Gameplay Design of Applied Games

Designing Games for Promoting Awareness about Visual Impairment

Master's thesis in Computer science and engineering

Samuel Dahlborg
Emil Ekroth

Department of Computer Science and Engineering
CHALMERS UNIVERSITY OF TECHNOLOGY
UNIVERSITY OF GOTHENBURG
Gothenburg, Sweden 2024

Master's thesis 2024

Gameplay Design of Applied Games

Designing Games for Promoting Awareness about Visual Impairment

Samuel Dahlborg
Emil Ekroth

UNIVERSITY OF
GOTHENBURG

CHALMERS
UNIVERSITY OF TECHNOLOGY

Department of Computer Science and Engineering
Chalmers University of Technology
University of Gothenburg
Gothenburg, Sweden 2024

Gameplay Design of Applied Games
Designing Games for Promoting Awareness about Visual Impairment
Samuel Dahlborg
Emil Ekroth

Supervisor: Staffan Björk, Department of Computer Science and Engineering
Advisor: Niko Pyrhönen, Psyon Games
Examiner: Morten Fjeld, Department of Computer Science and Engineering

Master's Thesis 2024
Department of Computer Science and Engineering
Chalmers University of Technology and University of Gothenburg
SE-412 96 Gothenburg
Telephone +46 31 772 1000

Cover: An image from the game *Fabian and Fables* that was developed for this thesis. The image has been slightly altered to fit the title page.

Typeset in LaTeX
Gothenburg, Sweden 2024

Gameplay Design of Applied Games
Designing Games for Promoting Awareness about Visual Impairment
Samuel Dahlborg
Emil Ekroth
Department of Computer Science and Engineering
Chalmers University of Technology and University of Gothenburg

Abstract

The initial goal for this master thesis was to answer the question: *What should be considered when designing gameplay to promote awareness through an applied game?* However, during the development of the thesis it was decided to narrow that research question down to: *What should be considered when designing gameplay to promote awareness about visual impairment through an applied game?* This made it possible to deliver a more relevant and higher confidence result. The goal of answering the question was achieved by investigating previous guidelines developed for applied and serious games and then analyzing the usability of those guidelines through the development process of an applied game. The development of the game was conducted together with Hedy Pettersson and Markus Grahn, who wrote the sister thesis on what should be considered when designing the audiovisual and narrative to promote awareness in an applied game [1]. The resulting game developed was *Fabian and Fables*, an awareness game that informed about and represented visual impairment. From the final analysis of the guidelines used during the development process and from the experience gained by creating an applied game a set of new guidelines is presented.

Keywords: Games, Applied Games, Serious Games, Awareness Games, Project, Thesis, Visual Impairment.

Acknowledgements

A big thank you to our supervisor Staffan Björk from Chalmers University of Technology and to our advisor Niko Pyrhönen from Psyon Games for their support in writing this thesis and developing the project.

We also want to thank the participants of the interviews conducted for this project as well as the people who playtested the game. Your feedback and insight have been vital for the development of both the game and the guidelines.

Finally, we want to thank Markus Grahn and Hedy Pettersson who collaborated with us during the development of the game. Without your insight into graphical design and narrative writing the development process would have been impossible.

Samuel Dahlborg & Emil Ekroth, Gothenburg, 2024-06-12

Contents

List of Figures

Lexicon

Aesthetics The word aesthetics in this thesis refers to the experienced feeling a player can have from playing a game, as defined by the MDA framework [2].

Artifact Refers to a created product, instead of for example an activity.

Audiovisual Aesthetics The audiovisual aesthetics refers to what you can see and hear within the game, as well as the players reaction to that.

Application Area The domain of the topic of an applied game's characterizing goal. See 3.1.3.

Applied Game A game with an entertainment goal and an additional goal that is not entertainment. See 3.1.4.

Awareness The knowledge that something exists or understanding of a situation or subject at the resent time based on information or experience [3]. See 3.3.2.

Awareness Game Refers to an applied game that focuses on spreading awareness about a specific topic.

Characterizing Goal The additional goal that an applied game has other than entertainment. See 3.1.4.

Diegesis Refers to a game element that is experienced by both the player and the character in the game. This can for example be that information is shown on an in-game object instead of in a UI element only presented for the player.

Game An activity or artifact, with a set of rules tailored for a specific purpose that creates an intrinsic motivation for interacting with it. See 3.1.1

Game Mechanic Refers to the particular components of a game, as defined by the MDA framework [2].

Game Systems Refers to larger systems of game mechanics and rules within a game.

Gamification Refers to using game design concepts in non-game applications. See 3.1.2.

Gameplay The structures of player interaction with the game system and with other players in the game [4]. See 3.3.

Gameplay Design Pattern This is a framework proposed by Staffan Björk and Jussi Holopainen which describes common design patterns found in gameplay [4]. This thesis uses Small Caps to note that a concept is a Gameplay design pattern.

