- Play takes place outside of real life, in a temporary time and space of its own.
- Play is limited to a time and space, meaning it has a beginning and an end.
- Play creates order and perfection.
- Play is not done for material gain.

In the book, Huizinga argues for the importance of play in human nature. The name Homo Ludens, roughly translating to Man of Play, was proposed as a complement to Homo Sapiens, Man the Thinker, and Homo Faber, Man the Maker. The concepts put forward in this book have formed a new design area, called ludic design. Ludic design is design for playfulness, encouraging more playful interactions over utilitarian ones.

Designing for playfulness

Several research project have evaluated the different aspect important to playfulness in HCI. In their 2010 paper, Bekker et al. defines three design values for the design of playful interactions. In the context of designing interactive pieces for outdoor play for children, the proposed design values were "Motivating feedback", "Open-ended play", and "Supporting social player interaction patterns" [4].

Gaver et al. also discuss some lessons learned from the testing of a ludic interactive coffee table. They similarly point to the importance of social engagement, but also put emphasis on the importance of ludic design to be interwoven with everyday activities, for allowing a ludic design to affect the users everyday activities, and the importance of not making a design which only fulfill the users immediate wants. The design tested, the table The Drift Table, was designed with a passive, ludic activity in mind. The Drift Table had a window which showed an areal view of the world, starting at the owners home. Using pressure sensors, the table reacted to the weight distribution on the surface to drift in different directions and speeds. The idea was to let users have an impact on the action of the table, but discourage users from trying to use the table for functional tasks such as navigation. However, the researchers were surprised at how the users still tried hard to use the device for specific goals, such as finding a specific place by stacking items from around the house on the table[6].

On the subject of designing for playful interactions, Bill Gaver argues in his paper *Designing for Homo Ludens* that it is important to include a subjective approach, and not just a scientific one. Designers should include their own experiences, becoming the ludic person they are designing for, and ensure to hold a conversation with prospective users. They also argue that the technology should allow for appropriation, through designing media that encourages lucid activity and by including ambiguity in all the steps of the design process. Finally, when designing ludic interactions pleasure is more important than performance[5].

In an evaluation of a communication device for social circles of families and friends, Siân et al. were surprised to find the device was used for many playful activities. They look deeper into how the device allowed for play, and the types of play which were seen. They came to the conclusion that the richness of the media (photographs, drawing, messages) contributed to more creativity, allowing for playful back-and-forth's, friendly banter, and competitive games. The interface had many constraints, a small display, input through a singular stylus, and everything sent to it could be seen by the entire family. All of this, however, was argued to also be a part of why the design was easy to engage in playful ways with, as the constraints made the interactions simpler. For example, a small display with a simple input made it less intimidating for those who did not view themselves as artistic to contribute, expressing creativity and playfulness[8].

Situated Play Design, proposed by Altarriba Bertran et al. in their 2019 paper *"Chasing Play Potentials: Towards an Increasingly Situated and Emergent Approach to Everyday Play Design"* [1], is a concept of using existing situations in which play is present as a starting point to the design process, which allows the designers to create interactions for everyday playfulness. Altarriba Bertran et al. explored in a later paper the prospect of including playfulness in everyday activities. They argue that designing for playfulness can be hard, as play potential is difficult to predict due to its fleeting nature, but that the emerging field of every day life playfulness is important enough to warrant more research [2]. Altarriba Bertran et al. argue in their description of a bridging concept for playfulness in everyday

activities that situated and emergent play interactions outside leisure can give the activities deeper emotional value. They argue that where as gamification (the use of game mechanics in non-game areas) can be used to increase motivation and productivity, using playfulness in situations where there are no productivity goals is beneficial as well, as play is vital to human life[3]. They also highlight three qualities of play in situated play design: " (1) bringing joy to otherwise unstimulating situations; (2) empowering and supporting agency; and (3) promoting social connection. "

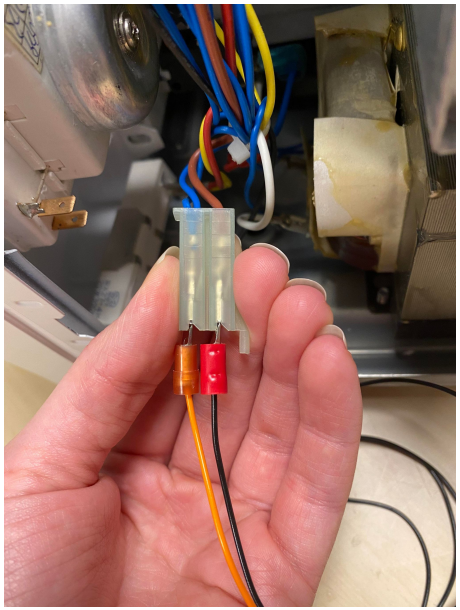

Figure 2: The on/off connection of the microwave, connected to a relay.

