OMNI

Fun and fair game play between people with and without visual impairment

A bachelor thesis presented for the degree of
Creative Technology

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Abstract

OMNI is a reaction game which is fully based on vibrations. That way, it can be played by people with and without visual impairment. When people with different abilities play OMNI together, the question whether that is still fun and fair will arise. Therefore, this research focuses on how to make OMNI as fun and fair as possible for people with and without visual impairment. With the use of researching related games, literature, survey, expert interviews, user interviews, designing prototypes and testing with the target group, this research provides insight into how fun and fair game play can be measured and evaluated for OMNI. These insights were given by game designers, people who work with visually impaired, people who design games for the visually impaired, friends and family of someone who is visually impaired and last but certainly not least, the visually impaired themselves. With these insights, this research has shown that there is fairness in the unfairness. The game should be designed around that concept by balancing the abilities of people instead of tackling their disabilities.

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List of Figures

List of Tables

Contents

Chapter 1

Introduction

1.1 Context

Today's society is highly based on visuals. In fact, people retain up to 65% of their information based on what they see and only 10 to 20% on what they hear [8]. From marketing strategies on social media to classic billboards along the highway, visuals have a significant role in our everyday life [15]. This also holds for tabletop games like *Settlers of Catan*, *Set* and *Halli Galli*. In a strategy-game like *Catan* the players need to have an overview of the board. In the card-game *Set*, players need to spot the right set of three cards while looking at a total of 12 cards [3]. *Halli Galli* is a card-game where players need to slam on the bell when the cards display the right number of same fruits. For these, and many other games, people need to be able to see the board or cards in order to play the game, making it nearly impossible for visually impaired people to play along.

1.2 Problem

In order to include the visual impaired, existing games have to be adapted or new inclusive games have to be designed. This has been done in various ways: from adding tactile elements to the product [23], braille to cards [24] or blindfolds for the sighted players [7]. These solutions seem great on the first hand, but when given a second thought these solutions are not optimal in terms of fun and fairness, especially when people with and without visual impairment (VI) play together. Even when tactile or braille elements are added to the product, people with a VI still have a disadvantage in terms of speed. Sighted people can see the overview of the board by simply giving it a glance while people with a VI have to feel everything first. Apart from missing an overview of the board, it has been shown that when readers who read braille are slower and less accurate at reading when compared to readers who read printed text [25]. Unfortunately, like adding braille or tactile elements, blindfolds are not the optimal solution.

When adding blindfolds to a game, sighted players get a handicap making them have the disadvantage since players with a VI play as they normally would. All in all, adding these elements to adapt the game do make it inclusive, yet it puts a focus on the handicap which can create uncomfortable situations as well as unfairness.

1.3 OMNI

In November 2018 a group of second year Creative Technology students did some research in designing a game where people with and without VI can play together as completely equals without any disadvantages, adaptations nor focus on the handicap. As a result of this research, a reaction-based game was created where the whole visual aspect is removed. This research was part of the project "Design and research for user experiences" of module 6 of the bachelor. After 10 weeks of research and lo-fi play testing, the project continued in module 7 where a business plan was made. The product got more identity with new prototypes, game modes and an overall theme, as well as a new name with accompanying slogan: "OMNI – Feel it, find it, flip it". The product consists of a hardware platform, four cups that can vibrate and contain movement sensors, and a game that can be played with it. The idea of the game is that the players have to feel around, find the vibrating cup and flip it to score a point. OMNI got many positive reactions from the public when it was showcased during Dutch Design Week 2019. The visitors considered it unique and innovative to build a game from the capabilities of the visually impaired instead of starting from their handicap.

1.4 Goal

In February 2020, fellow Creative Technology student Anouk de Graaf has worked on improving the hardware of the game to allow different game modes. She successfully has implemented several games with the improved hardware. Yet, these game modes have not been evaluated in terms of fun and fairness between people with and without VI. Therefore, the goal of this thesis is to present new game modes for OMNI without unfair disadvantages, exclusion or adaptations. The focus will be on fun and fair game play, so people people with and without visual impairment can enjoy and play the game as equals. To achieve this, the following research question must be answered:

"How to design and evaluate fun and fair game play of the tangible game OMNI between people with and without visual impairment?"

1.5 Approach

In order to answer this main question, specific table top games will be explored. After this exploration of the state of the art, literature is used to discuss bal-

anced and fun game play in the following chapter. Then, with the help of interviews and user research, more insights will be gained on how people with visual impairment perceive fun and fairness while playing tabletop games. From all these insights, new game modes will be designed which are to be tested with the user group. At last, these game modes will be evaluated and discussed. All in all, combining the above-mentioned results will hopefully bring more fun and fairness in the game play of OMNI.

Chapter 2

State of the art: Existing tabletop games

2.1 Introduction

From dice games to card games, from board games to tile games... When entering a toy store, one will find numerous tabletop games. Hopefully, OMNI will be one of those one day. But first, as the introduction stated, the game play needs to be improved on fun and fairness. In order to accomplish that goal, it is important to understand and analyze the field. Therefore, this chapter will discuss existing tabletop games. As there are many sorts of tabletop games, only certain games will be discussed in this state of the art analysis. There will only be looked at games which are related to OMNI. Since OMNI is considered a reaction game, this is the first group of games that will be discussed in this chapter. This will be followed by games which are based on senses and games with tactile elements. After the summary of all these games, a taxonomy will be presented to analyze this state of the art. This analysis will highlight the important mechanics and elements from the games which can be an inspiration for the games of OMNI. From the analysis, a conclusion will be drawn to see which games are for the visually impaired and where OMNI can fill in the gaps.

2.2 Reaction games

2.2.1 Definition

There are multiple ways to define a game as a reaction game. Notebeart and Conrilly characterize it as an action game, where one does not sit calmly on a chair[16]. On the site of BoardGameGeek, multiple terms can be found. Like Notebeart et al. they also mentioned the category action/dexterity, here they explain that with these games the phyiscal reflexes and co-ordination of the players are at heart [1]. An other category on BoardGameGeek which

describe reaction games is Real-Time. When playing these games, players need to take turns as quickly as possible [18]. It is possible to have multiple categories assigned to one game as Notebeart et al. stated[16].

2.2.2 Halli Galli

Halli Galli[1] is a card game with cards showing four kinds of fruits in groups of one to five. The idea of the game is that players need to slam on the bell as soon as there a total of five of one kind of fruit on the table. This type of game requires the skill of adding up the number of fruits as well as the reaction speed to hit the bell as quickly as possible.