MDA Mechanics, Dynamics and Aesthetics. MDA is a framework designed by R. Hunicke, M. LeBlanc, and R. Zubek [2]. It describes a formal approach to game design and game research.

MVP Minimum viable product. Refers to the first playable instance of a game during the development process. Most core systems are in the game, but in an early stage.

NPC Non-playable character. An in-game character that is not controlled by a player.

Player A person who interacts with a game with the ambition of playing the game.

Play Session Refers to a single continuous instance of playing a game without closing it down or taking significant breaks.

Serious Game A game with an additional goal that is not entertainment. See 3.1.3.

Sister Thesis Refers to the other master thesis that collaborated on the game development project. It focuses on how audiovisual aesthetics can be used in the development of an applied game about spreading awareness [1]. See 1.2.

UI User Interface. This refers to visual elements of the game that are not part of the game world or particles. This can for example be menus or panels that are placed in front of the game world.

Visual Impairment This refers to having severely limited vision to the point of making it difficult to rely on in daily activities. It is however important to note that not all visually impaired people are totally blind. See 2.1.

1

Introduction

The games industry is growing at a steady pace [5] and is becoming larger as a medium for consumers entertainment. As the industry grows, more pioneers explore the possibilities of games and what they are capable of. In general, games' primary purpose is to serve as entertainment, however developers have started to explore what other purpose games can serve as a medium. One such purpose is to promote awareness around a topic through applied games. These types of games, while being entertaining, are also attempting to make the players aware and inform them of different issues around the world that might not be apparent in their everyday life. These can include but are not limited to health issues, environmental issues, mental issues, disabilities, and more.

This thesis is meant for game developers who are looking to expand their knowledge in how to develop games with the goal of spreading awareness. Developers who have an interest in other types of serious and applied games might also find this thesis useful in providing new insights into similar topics. Finally, this thesis might also be useful for those who want to learn more about game design within applied awareness games.

1.1 Aim and Purpose

The initial aim for this master thesis was to research how to utilize gameplay design when designing and developing applied games about spreading awareness. Therefore, the research question of this thesis was defined as: *What should be considered when designing gameplay to promote awareness through an applied game?* However, during the development process it was decided to narrow this research question down to: *What should be considered when designing gameplay to promote awareness about visual impairment through an applied game?* This decision was made because a narrower research question would be easier to answer, and the answer could be more specific and useful.

The purpose of this project is to create and develop guidelines for how to design gameplay for awareness games. These guidelines will be developed by researching previous guidelines for similar purposes, and then using them in a game development project where they can be analyzed and reshaped into a format that answers the research question for this thesis.

Gameplay design in this project refers primarily to the design of different gameplay mechanics and the interaction between the system and the player, the actions they take and the consequences for doing so. This includes but is not limited to the gameplay loop, mechanics and the dynamic interaction between the system and the player. This thesis also takes steps to assure that these elements are tied together in a respectful way towards the chosen topic so those affected are not misrepresented.

The game development project was used to evaluate and develop the guidelines for the thesis needs to fit the research question. Therefore, the game's purpose should be to spread awareness about a specific topic. Visual impairment was the topic chosen for the game through ideation and paper prototyping.

1.2 Limitations

The aim for this thesis is to create guidelines specifically for how to design gameplay for applied games. The thesis does not focus on creating general guidelines for how to design applied games and it does not focus on other specific parts of game design such as aesthetics.

As mentioned, the topic of the game is to inform about visual impairment. This means that the target audience should not be people with visual impairment, because they would likely already be aware about the topic, and therefore the game loses its purpose of spreading awareness. This would reduce the game's value as a tool for developing the guidelines for the research question. This does however not mean that no consideration for accessibility for people with visual impairments should be made.

The scope for the size of the game development project should be large enough to be able to answer the research question. However, it does not need to be larger than that. For this thesis that means that the game needs to be finished to a point that it can be used in some capacity to inform and spread awareness about a topic. This means that the game is not required and not expected to be a complete game, but a vertical slice with necessary components implemented.

The purpose of the game development project is to spread awareness about visual impairment. This means that the project needs to represent people with visual impairment and inform the players about common experiences and situations that they might face. The project does, however, not need to simulate what exactly a person with visual impairment can see. This limitation of the scope exists because making an exact simulation requires a level of medical expertise within the field of visual impairment that would be hard to achieve during the limited time of the thesis. An exact simulation is also not the same thing as an applied game, as it does not have an entertainment goal, and therefore it lies outside of the scope of our research question. This being said some level of simulation or simulation like elements within the game is expected, even if it is not strictly required.

This project was done in collaboration with Markus Grahn and Hedy Pettersson. Their thesis [1] explores how to create guidelines for designing applied games from an audiovisual aesthetics perspective, instead of the gameplay perspective found in

this paper. Therefore, it is recommended to read that paper for more detail on how to use audiovisual aesthetics to promote awareness through an applied game. It is also expected that both theses will inhabit similarities and overlap to some degree. Their thesis is referred to as the sister thesis of this thesis.