METHODS

Design Process

The ideation phase of the design process included research into previous interfaces with novel interactions and research on playful design. Some projects reviewed for this design process include the*Drum Powered Blender* by comedy duo Foxdog Studios[10], the game *Punch the Custard* by George Buckenham[11], and the *Scream Powered Microwave* by Youtube inventor Michael Reeves[9]. With the ideas from the research in mind, a brainstorming session was held to produce potential concepts for a playful interface. The limitation of the shared kitchen was introduced in order to simplify the ideation process. Bodystorming was done in a shared kitchen space to explore the potential ideas, and from this session the idea of a dance controlled microwave was established. The microwave was chosen since its use typically lasts for 2-5 minutes which is comparable to the average duration of a musical piece and seemed like a convenient duration for dancing. During the construction of the microwave, an iterative method of continuous testing and improvements was implemented. The prototype was tested both in terms of how accurately it could sense dancing, but also in the user experience aspect of usage. This was done through both the designers' perspective as users, and through short tests with others. During these tests, participants who were not already aware of the project were initially instructed only to "move" to activate the device. This was done in an attempt to evaluate whether the music would be enough to prompt the users to specifically dance. Notes were attached to the floor, pointing to taped areas where the participants should stand to be in view of the camera.

Technological Solution

A standard microwave with a mechanical timer was used for the project. In order to turn the microwave on and off, a relay was attached to the pins connected to the timer of the microwave, as seen in Figure 2. The relay was connected to an Arduino UNO board (Figure 3), which allowed for the circuit to be closed and opened from a computer using the Firmata protocol.
The computer was used for dance detection, playing music and controlling the microwave. A web cam placed on top of the microwave was used as input for pose estimation, done using PoseNet by Tensorflow. PoseNet was called from within Max/MSP with the help of a Node for Max wrapper

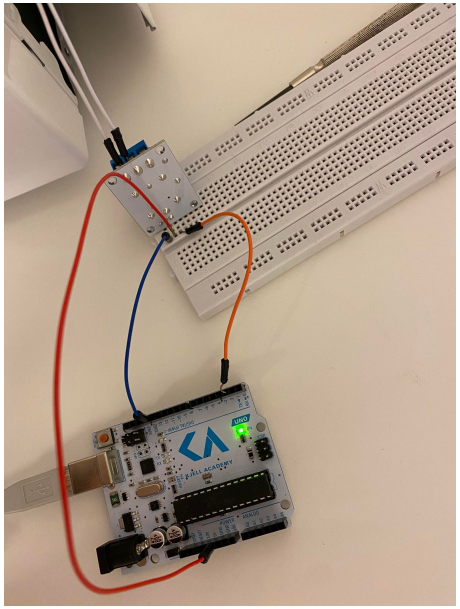

Figure 3: The connection of the relay to the Arduino.

developed by Yuichi Yogo. The pose estimation information consisted of coordinates about 17 joints on the human body, however, only the head position was used. The frequency content of head coordinates was analyzed and the information was reduced to a boolean indicating whether the person in front of the camera is dancing or not. For the movement to be considered dancing a high enough fundamental frequency on the vertical axis had to be achieved ($\tilde{1}$ Hz) with a big enough amplitude, this descriptor was used to trigger a simple drum loop. A similar process was used for the horizontal position, which was used for triggering an air horn sound. This process was performed for two people at the same time, the microwave as well as an additional music loop were turned on when two people where dancing in front of the microwave.