Figure 2.1: Game of Halli Galli

2.2.3 Set

During a game of *Set*[2] players need to find certain combinations of three cards out of the twelve cards shown. Every card has three attributes: color, shading and shape. A player has found a right combination when either all attributes are the same or all different. Here, the game mechanic *Speed Matching* is applicable[21], meaning players need to find a match with game elements as quickly as possible.

2.2.4 Spot It!

Another game which requires speed matching is *Spot It!*[3] also known as *Dobble*. Like the previous two games, Spot It! is also a card-game. Here, the idea is

[1] https://boardgamegeek.com/boardgame/2944/halli-galli; *Accessed on 09-04-2021*
[2] https://boardgamegeek.com/boardgame/1198/set; *Accessed on 09-04-2021*
[3] https://boardgamegeek.com/boardgame/63268/spot-it; *Accessed on 09-04-2021*

Figure 2.2: Game of Set

to find the matching symbol between two cards. The product offers various gamemodes, one where there is one card in the middle and players need to find the matching symbol from their own deck of cards but also one where the deck is in the middle and the players need to match the symbol on the card on top of the deck with the card they have. Depending on the gamemode, one wins by having as many cards as possible or by clearing their deck the fastest.

Figure 2.3: Idea of Spot It!

2.2.5 Loopin' Louie

Loopin' Louie[4] is a game where the players need to protect their chickens. These chickens are represented by coins which can be knocked by a rotating plane in the middle. Every player has a small lever which can dodge the plane. By

[4]https://boardgamegeek.com/boardgame/327/loopin-louie; Accessed on 18-04-2021

dodging the plane, there is a possibility that the plane knocks down the other players' chicken.

Figure 2.4: Gameplay Loopin' Louie

2.3 Games based on senses

2.3.1 Definition

Since the game of OMNI is designed to be played by people who are able and unable to see, the sense of sight is disregarded. In this part of the chapter, there will not only be looked at games where senses have been disregarded, but also at games where the use of a specific sense is specifically implemented.

2.3.2 Konario

Like the makers of the game promote, *Konario*[5] is a game for every sense. Each of the five senses have a certain amount of pairs of cubes. The idea of the game is for players to find matching cubes. All the cubes are laid down the table with the black side on top. A player picks up a random cube and everyone explores it. This can be done in five different ways as stated in table 2.1. After every player has explored the cube, the active player can now turn an other cube in order to find a matching pair.

The base concept of the game is just like the classic game of *Memory* where match-making is central. What makes this game so unique is that it can be adapted quite easily to the players. If a player can not see for example, there are still 4 categories of cubes left which makes it still playable.

[5]https://konario.com/about-konario/; Accessed on 10-04-2021

Sense	Way of exploring
Smell	Scratch and sniff
Sound	Shake and listen
Touch	Put finger inside the cube and feel
Taste	Open the cube and taste a pastille
Sight	Look at the pattern

Table 2.1: The ways of exploring the cubes of Konario based on their sense

Figure 2.5: The box of Konario together with its cubes

2.3.3 Sense of Smell

The Perfumer

Here the sense of smell is put central. The board and cards are made with a special printing technology where they have been made olfactory. The idea of *The Perfumer*[6] is that the players have to find out the special ingredients of the secret formula by smelling.

Spice Navigator

In this game, players are on European merchant ship to go on a journey to Asia and Africa. The main purpose of *Spice Navigator*[7] is to bet and bluff in order to make the best trades. Players can get an expert price for a spice. In order to get that, they need to open a random container and guess which spice is in it. The spices are in random containers and the players have to sniff them in order to find out which spice it is from the list. Unlike with The Perfumer, the sniffing element is just an extra and not the main mechanic of the game.

[6] https://boardgamegeek.com/boardgame/204576/perfumer; *Accessed on 09-04-2021*
[7] https://boardgamegeek.com/boardgame/2697/spice-navigator; *Accessed on 09-04-2021*

Figure 2.6: Game elements of The Perfumer

Figure 2.7: Original (French) version of Spice Navigator

2.3.4 Sense of Sound

Charades

A traditional parlor game which can be traced back to the 16th century, then simple, nowadays available as boxed versions. *Charades*[8] is the classic party game where people have to silently act out a word or phrase. The key here is that the sense of sound is completely removed. Players need to rely on non auditory gestures and signals, which makes it frustrating yet a lot of fun.

Stop Thief

Where Charades is a game without sound, *Stop Thief*[9] is a game where it is all about sound. The first version of the game contains an electronic crime scanner. Through this device, players can hear the thief they need to catch. The players do not know where the crime has been committed, so by listening closely to the auditory hints given via the scanner the players can find out where the thief is located. This game has been revived in 2017 where the scanner is replaced

[8] https://boardgamegeek.com/boardgame/5122/charades; Accessed on 09-04-2021
[9] https://boardgamegeek.com/boardgame/1992/stop-thief; Accessed on 09-04-2021

by an app, giving the game more dynamic and better sound quality[10]. Where the first version had dice to move around the board, the newest version now has movement cards. With this alteration, the luck has been replaced by the element of strategy.

Figure 2.8: Old version of Stop Thief from 1979 (Left) and the renewed version from 2017 (Right)

Igloo Pop

The following game could also have been placed in the category of reaction games. *Igloo Pop*[11] is a children's game where players need to guess how many beads are in a igloo, solely by shaking and listening. During this game, there are multiple igloo and 9 cards displaying certain numbers. When these cards are dealt and can be seen, the players start shaking the igloos to find one that matches a card. Once a player has found that match, he can claim the igloo by placing a chip on top of it. The player with the most right claimed igloo's wins. This game uses sound as the players need to listen carefully in order to know how many beads are in the igloo. However, the vibration which occurs from shaking the igloo is also to be noted making it using sound and touch.

Bop It!

With the game of *Bop it*[12], players need to listen carefully to the instructions. The electronic device will tell the players what to do with it, and the players need to act fast and accordingly. There are three actions within the original game; to bop, pull or twist. Bop it! offers multiple ways to play, solo where

[10] https://boardgamegeek.com/boardgame/215312/stop-thief; Accessed on 09-04-2021
[11] https://boardgamegeek.com/boardgame/8668/igloo-pop; Accessed on 09-04-2021
[12] https://boardgamegeek.com/boardgame/95710/bop-it; Accessed on 18-04-2021

Figure 2.9: The game of Igloo-Pop

you can beat your own high score as well as for multiple players, one of which is Party Bop where players need to use their elbows, knees and hips as well.