2

Background

In this chapter visual impairment and what it means is described as well as some different types of visual impairment. This chapter also discusses examples of existing applied games. Finally, the chapter describes the different stakeholders in the game development project.

2.1 Visual Impairment

According to the World Health Organization world report on vision 2019 [6], visual impairment is a broad spectrum with multiple categories based on one's *visual acuity*. In short, visual acuity is a simple non-invasive measure of a person's visual ability to discern between two high contrast points in space. Two different types of visual acuity exist, *distance visual acuity* is a measurement based on how well a person sees objects further away and *near visual acuity* is a measurement based on how well a person can see things close to them. Visual impairment is not only based on visual acuity but also based on the degree of a person's visual field. Multiple different eye diseases or conditions exist that can cause visual impairment and some of the different ways one could be visually impaired include reduced field of view, reduced central vision, reduced side vision, destroyed night vision, cloudy parts of vision, and high light sensitivity [7]. This means that most people categorized as blind still have some sense of vision although severely limited to the degree of making it difficult to rely on in daily activities.

2.2 Existing Applied Games

Celeste [8] is a platforming game about Madeline surviving her inner demons as she makes her way up the Celeste Mountain. The game shows anxiety and depression through Madeline and a personification of her emotions. Throughout the game several game elements exist that act as representations of different mental issues and gameplay elements also exist that are directly related to how she deals with panic attacks. Overall, the game is primarily focused on spreading awareness through audiovisual aesthetics.

Antidote COVID-19 [9] is a tower defense game where you are defending the stem cell from pathogens (enemies in the game). The game's goal is to inform people about COVID-19 as well as the importance of developing vaccines. This goal is achieved by informing the player through both gameplay, audiovisual and narrative aesthetics. One example of using game mechanics for an applied purpose is when you develop a new vaccine your defenses grow stronger, becoming more effective against the pathogens and thus informing the player through gameplay design.

MindLight [10] is a game specifically made to help teach kids how to handle anxiety where you use biofeedback to turn your emotions to game inputs. According to Schoneveld, Lichtwarck-Aschoff, and Granic [11] MindLight has proven to be as effective as the standard method for treating anxiety disorder. This game, while still trying to be an enjoyable game for kids, also actively tries to convey important teachings through gameplay design.

Lost and Hound [12] is a mystery adventure game made to be fully accessible for blind people to play. The game is heavily based on sound and uses it to portray other senses not available. You play as a dog named Biscuit who uses their smell (represented as sound) and hearing to gain access to more information as you use it to help people in trouble. The game is meant to be played without its potential visual components and instead incorporates game mechanics with sound to give the player information to progress.

Minecraft Education [13] is a version of *Minecraft* specifically made for use in a classroom environment for game-based learning. It covers many different topics such as math, computer science, chemistry, programming, and also allows the teacher to use it as a tool for creating a classroom setting. Here the original game is expanded upon with new game mechanics and other components to support education while still trying to be entertaining for its users.

2.3 Stakeholders

This section describes all the stakeholders that are tied to this project and what their expectations and demands for the project are.

2.3.1 Chalmers University of Technology

Chalmers University of Technology is the university where the master thesis is being published, therefore they are examining the thesis to ensure its academic significance. This sets the deadline for when the project and master thesis has to be completed. This also sets the foundation that the thesis and project are grounded in research and for research purposes and that the project needs to be used for answering the research question.

2.3.2 Psyon Games

Psyon Games [14] is a game company based in Finland specifically focused on creating games that improves people's health through awareness, diagnosis and therapy. By working with other companies and organizations, Psyon Games manages to create games that serve not just as entertainment, but also spreading information. They have developed games like *Antidote* [15], a tower defense game focused on spreading awareness about viruses, bacteria and the immune system. The variant *Antidote COVID-19* [9] also exists and is specifically focused on informing people about COVID-19 and vaccines in general. *Full ADHD* [16] is another game created by Psyon Games which is a visual novel where you get to explore and experience the world of attention deficit hyperactivity disorder (ADHD) through many different situations. The game focuses on giving the player several perspectives as ADHD is very individual by nature.

Psyon Games provides regular and continuous advice and helps guide the project, providing experienced insight into the applied games industry, and giving valuable feedback on the developed game. As Psyon Games focuses on making mobile games it is reasonable to expect that the game being developed should aim to be able to port to mobile. They are also focused on making games with a theme within the medical or healthcare field, and so it is reasonable for the developed game to follow these expectations as well.

2.3.3 People with Visual Impairment

As the game aims to inform the target audience about visual impairment it is crucial that the game itself is not harmful or otherwise negative towards people with visual impairment. It is essential that the game aligns with visually impaired people's expectations and that effort is put to not promote inaccuracies or otherwise have inaccurate representation.