RESULTS

The device was evaluated in two ways, through the experience of the designers when using it (Figure 4), and through four short tests held with students and staff at The Royal Institute of Technology KTH. The setup can be seen in Figure 5. The observations from the tests show that users of the device found the interaction humorous and enjoyable. The participants showed signs of discovery and exploration, trying different movements to understand which ones would illicit a response. One participant tried to stop dancing, and then start dancing again to see what would happen. One participant mentioned it was like "powering the machine [by] dancing". Two participants had a hard time getting it to work, as they did not move enough for the software to pick up on it, but when instructed to move more they kept it up in an attempt to get the microwave to run continuously. In one test, where neither of the participants were part of the design team, the participants were told it only works when both are moving. This prompted one of the users to try to encourage the other to keep dancing to turn the microwave on. Due to some technical issues with the device, there were instances where the microwave shut off even when the participants moved in front of it. Because of this, two participants had to be told to continue moving, as the stops were initially confusing. A demo video of the microwave in action can be found at the following link (https://drive.google.com/file/d/1_PJMc8WXZnygarllZvHo7-2Ss75A7cFj/).

DISCUSSION

The exploration of playfulness interactions in HCI has potential, as they can add deeper value to more mundane experiences. However, designing playful interfaces, especially for prolonged or everyday use, comes with its difficulties. It is hard to pinpoint the contributing factors to a playful experience, partially due to its ephemeral nature. Playful interfaces can also be affected by novelty, something which could easily wear off. The humorous aspect of using a device in an unexpected way is mostly spent as soon as the interaction starts to become less unexpected. In our short tests with participants, it was noted that there was a lot of playfulness portrayed in the initial use of the device. However, the

Figure 4: Dancing in front of the microwave.

designers who had been testing the device for weeks were somewhat less amused by using it. This is a pretty clear indication that part of the enjoyment of the interaction was dictated by novelty.
The user evaluation on the device was very short, and included only the first impression of the device. This means the conclusions which can be drawn from the tests are limited. Considering the designer's perspective, it is likely that the device would not be seen as equally engaging if it was used for a longer period of time, or if it was the only technology available for heating food.
The microwave was designed to encourage dancing by using music, however, it does not differentiate between dancing and other movement. This is due to a difficulty in interpreting the input, and a subjective view of what constitutes as dancing, but during our tests all participants used dance movements, regardless of whether they were prompted to do so or not. The choice to include dance-friendly music in the design could have contributed to this, but it is not possible to confirm this with the small scale tests performed in this study.
On a grander scale, using the body to control a machine can be a way to conceptualize usage of energy. The comment from one of the participants on how it was like powering the device with your body is a strong indication of the device having this effect. Technology for conceptualizing energy consumption could be utilized in an effort to reduce energy consumption in the household, something that could be necessary to reduce environmental effects.
The experience of interacting with the Move it Move it Microwave raises many questions. Why is it playful or fun to control a microwave through dancing? Novelty, of course, is an obvious answer to this, but not everything which is novel is fun or invites play. This interaction method of dance requires investment and effort, compared to the previous interaction of pressing a button, which in our experience creates a feeling of connection with the device. You want the microwave to run, not only to heat your food, but it gives the feeling of an accomplishment, and a feeling of doing something together with someone, even when using it yourself.
It is difficult to evaluate the two player perspective, as tests were only run on one condition, but from one of our tests we noted a relationship between the users as being almost competitive. One of the participants tried to make the other one dance more vigorously in order to keep the microwave from stopping.
We suggest further research into several topics touched upon in this project. One thing that could be investigated is the topic of playful household devices. Considering the increase in computers in the home, the subject of how to include playful design in the home in a way where it remains appreciated over time is a worthwhile topic to explore. Another topic warranting further investigation is how the interaction with playful devices is affected by requiring multiple participants. Which elements make playful interactions competitive or collaborative? How does needing another person to perform an otherwise solitary task affect your reaction to the device, and to the people around you? This design showed promising results for using dancing as input. Could it be possible to use this to achieve other

Figure 5: The microwave setup during tests.

goals in conceptualization? Dancing can show energy consumption, but also effort or rhythm. Could a dance controlled vacuum cleaner show children how much effort is needed to clean a house, or a dance controlled sound instrument to show rhythmic movements in choreography?

CONCLUSION

Playfulness is an important topic for the future of interaction design. It can allow us to change the way we interact with the devices in our homes, and add value to our lives through engagement and entertainment. The design and evaluation of devices such as The Move it Move it Microwave can contribute to knowledge in this field as they allow us to experience how playful interactions can affect the way we view our relationship to our technology.

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