Figure 2.10: Bop It!

2.3.5 Sense of Touch

Taxi Wildlife

In the game of *Taxi Wildlife*[13] the sense of touch is used by searching for the right wooden object. These objects are in the shape of certain animals and are placed inside two seperate bags. When the dual cards are drawn, two players need to find their animal shown on the dual card as quickly as possible. To

[13]https://boardgamegeek.com/boardgame/159573/taxi-wildlife; Accessed 09-04-2021

achieve this, they can not look inside the bag and are therefore reliant on their sense of touch.

Figure 2.11: The game setup of Wildlife

Dr. Shark

During a game of *Dr. Shark*[14] players need to form evidence by retrieving hidden clues in order to put Dr. Shark (head of a secret criminal organization) behind bars. These clues are hidden in a bag which players need to grab from without looking inside the bag. This ensures that the players are relying on their sense of touch in order to find the right clues.

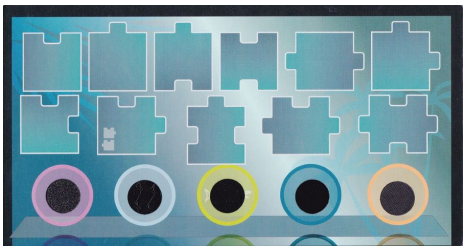

Figure 2.12: The different textures and shapes of the clue tiles.

Lightning Reaction Reloaded

Lightning Reaction Reloaded is a reaction where the objective is to push a button as soon as the red light turns green. The last player to push the button will get a (painless) electric shock. With this feature, the fear of getting shocked adds an extra dimension to the game.

[14]https://boardgamegeek.com/boardgame/108783/dr-shark; Accessed on 18-04-2021

Figure 2.13: The game object of lightning reaction.

2.3.6 Sense of Taste

TasteBud

Vi, Arthur and Obrist have integrated the sense of taste to the classic game of Minesweeper[22]. Although Minesweeper is a digital game, this taste-integrated version is worth mentioning in this state of the art analysis. Vi et al. used bitterness, sweetness and sourness to give the player feedback. The player will receive a bitter taste in their mouth if the player clicks on a mine or when the countdown timer reaches zero. When there are only 10 seconds left on the countdown timer, the player will get a sour taste in their mouth. This also happens when the game has started. When the game is won and when the player reveals a large space, they will receive a sweet taste in their mouth. The game can be perfectly played without the taste, but with TasteBud the gaming experience is enhanced creating totally new experiences.

2.3.7 Sense of Sight

Pictionary Air

The classic game of pictionary has now been reimplemented with an electronic pen and app. With *Pictionary Air*[15], instead of drawing on the paper, players have to draw in the air. The drawing can then only be seen by the guessing players with the help of the application. This is noteworthy since the player who is drawing the word, does not have a clue what they are drawing. This makes it quite interesting since it is necessary for the guessing players to see, while removing the sense of sight from the drawing player.

[15]https://boardgamegeek.com/boardgame/272889/pictionary-air; Accessed on 10-04-2021

Figure 2.14: The product box of *Pictionary Air*.

Blindfolded Twister

A normal game of Twister contains a spinner and a playing mat with different coloured spots. One player spins the spinner which shows the other players what limb they have to put on which coloured sports. In *Blindfolded Twister*[16] this is all done without the ability to see. All players need to put on blindfolds and feel around the playing mat to distinguish the stop they need to be at. Because of the lack of the sense of sight, the original game of twister is completely transformed, making the users use their sense of touch as well.

2.4 Games with tactile elements

2.4.1 UNO Braille

The popular cardgame UNO has been made into a visually impaired friendly version. A collaboration of Mattel Games (developer of UNO) and the National Federation of the Blind have created this Braille version of UNO. By adding braille to two corners of the cards, people with a visual handicap can now play along with sighted players. Rules have been adapted as well since every players need to call out their drawn card which can be checked by the player who is visually impaired by touching the discard pile. Besides that, as the site

[16] https://boardgamegeek.com/boardgame/266000/blindfolded-twister; Accessed on 18-04-2021

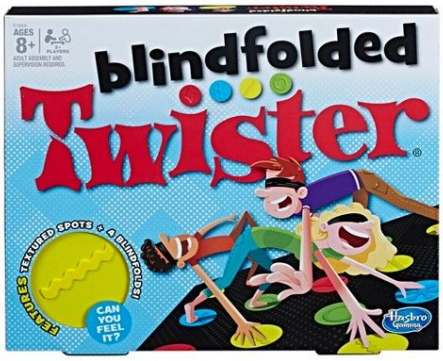

Figure 2.15: The product box of *Blindfolded Twister*.

mentioned, now blind players can always call for a "Card Check" to find out how many cards each player has left. This is a great way to make games inclusive to all [**UNOGames**].

Figure 2.16: The product box of *Cards of UNO braille*.

2.4.2 Connect Four

In a classic game of Connect Four, where players need to make their chips form a row of four either horizontally, vertically or diagonally, the chips are distinguished by their colour. With this tactile version, the chips can now also be differentiated by whether they have a hole or not. Now, the red chips have a hole which makes the difference in chips tangible.

Figure 2.17: The product box of *The tactile version of Connect Four*.

2.4.3 Braille Sudoku

A puzzle game which is mostly played on paper, but then tangible. That is what this braille Sudoku is all about. This set contains a wooden board where coloured pegs with a number in text and in braille can be placed on. Since a Sudoku comes with pre-placed numbers, the pegs can be placed on two different heights. That way, a player can now which numbers are definitely on the right place and which are not. Delivered with the Braille Sudoku Set is a braille booklet containing the puzzles and their solutions.