2.3.4 Target Audience

The target audience are the people that will play the game and what is most important to them is that the game is engaging to play and that the game fits their expectations. This is because it is expected that the game is primarily picked up because of entertainment purposes and is not distributed through means such as organizations or schools. The game's goal is to inform and spread awareness to these people about visual impairment and how it might feel but this will never be achieved if the game is not fun and engaging to play or otherwise provides some sort of motivation to be played.

The target audience for the game design project is defined as people who enjoy playing slower paced exploration games where dialogue and narrative are important factors. They are players who enjoy investigating and analyzing game elements such as thoroughly reading item descriptions. The target audience is also defined as players who enjoy cozy games and value the audiovisual aesthetics of the game. The game is aimed at pre-teens and older.

2.3.5 Sister Thesis

As mentioned in 1.2 the project is done in collaboration with another master thesis group with similar interests but with a different perspective and research question. Their research question is defined as: *What should be considered when designing aesthetics to promote awareness through an applied game?* It is important to note that their use of the word "*aesthetics*" focuses on the audiovisual and narrative aesthetics, and not the MDA [2] definition used by this report. As there are two groups working on developing the game together the game needs to support both groups in evaluating their research questions and providing feedback and insight. While it might be hard to acquire a completely even split between the groups' usefulness for evaluation, effort should be put in to strive towards this as best as possible.

2.3.6 Our Thesis Group

It is also important to mention that our master thesis group are also considered as stakeholders to the project. This means that the project needs to be able to be used to answer our research question. It is also important for us that the project is done within the dedicated time for the master thesis, as we do not want to do extra work after the appointed time plan for the thesis.

3

Theory

This chapter contains the theoretical background for the research question of this thesis. The aim for this chapter is to define the concepts of the research question further and to make a theoretical investigation into if answering the research question is at all feasible.

3.1 Definitions

To properly address the research question a definition of applied games needs to be formulated. In this section the definition of applied games will be made by first analyzing the definitions of the related subjects of games, gamification, and serious games.

3.1.1 Defining Games

Although it might initially appear to be a trivial task to define what a game is, that is in practice not the case. Games come in many different forms such as mobile games, board games, tabletop role-playing games, live action role-playing games, and many more which are all distinctly different, but still considered to be games. There are many different definitions already created which can be used depending on the circumstance and purpose.

One definition by Avedon and Sutton-Smith [17] states that games are an exercise of voluntary systems. There is a contest between powers, and these powers are confined by rules to produce an unequal outcome.

Another definition by Suits [18] states that playing a game is to engage in activity that looks to bring about a specific state of affairs. The only means allowed to do this are the ones permitted by specified rules, and these rules prohibit more effective means in favor of less effective ones to enable such activity.

These two definitions share similarities but are also clearly different. Both definitions define the existence of rules, but only Avedon and Sutton-Smith mention a contest while Suits defines bringing about a specific state of affairs. A newer definition by Caillois [19] also has similarities like rules but defines a game as something specifically unproductive in that it creates no goods or wealth, something that is not mentioned in prior definitions.

Stenros [20] gives an overview and analyses over 60 different game definitions to provide further information around the topic. It is presented through ten questions where each definition is put against one another to see where it aligns according to each question. These questions regard things such as rules, end goals, competition, conflict, and more. It presents a multitude of examples of different definitions, where they are similar, and where they are different.

The purpose of this thesis is not to define what a game is; however, a working definition is still needed for practicality. Therefore, a definition derived from the previous sources is used in this paper. It is as follows: *A game is an activity or artifact, with a set of rules tailored for a specific purpose that creates an intrinsic motivation for interacting with the game. This activity can be carried out, or artifact interacted with, by one or more persons. The people who are interacting with the game are defined as the players of the game.*

Stahl's definition [21] states that the purpose of a game does not have to be for entertainment as he believes entertainment is just one of multiple different types of goals for games. However, it is still important that the players motivation to play the game is created, at least partially, by the game itself instead of an external factor.

3.1.2 Defining Gamification

Deterding et al. defines gamification as *"... the use of game design elements in non-game context"* [22, p. 10]. This definition is neat and simple, but it fails to define what should be considered game elements. According to this definition, and others [23], [24], a gamified artifact is by definition not a game even though it does make use of game design elements. This does however raise the question of why discuss gamification in a report about applied games.

Landers [23] argues that gamification is inherently linked to serious games, and when researching either area, you also need to address the other, because they are addressing the same topics. It is important to note that Landers argument is from the perspective of gamification while this report's focus is on applied and serious games. Landers defines gamification as the use of Bedwell et al.'s [25] game attributes for learning for non-game contexts. This definition is similar to Deterding et al.'s definition [22], with the main differences being that Landers focuses on the learning part of gamification and uses a defined list of what should be considered as game elements. Landers also talks about gamification's relation to serious games from a learning-based perspective. He argues that both mediums try to improve learning outcomes. However, serious games tries to do that directly while gamification try to improve learning outcomes through altering already existing means.

Landers definition of gamification is a practical definition that works well when talking about gamification to promote learning. However, this is not the only use case for gamification. Examples of other use cases include affecting user behavior and increasing attributes such as satisfaction, user engagement, or loyalty to an application [26]. Therefore, Landers definition could be a bit too limiting in some contexts. Deterding et al.'s definition does not have this limitation. However, that

definition is somewhat lacking because as the authors themselves mention; it can be difficult to define what should be considered game design elements. Another problem with this definition is that elements usually refer to specific things that can be found in games, as for example resources, avatars, or cards [4] but many examples of gamification does instead use Gameplay design patterns such as leveling or scoreboards [23], [26].

From a practical perspective this thesis will use Deterding et al.'s definition but with the additional context that game elements refer to *gameplay design patterns* defined by Björk and Holopainen [4]. Gameplay design patterns describe common design patterns found in gameplay.

3.1.3 Defining Serious Games

Defining serious games is of interest in this report because of their close relation to applied games. In some cases, they can even be considered the same thing [27]. Dörner et al. defines serious games as:

> *"A serious game is a digital game that was created with the intention to entertain and to achieve at least one additional goal (e.g., learning or health). These additional goals are named characterizing goal."* [24, p. 3].

This definition is fairly similar to Laamarti et al.'s definition; that serious games are defined out of three main categories; experience, entertainment and multimedia [28]. In this definition the authors describe the experience category as being the ability of the game to enhance the players experience in different contexts such as education, training, or health, which is similar to Dörner et al.'s definition of characterizing goal.

Both definitions define serious games as needing to be multimedia or digital, and therefore exclude most types of non-digital games [24], [28]. This approach is somewhat problematic, because as Deterding et al. writes about gamification; it should not be limited to digital media as games are by themselves transmedial categories [22]. This applies to serious games as well.

Based on these definitions for serious games two main characteristic features can be extracted. First of all, the game needs to be to be entertaining and secondly it needs to also have an additional goal. The focus on entertainment and engagement of the player is important because without that the game will not reach its audience and motivate them to engage with the game's secondary goal [27]–[30].

The secondary goal for the serious games is by some sources defined to be a learning related goal [23], however, similar to with gamification (3.1.2) this does not need to be the case. Laamarti et al. does instead state that this secondary goal can be in several different domains, which they define as the game's application area. They also list several different examples of application areas; *Education and Training, Well-Being, Advertisement, Cultural Heritage, Interpersonal Communication, and Biomedical and Health Care* [28]. Several sources also note that the importance of the entertainment and characterizing goals should not be ranked [24], [27], [28]. This is because both traits are needed to be able to promote the game's application area.

3.1.4 Defining Applied Games

Psyon Games defines applied games as *"A game with an applied purpose"* and defines the game as *"A structured form of play for entertainment purposes"* [31] (Appendix A.1). This neatly matches the two main characteristic features for serious games (3.1.3) and therefore also supports the argument that applied games are only a synonym to serious games [27].

Schmidt et al. made another definition of applied games, being that:

> *"Applied games are the result of an applied game design process. They are an implementation of a subject, inspired by and designed along a context- and user-centric transfer of design concepts and qualities from the game world. Applied games consist of multimedia, digital and/or non-digital artefacts that constitute an individual and/or social experience for their respective users."* [32, p. 10].

Even though this definition has some similar aspects to the previous definition, being that the applied game needs to implement some type of application area using game design concepts, this definition does have several differences to the previous definition. First of all, this definition does not highlight the importance of entertainment for the applied game, instead it highlights the need for user centric design. Secondly it does not specify that the artifact in question needs to be a game, just that it needs to use concepts from game design. Therefore, this definition could be used as more of an umbrella term for both gamification and serious games. The authors' note that applied games also can be non-digital differentiates this definition from some of the definitions of serious games found in 3.1.3.

To be able to properly address the research question of this paper a more concrete definition of applied games is needed. Therefore, this report will use a definition that makes use of concepts from both mentioned definitions with added context from the definitions of serious games, because as stated previously serious games are by many defined as applied games.

An applied game:

- ... needs to be a game, as defined in 3.1.1.
- ... is created with the goal of entertainment.
- ... is created with a characterizing goal within an application area.
- ... 's entertainment and characterizing goal are not ranked by importance.
- ... is not limited to a specific medium, (e.g. digital or multimedia).

Even though this definition defines applied games as a distinct different topic to gamification, and not as an umbrella term for both gamification and serious games, it is important to note that the subject is still closely related to gamification. The main difference being that the applied game is an artifact that can be defined as a game while gamification cannot be defined as a game.

3.2 Related Topics

This section describes topics related to the research question. The section serves as a theoretical background to topics that are important later in the thesis.