2.5 Analysis

In this section, the 19 games of the previous sections will get tags based on their game elements and characteristics, these are shown in Table 2.2. These are the tags which are relevant to OMNI as seen in Table 2.3

ID	Tag	Explanation
1	Action	Use of physical reflexes and coordination skill
2	Speed	Players need to act as quickly as possible
3	Electronic	The game contains electronic devices
4	Game Modes	The product offers multiple ways to play games
5	Overview	Players need to have an overview of the game
6	Accessible	Main game objects need to be accessible to all players at all times
7	Sense	Enhances the game experience by the use of a specific sense
8	No sense	Disregarding a sense to create a different game experience
9	Adaptable	Game can be adapted for players with a VI without changing the game experience of all players
10	Vision	Game can be played without vision

Table 2.2: The tags used to distinguish the games

ID	Tag	Relevance OMNI
1	Action	Physical reflexes to find and flip the right cups
2	Speed	Players need to act as quickly as possible*
3	Electronic	The cups of OMNI are electronic driven
4	Game Modes	The product of OMNI offers multiple game modes
5	Overview	Convenient to have an overview of where all the cups are*
6	Accessible	Cups on the table need to be equally accessible for every player*
7	Sense	Players need to feel around, hence the focus on the sense of touch
8	No sense	OMNI can be played without vision
9	Adaptable	OMNI is already inclusive meaning no adaptations need to be done for players with VI to play the game
10	Vision	OMNI can be played without vision
* = Only applicable for certain game modes		

Table 2.3: The tags and their relevance to OMNI

From the overview of table 2.4, it can be concluded that except for the party games charades and Pictionary air, all games which disregard a sense, do use a specific sense to enhance the game experience. When looking at the game description in the previous sections, games where the sense of sight is missing, either use the sense of touch or the sense of sound to enhance their game experience. When using the sense of smell and taste, the sense of sight is not disregarded. Notable is that disregarding the sense of sight, does not mean that the game can be played by the visually impaired. That is because most

Game Name	Tags										Total
	1	2	3	4	5	6	7	8	9	10	T
Halli Galli	x	x			x	x					4
Set	x	x			x	x					4
Spot It!	x	x		x	x	x					5
Loopin' Louie	x	x	x		x	x					5
Konario	x			x	x	x	x	x	x	x	8
The Perfumer					x		x				2
Spice Navigator					x		x				2
Charades	x	x		x				x			4
Stop Thief			x		x		x				3
Igloo Pop	x	x			x	x	x	x			6
Bop It!	x	x	x	x	x	x	x		x	x	9
Taxi Wildlife	x	x			x		x	x			5
Dr. Shark	x	x			x		x	x			5
Lightning Reaction Reloaded	x	x	x			x	x				5
TasteBud	x		x		x	x	x				5
Pictionary Air	x	x	x	x		x		x			6
Blindfolded Twister	x				x	x	x	x	x	x	7
UNO Braille					x				x	x	4
Connect Four					x	x			x	x	4
Braille Sudoku					x	x			x	x	4

Table 2.4: Overview of the games

games still contain game objects which they need to see in order to read the cards or maintain overview.

2.5.1 Games playable by the visually impaired

Although most games still need vision to play the game, there are six games which can be played without vision. From these six, five of them do not have the tag speed. To state in other words, all the games where the player needs to act as quickly as possible can not be played when visually impaired. All games, except for one, Bop It!. The only tag missing from Bop It! is that it is not disregarding a sense to create a different game experience. The interesting thing here is that they did not need to, the game is still playable when players can not see. The question that arises is whether sighted players have an advantage over non-sighted players when playing the game. Ideally, this does not happen and all players are equal since engagement of the players is crucial for a game to be liked [5]. The next chapter will discuss this equality and engagement on a deeper level.

Chapter 3

Balanced and fun game play

In most cases, multiple players are involved when playing tabletop games. Generally, their game experience is dependent on their own and their opponent's skill. The key when designing games is therefore to make it enjoyable no matter the player's skill. It could be boring when it is too easy to beat the other player(s), yet it could be frustrating when it becomes too difficult [13]. That is why it is important to know where to find the right balance between those two. In this chapter, the definition of balanced game play will be explained as well as how it can be designed. Following will be how to measure such balancing in board games and how to translate this all to balanced game play for the visually impaired.

3.1 Balance

3.1.1 What it is

Balance in games is quite a broad term and can be defined in many ways. One of those is to find the right balance between the previously mentioned difficulties of challenge. That balance can be found in the "flow-channel" , which Csikszentmihalyi was the first to explain it, and Koster was the first to bring it into a gaming context [13]. According to Sirlin, a multiplayer game is considered to be balanced when there are tons of viable options for the players available. These options are presented before and during the game. The options that are presented before the game can be defined as "fairness", this entails the equal chance of all players no matter their starting position. The options available during a game are also important, the player must have meaningful choices which should not be overshadowing each other. These different options can also be named local and global balance, where local describes the elements which happen at any moment during the game and global describes element which are happening through out the whole game [20]. Schreiber has differentiated the term by putting it into four different categories: single player, multiplayer,

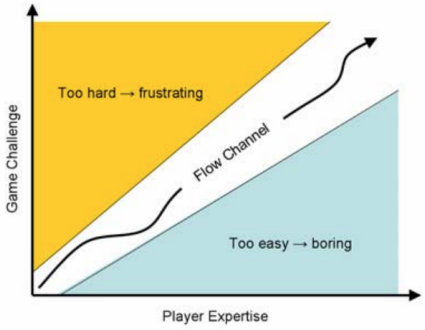

Figure 3.1: The flow-channel which shows the right balance between the challenge of the game and the skill of the player.

within a game, within a system [19]. The term "balance" is used in single-player games to define whether the difficulty level is suitable for the target audience. In multi-player games the starting position of all players are compared to one another. This is especially the case with games which contain asymmetry, meaning players do not start with exactly equal positions and resources, that way, it could be easier to win when having a certain starting position. When there are several strategies or paths to victory within a game, balance is used to describe whether following one strategy is better or worse than following another. Lastly, the category within a system contains games which have similar game objects. Here, balancing is used to make sure the cost/benefit-ratio of these objects are similar and rational as well as not too overpowering from each another.

3.1.2 How to design

As there is not one single concrete definition, there is not one exact method on how to design a balanced game. A game can be balanced either indirectly or explicitly. The players in an indirectly balanced game are unaware of the balancing process. When the players are aware of the fact that the game is balanced, it is called an explicitly balanced game. Then there is also a difference between statically balanced games (based on skill skill level prior to the game) and dynamically balanced games (based on performance during the game) [13]. In the end, it comes down to what experience the game designer wants to achieve with its game. Designers work on different rules during the creation process of their games in order to explore the space of potential actions and consequences. When their systems become more complex, it becomes more difficult to manage the variety of all potential scenarios that can arise from various player interactions with not only the system but also one another, eventually making it harder to measure.