3.2.1 Spreading Awareness

The Cambridge Dictionary defines *awareness* as *"knowledge that something exists, or understanding of a situation or subject at the present time based on information or experience"* [3]. This means that to promote awareness you can either directly inform people about the topic or let people experience it. This is per definition similar in nature to teaching and informing people about the topic. It is however important to note that when spreading awareness, it cannot be assumed that the participant is engaged in the learning process from the start, as it can be assumed that the participant is unaware about both the subject and the process. This is a difference between spreading awareness about a subject and teaching about a subject, when teaching someone about a subject it can in some circumstances be assumed that the participant is aware that they are about to learn something new. Therefore, when spreading awareness, it is important to first engage the participant in the process and then teach them about the topic.

3.2.2 Cognitive Load

Cognitive load refers to how much information the working memory can process [33]. Cognitive load can be divided into three types, intrinsic, extraneous, and germane. The intrinsic cognitive load refers to the cognitive load provided by the intrinsic characteristics of the information itself. Extraneous cognitive load refers to how the information is presented. Germane load refers to the cognitive load it takes to store the information in long term memory. As stated by Catalano, Luccini, and Mortara [30] managing cognitive load in video games is closely linked to managing the player learning curve. They state that to keep cognitive load down the learning curve should be designed to introduce things gradually, so that the player can get accustomed to each part before moving on to the next.

That learning requires working memory capacity is something that P. A. Kirschner states in their paper on cognitive load theory [34]. Kirschner states that learning by itself requires all types of cognitive load, however the amount of germane and extrinsic cognitive load required can be altered by the design of the learning material. If the combined cognitive load of learning information presented to the learner exceeds their working memory capacity, it drains mental energy and can lead to cognitive overload [33], [35]. Cognitive overload can result in the learner having difficulties processing the information actively and therefore negatively impacts the learning effectiveness.

3.2.3 Navigation and Visual Impairment

Navigating a space that is unfamiliar can often be significantly more challenging for someone that is visually impaired [36], [37], [38]. One important strategy visually impaired people use for navigating a space is to make a mental map of the area [38]. Using landmarks such as stairs and doors can often be used for creating mental maps. The lack of such landmarks or points of reference, as for example in a wide-open area can make it harder to navigate. Audio cues such as the sound of a fountain or scent, like the smell of a coffee shop, are also used for environmental awareness and navigation [36].

Some research indicates that route-like, instead of survey-like representations of the world is preferable for visually impaired people when navigating [39]. This might be caused by the fact that when navigating to a completely new place visually impaired people are often more focused on the exact route there, instead of exploring the environment around it [36]. However, if a place needs to be frequently visited or if an area is content rich they often find it useful to make a detailed mental map of the area.

Research also shows that visually impaired people can have a hard time estimating euclidean distances between specific locations [39]. This is backed up by the fact that visually impaired people do not usually count paces when navigating, and instead rely on navigational cues [38].

3.3 Feasibility of Research Question

Björk and Holopainen defines gameplay as *"The structures of player interaction with the game system and with other players in the game"* in their wiki for Gameplay design patterns [4]. This definition highlights the fact that gameplay is merely a structure and rules that allow for interaction between the the player and the game. Therefore, to be able to answer the research question for this report, it is assumed that these structures and rules are enough to promote awareness through an applied game. Combining this with the definition of an applied game (3.1.4) it can be concluded: To be able to answer this report's research question the structures and rules of gameplay needs to be enough to be able to achieve both a games entertainment and characterizing goal, where the characterizing goal is in the application area of promoting awareness. Therefore, this section will explore previous work on whether this is at all achievable.

3.3.1 Entertainment through Gameplay

Cziksentmihalyi writes in his paper about flow [40] that enjoyment has seven major components:

- Tasks with a reasonable chance of completion
- Clear goals
- Immediate feedback
- Deep but effortless involvement
- Sense of control over our actions
- No concern over self
- Alterations of concept of time

Enjoyment is an experience with both physiological, cognitive, and affective components that is in the core for Vorderer et al.'s model for entertainment [41]. Therefore, it can be assumed that if the gameplay can by itself provide a majority of the components of enjoyment in Cziksentmihalyi's list, it can also by itself achieve the goal of entertainment.

Goal Indicators, Goal Hierarchies, Quests, and Goal Achievements are all examples of Gameplay design patterns that can provide clear goals to the player and give them tasks that they have a reasonable chance to complete [4]. Immediate feedback can also be achieved through gameplay with for examples Killcams, that can show a player what mistake they made directly after they died. Giving the player a sense of control over their actions is also an important aspect of many gameplay patterns such as Framed Freedom, and Player Agency.

Deep but effortless involvement can be achieved through immersion, something that Ermi and Mäyrä divide into three main categories: sensory immersion, imaginative immersion, and challenge-based immersion [42]. Of these three components the challenge-based component is best achieved through a balance between the challenge of the game and the abilities of the player. To be able to achieve this balance the gameplay challenges should ideally change and match the players proficiency in the game throughout the game, called the difficulty curve of the game [43]. Something that can be predicted and controlled throughout the game through e.g.Balancing Effects [4].

That when playing games, you have no concern over self can somewhat be motivated by Huizingas magic circle, the concept that the act of playing is separate from normal life in both time and space [44]. This concept has however received a lot of criticism because in real life the boundaries of the magic circle is often permeable, meaning that real life can affect what is happening inside the magic circle, and things that happen in the magic circle can affect real life. This is especially prominent with serious games and gamification, where the characterizing goal often is to affect the players real life in some way [45]. However, the concept of having some separation of play and the real life, even though it is permeable, can be useful for allowing

the player to enjoy the gameplay while not needing to worry that it will negatively affect their real life. Therefore, this report assumes that gameplay can be designed to allow some things to pass through the magic circle while blocking other things, to be able to achieve the games characterizing goal without the player needing to have a concern over self.

It is clear that gameplay can by itself, if designed properly, be used to achieve the majority of the components of enjoyment in Cziksentmihalyi's list. Therefore, it can be concluded that gameplay can be used to provoke enjoyment, and through that it can also be used to achieve the games entertainment goal.

3.3.2 Characterizing through Gameplay

The characterizing goal of an applied game can vary widely depending on the game's application area. Therefore, it is assumed that the gameplay design will also vary depending on what type of characterizing goal the game has. In the case of this thesis the research question states that the aim is to find gameplay design guidelines for creating applied games that promote awareness about a specific topic. The purpose of this section of the text is therefore to prove that it is possible to use gameplay design to achieve the characterizing goal of promoting awareness about a topic.

As described in 3.2.1 spreading awareness is similar to teaching and informing about a subject but with the added component of also engaging people. Using gameplay to promote engagement and learning in game-based learning is something that Iliya et al. studied in their paper about game-based learning [46]. They focused on two main questions, what elements could provide opportunities for students to become engaged in game-based learning and how these elements created engagement and influenced learning. What they found was that players often had something to gain from the gameplay, and that in game-based learning the engagement is highly dependent on the students' involvement in the gameplay. This shows that gameplay itself is an important aspect of applied games with the characterizing goal of game-based learning, and therefore it can be assumed that it also is important for promoting awareness.

3.3.3 Feasibility Summary

To summarize this section, it can be concluded that gameplay is an important element that can be used to achieve both an applied game's entertainment and characterizing goal. This does not mean that all gameplay design will support these goals, but the fact that it is theoretically possible does create an opportunity for this report to answer its research question.

4

Methodology

This chapter describes potential concepts, methods, guidelines and software's that could be used throughout the course of the thesis.

4.1 Wicked Problems

Wicked problems are special problems with specific characteristics making them unique and difficult to handle [47]. The term was first coined by Horst Rittel [48] and was described by ten characteristics [47]. Together they describe a wicked problem as something that has no definite formula for being solved, making it hard to approach. It also has no right answer, only better or worse solutions, there is no stopping rule as it is not possible to know if the solution is final and every wicked problem is essentially unique. Thus, it is important to know when a wicked problem is being worked on as they require special care and knowledge to be tackled. It is important to note that answering the research question of this thesis, and the development of an applied game, both can be defined as wicked problems. They both have the characterizing traits of having no right answer and it is not possible to know when the solutions are final.

4.2 Agile Development

Agile development is a work process that focuses on how to work with development projects that are by definition wicked problems [49]. Agile development focuses on breaking down both the problem itself and the development time into smaller parts. Development happens within defined parts called sprints. During each sprint the team then selects a set of problem parts, called tasks, that they want to implement. This allows the team to work through the wicked problem in a structured way where you can see the progress throughout the development process while still keeping the development flexible for any changes that might occur [50].

4.2.1 Scrum

Scrum is a more structured way of conducting agile development, where each sprint is a set amount of time, and they are usually quite short [50]. The scrum method defines scrum teams as consisting of three parts: project owner, development team,

and scrum master. The project owner focuses on maximizing product values, the development team develops the product, and the scrum master focuses on continually creating improvements for the product, process, and organization [51]. In scrum you also work with a scrum board that consists of a project backlog, a sprint backlog and a product increment. The backlog contains all tasks in the project, the sprint backlog contains all tasks to be completed during the current sprint, and the product increment is a collection of all work done so far. A sprint review is also held at the end of every sprint where the team, together with stakeholders inspect the product increment and together they discuss needs and wants which are then added to the project backlog which is the basis for the next sprint. Even though scrum might not be the most flexible form of agile development it can be suitable when working with smaller teams and on projects with a tight deadline [50].

4.3 Ideation

When doing ideation, a model that can be followed is the Jones model. The Jones model splits the process into three parts, divergence, transformation and convergence [52]. In ideation this means that you first diverge and try to find many ideas, then you explore and transform those ideas and lastly you narrow the number of ideas back down to a single, or a few ideas through convergence.