3.1.3 How it is measured

This is where play testing comes in, during these sessions edge cases can be be uncovered that the designer overlooked, as well as insights about the game's many complexities [4]. Key here is to make small changes to specific aspects of the game for every play test round. These small adaptations can have unintended consequences for the game experience which are also not that easy to justify [11]. That is why it could be convenient to hold a questionnaire afterwards where the play testers could state how they felt when playing the game. IJsselsteijn, de Kort and Poels have built The Game Experience Questionnaire (GEQ) which is based on game components, psychological and behavioural involvement and how players felt afterwards [10]. Apart from questionnaire like these, observations can be made during the play test. Multiple researches have been done to experiment with making those observations with the help of smart algorithms and artificial intelligence [4, 11]. An other way of evaluating the balance of a game is to interview the play testers afterwards. These interviews can also consist of questions from the GEQ like done in [13]. The benefit of asking the play testers the questions yourself is the option to follow up and elaborate more on given answers.

3.1.4 Balanced game play for the visually impaired

The above mentioned theories can all be put into practice when designing balanced game play for the visually impaired. Things to focus on could be to remove the asymmetry in the games. This can be done by making sure all players start with equal positions; a sighted person should not be able to have an unfair disadvantage at the start of the game because it has seen certain game objects. This also holds through out the game where stimulant-response-feedback must happen in a consistent manner [2], people who are sighted and non sighted must experience the same. This is interesting since that is quite difficult to achieve, as stated when an adapted game of memory is play tested by children with a variety of visual impairments [17]. For partially sighted players, the game does not place as much of a cognitive burden as it does for blind users. Users who are partially sighted have a better way of localizing the positions of the game objects. During game play, partially sighted users may focus on recalling the sound and using visual memory to locate it, while blind users lack these external visual aids for remembering. A blind person must use a mental picture and/or the game's position sounds to replace visual memory aids.

Because of these differences, a recommended approach of designing balanced inclusive game play contains several key elements [14]. Starting with having a mixed set of visual abilities, age groups and roles as participants of the play test. Having this variety, the representation of each group will be included making the designing of the game more inclusive to everyone. Secondly, accommodating a familiar and comfortable environment for the participants could be useful as well since that mimics the ambience of playing table top games in real life. Lastly, by the use of a variety of design methods inclusiveness can also be achieved. These

methods mentioned in [14] entails three things. First, the use of multi sensory materials which are mainly audio and haptic. By having consistent feedback which can be perceived the same amongst everyone, it becomes balanced since the experience is equal to all players [17]. An other design method is having the players role play with each other. When players are individually given a certain role, feelings of control and responsibility can arise which puts an emphasis on being included in the game. Thirdly, narration techniques by players can be used in order to let the players with a visual impairment aware of what is going on in the game.

Roland Graf mentions one other type of balance which is especially helpful when players with and without disability play together [6]. This balancing approach, which is also known as player balancing, typically involves modifying game mechanics to provide an handicap or help to one of the players.

All in all, these methods combined will give a good approach of removing asymmetry and exclusiveness in games for visually impaired people.

Chapter 4

Visual inclusive games in practice: an ethnographic perspective

4.1 Introduction

The previous chapter discussed the theory of fun and balanced gameplay. The next step is to translate that into practice by approaching the target group and its experts in the form of surveys, interviews and a playtest. This chapter will discuss all these different parts of the ethnographic research and explain how it was done for each part. By using this ethnographic perspective, more insight will be gained from the point of view of the target group and their experts. Combining these insights with the literature discussed in the previous chapter, a list of the objectives and requirements can be formed which will be discussed in the next chapter.

4.2 Approach

The ethnographic research was done by sending out a questionnaire to the target group and taking interviews with both the target group and their experts. First, permission from the Ethical Committee was requested by informing them about how this part of the research will go, and how it follows the current COVID-19 measures. The form and additional document about the research methods can be found in the Appendix.

4.3 Questionnaire

For the Questionnaire, the target group was divided into people who are visually impaired and people who know someone who is visually impaired. The goal of the questionnaire is to do more research on how the target group experience playing tabletop games (with each other). Since that experience can vary from person to person, the purpose of this questionnaire was to gain as many insights as possible.

4.3.1 Method

To receive as many responses as possible, the threshold for participants needed to be low. Therefore, it was purposely chosen to have a digital questionnaire made in Google Forms which does not include an extensive consent form as that might scare people. Nonetheless, the participants did get information about the research beforehand. It tells them that the questionnaire is completely voluntary, takes no more than 15 minutes to complete and can be done anonymously if preferred. The participants could only start with the questionnaire if they agreed with these terms and if they are either over eighteen years old or have their parent's or guardian's approval. After those formalities, the real questionnaire began. In order to make it accessible for all users, the questionnaire is designed along the guidelines of Kaczmirek and Wolff [12]. These rules state that users need to maintain overview, have navigation/orientation aids and have a streamlined answer process. This can, for example, be achieved by dividing questions into sections, limit the amount of questions and answer types and formulate the questions to include all answer categories. With these guidelines in mind, the questionnaire was first divided into three sections:

- Playing games in general
- Elements in games
- Playing with other people

At the start of each section, an explanation is given about what and how many questions are in that section as well as the answer categories. The individual questions were then formulated in a way that all the answer options are included. Luckily, Google Forms already had good accessibility options like a progress bar at the bottom of the page and the ability to make questions required or not. At the end of the survey the participants are given the option to leave their email address for an eventual follow-up interview.

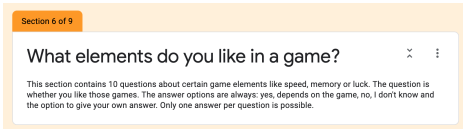

Figure 4.1: The introduction of the section about game elements

4.3.2 Participants

The questionnaire is shared to different Facebook Groups concerning visually impaired people and via a newsletter of Visio[1], an organization specialized in rehabilitation and care for the visually impaired. Although the questionnaire is sent to many people, there were only five submitted forms. The table gives an overview of the participants and some additional notes.

ID	Notes
A	is visually impaired
B	is visually impaired
C	Knows someone who is visually impaired
D	Knows someone who is visually impaired
E	Knows someone who is visually impaired

Table 4.1: Participants of the questionnaire

[1] https://www.visio.org/nl-nl/home; Retrieved at 23-06-2021

4.3.3 Results

Below is a summary of the results of the questionnaire. See the appendix for the extensive overview of all the answers.

Question	Top Answer	#
Most played game category	Card games	5
Reason to play a game	Because I like it	5

Game element	Top Answer	#
Quick reaction	Don't like it	4
Get high score	Like it	4
Compete against players	Like it	4
Working together	Like it	4
Use memory	Like it	3
Bluffing	Depends on the game	3
Solve puzzle or mystery	Like it	4
Different game modes	Like it	4
Chance	Like it	4
Audio cues	Like it & depends on game	2

Question	Top Answer	#
Mostly play against	Sighted people	4

How do you experience playing alone	#
It is fun	2
Depends on the game	2
I don't play games alone	2
It is not fun	1
It is boring	1
It is easy to win	1

How do you experience playing with/against sighted person	#
It is fun	5
Depends on the game	2
Need to adapt games, if not possible then hard because of the use of my memory	1

= Number of participants (n=5) with this answer

Table 4.2: Summary of the questionnaire results

4.3.4 Analysis

Together with the fact that 4 out of 5 participants do not like reaction games, the most notable things to mention is that 5 of the 5 participants like to play card games. This is interesting since OMNI is not a card game but a reaction game. Since the participants play a game because they like the game, it is of importance to make a reaction game that they do like. he main reason why they play games is because they like the game and because it is a way to have a nice moment together with other people.

4.4 Interviews

Interviews will be done to get more insight and specific stories or opinions on certain topics relating to the research. These interviews are voluntary and will take place digitally either via audio or video-call. The interviewees will be given a consent form which they need to sign first.

4.4.1 Approach

Before the search for participants, approval was asked All interviews were designed and executed in a semi-structured way, meaning the participants got asked both planned and unplanned questions. This way, there was room for follow-up questions when needed.

4.4.2 Participants

The participants for my interviews were all experts in the field.

ID	Category	Notes
F	Expert	Commercial game designer
G	Expert	Commercial game designer
H	Expert	Game designer for the visually impaired
I	Expert	Ergotherapist for the visually impaired

Participants of the expert interviews.

4.4.3 Results

Whereas the literature says to remove the asymmetrical information, the game designers say that it should be used to enhance fun. When asked about fun, they mainly mean the play again factor. One can know that a game is fun, when players want to play again. As an other game designer mentions, fun is not necessary the game itself, but the fact that it is a social interaction with friends or family.
And this is backed up very well by the ergo therapist for the visually impaired. She mentions that social interaction with loved ones is the biggest reason and motivation why people who are visually impaired play games. There are however

also reasons as to why they do not play games. These may include that it is too tiring, takes too long to maintain overview (keep feeling or reading) and it takes too much effort to adapt existing games.
The way games get adapted is by adding tactile elements to the game objects, braille to cards or some sort of screen reader. As participant H mentions, these adaptations are great despite them taking a long time to implement. However, these do not work for reaction games.

4.5 First play test and user interviews

4.5.1 Approach

This first play test is held in two separate rounds. There are a total of six participants which have all different seeing conditions. At the beginning of the round (which takes 1 hour), the participants are asked to sign in the consent form. After that, the questioning begins. First, an introduction round has been held to get to know the participants. This will include some information like how long they have been visually impaired. After the introduction round, some questions about games are asked. Those questions are about which kind of games they like to play as well as to why they like to play those games. Then the prototype is brought in and the participants are asked their opinions about it. It is asked what they think of the game objects and the game itself.

4.5.2 Participants

ID	Category	Notes	Age
J	Target Group	blind for 8 years	55
K	Target Group	friend of visually impaired	23
L	Target Group	visually impaired for 20 years	50
M	Target Group	born blind	21
N	Target Group	visually impaired	49
O	Target Group	visually impaired for few months	29

Participants of the preliminary user test

4.5.3 Results

Context Questions

All the participants like to play games with their family and friends. As the expert already gave away, they mainly do it because of that social interaction. The games they currently like to play are 30 seconds, uno, monopoly, Catan and yathzee. Allthough they like playing these games, it is quite tiring for them to remain overview.

Hardware

Some participants had feedback on the cups and their vibrations. Although they could not always feel the vibration through the cup, they could feel it clearly on the table. Because the vibration can be felt on the table, the sound of it was too loud and disturbing. Next to that, the cups could be improved by changing the vertical texture, decreasing the size and to use contrasting colors. Some participants suggested adding a mat so the cups are always contrasting with the surface.

When getting asked about a board, there were some mixed feelings. Some participants liked the idea, because there will be an indication of where the cups must go. However, as some mention, this makes it even harder for the visually impaired. That is because they now not only have to find the cup, but they have to put it in the right spot as well.

Game itself

As for the game itself, the participants also had some feedback. It needed some more levels or challenge to be enjoyable. As of the scoring system, the participants found that this could be clearer. They said that a simple audio cue would suffice in order to know whether the player is on the right track. They also mention putting the cups in the middle is a bit unfair since that will become too chaotic and they have a disadvantage in terms of speed and orientation.

4.6 Conclusion

The survey with the user group showed that nobody likes reaction games and that they play games because they like the game and for the social interaction. The expert interviews confirms that and adds that playing games as a visually impaired can be tiring. It takes too long to remain overview making reaction games impossible to play. Other insights from the expert interviews are that asymmetrical information should not be disregarded since that makes a game fun. Apart from the survey and expert interviews, a preliminary play test has been done with the user group. From this test, the opinion about reaction games is once more confirmed. They felt like there should be more levels or challenge to be really enjoyable.

Chapter 5

Objectives and requirements

Requirements are made based on the outcomes of the surveys and interviews:

- Let there be a challenge
- Interaction with others
- Easy to play
- Easy to learn
- Play again factor
- Clear objective
- Clear way to know the score/process

Based on the interviews with the game designers the following tips could be concluded:

- Combine two different mechanics
- Game must be easy to explain (¡15 seconds)
- Let players want to play again
- Make clever use of asymmetrical information
- Be original, have a theme

The next step is to translate these requirements to the MDA framework: Mechanics, dynamics and aesthetics [9]. This framework is used as a formal approach to better understand games. Therefore the following list will contain the requirements of the games for OMNI when put into the MDA framework.

5.1 Mechanics

Mechanics consist of all the actions, rules, rewards and control mechanisms of a game. For OMNI this will be the following:

- vibrating cup
- scoring a point
- impulse-based turn

5.2 Dynamics

Dynamics work to create the aesthetic experiences of a game. For OMNI this will be the following:

- flip a cup to stop a cup from vibrating
- time pressure/limit
- sharing information with other players

5.3 Aesthetics

Aesthetics describes the desirable emotional responses evoked in the player, when she interacts with the game system [9].

- fellowship
- challenge

Chapter 6

Design and Implementation

6.1 Introduction

This chapter explains the final prototype in greater detail. The method of making the prototype will be explained as well as details on the hardware and the four game modes.

6.2 Method

The existing prototype of OMNI has been evaluated by the target group and the experts. Based on their feedback (See 4.6)

6.3 Product

6.3.1 Hardware

Because of some hardware deficiencies in the first round of interviews, there has been chosen for an other way of making the cups work. In order to make the cups work, the product needs the following functionalities:

- cups need to be able to vibrate in a controlled way
- recognize when a cup has been flipped
- there needs to be sound for audio feedback

After some research and trying, the Nintendo Switch Joy-Cons seem to be the best solution. These Joy-cons have a gyroscope inside them as well as the option to vibrate, meaning it can sense whether the joy con is held in a certain way.

Figure 6.1: The Nintendo Switch Joy-Con in an OMNI cup.

6.3.2 Software

For the software there has been looked at different things as well. There is code written for Arduino which was used in the first play test which can let the cups vibrate randomly and stop when it is flipped. This method, however, was not reliable enough for the real play test. And since the hardware has been replaced for joy-cons, there could be looked at other solutions than Arduino. The solution needs at least to be able to:

- Make cups vibrate on commando
- Change intensity of vibration
- See how long each cup has been vibrating
- Let the vibration stop and play a sound when a cup is flipped
- Count how many times each cup has been flipped

Nintendo has made a game called Nintendo Labo. This game has a function which lets players build their own game or application by using some simple inputs, conditions and outputs.

The following scheme will show how each cup has been programmed.

6.3.3 Cups

The participants in the first play test had some critiques regarding the cups. Since the cups are not the main scope of this thesis, only one change has been done to the cups. On the top and bottom of the cup, some felt has been added. This way, there has been ensured that the cup has some contrasting colors so

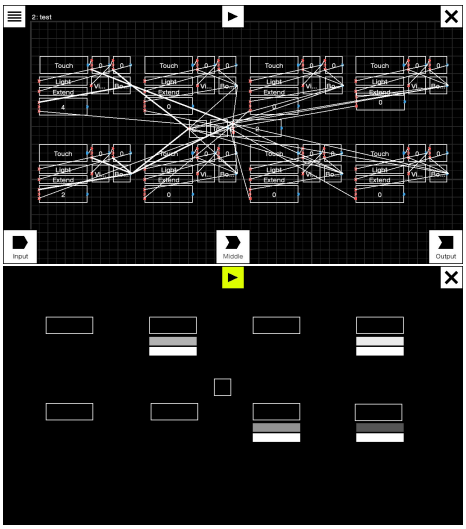

Figure 6.2: Software set up of the prototype

it can be distinguished better. Furthermore, the felt makes sure the vibrations are heard less loud and can not been sensed via the table.

Figure 6.3: The cup when it is closed.

6.4 Games

There are four game modes developed which could be implemented with the hardware. This following section will discuss them one by one:

6.4.1 As fast as possible

The Game

This game is actually the default mode. It has the most simple mechanics and can be played in any set up with any interaction type. In this game mode, only one cup will be vibrating. Once this cup is found, the players need to flip it where they will score a point. After that cup has been flipped, and is not vibrating anymore, a new cup will vibrate. Since this game has a time limit of one minute, the players need to find these cups as quickly as possible. Because the faster they find the cup, the more time they have for a new cup to vibrate.

Implementation

During the play test, there will be a timer set for one minute. In this minute, the game moderator make sure that a cup is vibrating. Once a cup has been flipped by the players, the game moderator needs to click the screen to let an other cup vibrate.

6.4.2 As many as possible

The game

This game mode is similar like the previous one, except here there is no time limit. Instead of a time limit, the cups will just start vibrating after a certain interval, meaning they will not wait until one cup has been flipped. This means that there will be more than one cup vibrating at the same time and the goal is to flip as many as possible before the game is over. The game is over when there are more than three cups vibrating.

Implementation

During the play test, there must constantly be looked at how many cups are vibrating at that time. The game moderator has to make sure that at least one cup is vibrating. Once a cup has been flipped by the players, the game moderator needs to click the screen to let an other cup vibrate.

6.4.3 Missions

The game

This game mode is a little bit different from the previous two. All though the concept of flipping the cup when it is vibrating remains, the game experience will be totally different. This is because during this game mode, the player will get two minutes to complete as many missions as possible. These missions, which are listed below, are orders that the game will give by means of an audio cue.

- Make sure that x number of cups are vibrating
- Make sure that x number of cups are silent
- Flip all silent cups
- Flip all vibrating cups
- Flip the softest vibrating cup
- Flip the hardest vibrating cup
- Flip cups in the order of the intensity

Once a mission is finished, a new mission will be given until the times is up.

Implementation

For this, the list of missions needs to be accessible by only the game moderator. During the game, the game moderator will randomly let some cups vibrate to a certain intensity. Then a mission will be given by shouting it into the group. Once a mission has been completed, a new mission will be given. This will continue until the timer will go off.

Chapter 7

Evaluation

7.1 Introduction

This chapter describes the final evaluation of the product. There has been tested with two groups all containing people with different abilities.

7.2 Method

The final play tests are held at Visio in Apeldoorn and in Enschede. Due to COVID-19, the play tests only lasts one hour, which is unfortunate since that is quite short. There will be playtested in every interaction setting possible as seen in the picture below:

One round stands for one specific interaction setting, for example co-operative when all the cups are laying in the middle. After each round of playing, this mode will be evaluated. There has been chosen to not use a questionnaire, as that was not recommended by the therapist since it will be too tiring for the participants. Therefore it has been chosen to do a structured interview based on the GEQ. To be as time-efficient as possibly, these questions are not asked individually but to the whole group.

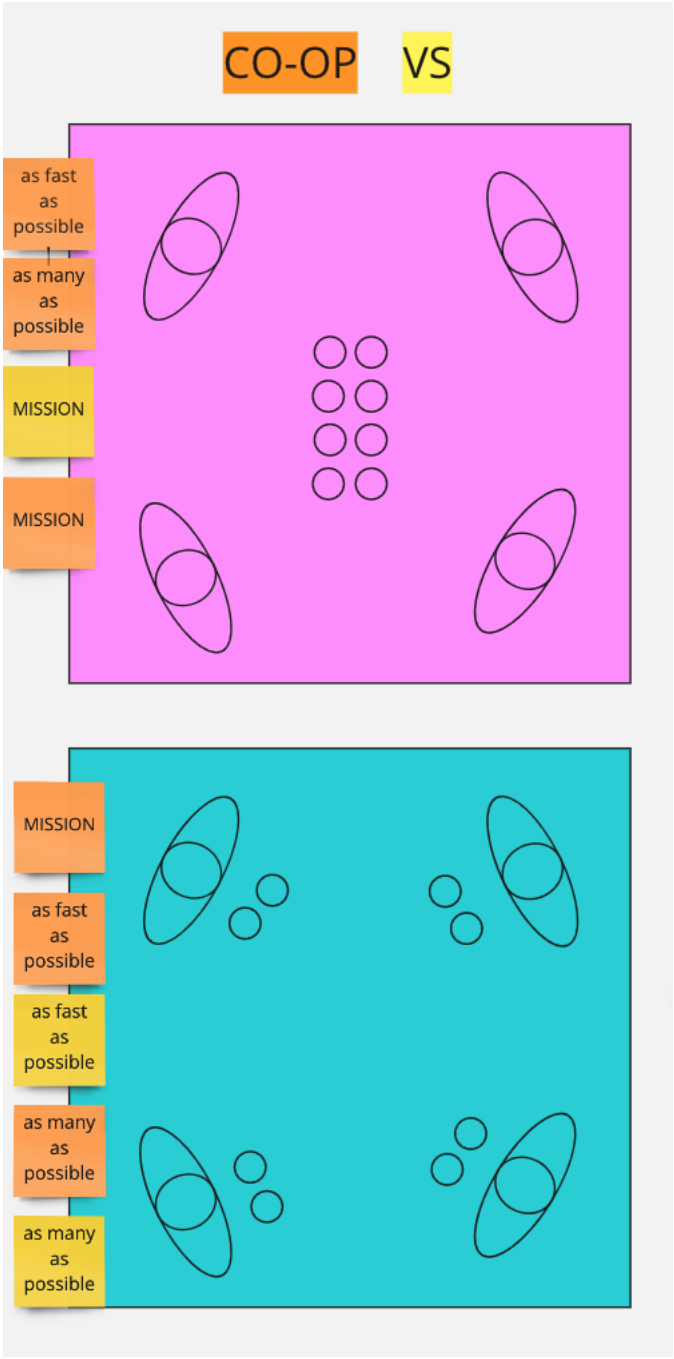

Figure 7.1: The different interaction settings.

7.3 Participants

ID	Notes	Age
O	visually impaired for few months	29
P	visually impaired for 1.5 years	36
Q	blind	44
R	visually impaired	37
S	sighted	23
T	sighted	23
U	sighted	23
V	sighted	21
W	sighted	21

Participants of the final user test

7.4 Results

To summarize the results of their opinions, the participants found the game very entertaining and something that they have never done before. They really could see them playing this with their family, meaning this game is appropriate for young and old people. They thought that the variations of the missions would be a great game mode and the interaction was the best when all the cups were in the middle. The vibrations could be heard, either this needs to be removed or it should be implemented in a game mode.

As of the scoring results, there is no difference in score whether they are blind, visually impaired or sighted. It was considered harder when all the cups are in the middle, yet the players had more fun during this game mode. When looking at the player interaction, people are more social during the co-operative rounds than the competitive rounds.

Chapter 8

Conclusion

The aim of this research was to find out how OMNI's game play between people with and without visually impairment could be designed and evaluated as fun and fair possible. In order to find the answer, a state of the art analysis was done first. Here it became clear that there is no reaction game on the market which is designed to be played without vision, meaning that OMNI will add something to the market.

After this state of the art analysis, there has been looked at the definitions of fun and fairness according to the found literature. Here it is stated that the key for fair game play is to remove the asymmetry of the players. Players must start from the same position as well as have the same experience. This can either be done by adding tactile elements, adding a narrator or modifying certain game mechanics to provide an handicap or to help certain players.

To bring these definitions into practice, some ethnographic research has been done. From the survey, expert interviews and a preliminary user test the following insights are gathered. In order to make the games of OMNI fun, participants mentioned that a clear challenge and objective is needed. Next to that, the interaction with other players is the most important thing. This could be achieved in two ways. The first way being competitive, where players feel frustration, making the need to win bigger.
Visually impaired have an advantage in terms of hearing and feeling the vibrations as well as feeling and therefore distinguishing the textures. Sighted people, on the other hand, have the advantage of seeing the overview of the cups. Therefore, they can reach the cups faster which gives them a great advantage.

After this ethnographic research, the objectives and requirements are made clear through the MDA framework. It became clear that the game should be simple to learn and play. The mechanics should therefore remain simple. Furthermore, the game should more challenges and asymmetrical information should be used

in the right way.

A new prototype has been made with the help of Nintendo Switch Joy-Cons for the hardware and the game Nintendo LABO for the software. Felt has been attached to the prototype to decrease the sound and to add some contrast. Furthermore, there have been three new game modes: As fast as possible, As many as possible and Missions.

This new prototype has been tested with the user group and it is found that this way of playing is innovative, fun and quite fair as the scores do not differ and every player participated equally.

In conclusion, this research has found definitions of fun and fairness and brought these into perspective for the visually impaired when playing OMNI.

Chapter 9

Discussion and recommendations

9.1 Contribution

The most interesting thing about this research has been getting the insights of the user group and their while they were playing the games. Where the goal of the product was to remove all inequalities and unfairness, it has been shown that that is just not possible. Therefore, the unfairness should be used to create fairness. Instead of looking at what people can not do, the game should be designed from what people can do. People who are visually impaired have advantages when feeling, hearing and distinguishing the vibrations. Whereas people without visual impairment have the advantage of reaching for the cups as they can see where the cups are. This could be explored further in further research.

9.2 Limitations

9.2.1 Hardware

The hardware was not working as expected and fixing these issues in order to be able to test with the target group took a long time. Because of the current state of the hardware, the game could not be played as it would be played. Instead, a wizard of oz technique had to be used in order to make the game playable. This is fine, however, it is not totally reliable in terms of game play.

9.2.2 Testing

Due to COVID-19, limited amount of testing could be done. Only one game could really be tested with the visually impaired people, other game modes were

only talked through or tested with sighted people only. Therefore, these games and interaction settings could not be evaluated as whether they are fun or fair.

9.3 Recommendations

My first recommendation for further research is to test, test and test. It is of importance to test all the game modes, played in different interaction settings with different people.

My other recommendation will be to improve the hardware in a later state. The hardware can now be used for simple games and testing, but for the future of the product, it is recommended to look at other hardware options.

Then, in the far future a whole product needs to come out of this. Meaning a theme needs to be added, as well as a a manual and a box. This manual should be put online as people found that the most accessible option. This online area could be a platform where people can see each other high scores or maybe even have an online multiplayer mode.

Appendices

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