4.3.1 Divergence

Brainstorming is at the start of ideation where the aim is to find as many ideas as possible for a potential solution. During this phase it is important to not criticize any ideas as even ideas that seem unfeasible could provide something that proves useful elsewhere [53]. Brainstorming is also a good start in trying to find an idea to address a wicked problem. Sketching is an important tool when brainstorming as it helps the user visualize their ideas to other members of the team.

A popular method for brainstorming is *Crazy 8's* [54]. The method is centered around quickly creating ideas by pushing members to create many ideas, with each idea not given too much thought but instead focusing on creating a quantity of ideas. Each member is supposed to sketch or write down eight ideas in eight minutes, no matter how small the ideas are. These ideas may prove difficult to implement themselves, or even prove detrimental to the original problem if developed but the point is to generate ideas, not necessarily good ideas. This method is also easily adaptable, while the idea is to produce many ideas there is nothing stopping the users from tweaking the method, such as increasing time per idea or changing the number of ideas to create per member.

4.3.2 Transformation

Two methods good for analyzing and refining ideas are *Six Thinking Hats* [55] and *SWOT Analysis* [56]. Six Thinking Hats is a method that has members using and switching between different hats to analyze an idea from different perspectives,

with the different hats representing different perspectives. This in turn could help with finding strengths, weaknesses, or other points about the idea that might have otherwise been overlooked and also helps everyone involved to get a better understanding of each idea. SWOT Analysis is another method where each idea is analyzed from four different perspectives, strengths, weaknesses, opportunities and threats. This provides both an internal and external analysis which helps further developing and refining the idea. The Six Thinking Hats provides a more detailed investigation from each perspective with the cost of doing one at a time, taking longer and potentially not allowing a member to say something relevant when they want. Comparatively, SWOT Analysis provides a quicker overview from multiple perspectives at the cost of not being as detailed.

4.3.3 Convergence

After Brainstorming the next step in the process is to figure out which ideas are liked the most and which ones are seen as the best ones to pursue further. A good method for narrowing down ideas is *Dot Voting* [57]. Each participant gets a set number of votes that they then freely allocate to the ideas they like the most. This allows the group to see which ideas are most interesting for the group and which ones there is no interest in. A similar method is *Plus Minus Voting* [58]. It works the same as Dot Voting with the added functionality of also being able to assign minus points to ideas instead of just plus points. This allows for more expression in terms of what someone likes and dislikes to get a better overview of what the group likes and dislikes as a whole. Care should be taken though as it could affect the group's morale negatively if people are not comfortable enough to handle their ideas getting rated negatively. Both methods serve as a good way to narrow down the scope and it is not uncommon to go through these steps multiple times. The group would brainstorm ideas, analyze, and narrow down to a subset of ideas, then brainstorm on these subsets and after that further narrowing down to eventually reach a refined conclusion.

4.4 Paper Prototyping

Paper prototyping is a popular tool for both interaction and game designers as it allows for quick testing of ideas or different mechanics to provide valuable insight about them. The Interaction Design Foundation has produced a list containing some of the main strengths and weaknesses of paper prototyping [59]. Some of the strengths include cheap cost, flexibility and accessibility as anyone can contribute, team-building and useful insight into the feasibility of a current idea or mechanic. Notable flaws include lack of realism as it is impossible to fully mimic something, peoples' reaction will differ compared to the potential end result, it requires in-person testing and everything learned has to be analyzed carefully. Positive feedback does not necessarily mean something will work later on but should rather be seen as indicators to be used in judgement. Paper prototyping can be used in many stages and a common place to use paper prototyping is to get information from the ideas produced by brainstorming to indicate which ideas seem to have something worth

pursuing. It can also be used for quick testing of specific parts later in development in order to get quick feedback about something before committing a lot of work to it.

4.5 Testing Methodology

Qualitative testing is a type of testing where testers are asked to perform a task, and facilitators gather data and insights by observing how the task is performed [60]. Cooper et al. [61] state that the observation can be combined with interviews to efficiently gather qualitative data. Qualitative testing provides great understanding of how users might perceive an experience but by itself it does not prove anything as there is no certainty that someone else will have the same experience [60]. Qualitative testing is, however, very quick to perform and still proves helpful in many ways in finding potential problems and frustrations that can then be worked out before they take hold.

Quantitative testing on the other hand focuses on gathering and analyzing a large amount of numerical data [60]. This can be combined with gameplay metrics to give insights to how the users are actually playing the game [62]. Some benefits of doing quantitative testing together with gameplay metrics is that it can give detailed data on player behaviour, is an objective way of evaluating the players behaviour, and can give detailed feedback on gameplay mechanics. It does also allow for analyzing the game from a top-down approach, where you work towards more and more detailed layers of analysis. However, to do proper quantitative testing a lot of participating testers are required and to be able to receive a high confidence answer it is not uncommon that you need hundreds of participants [60]. Therefore, the development of interaction design projects usually focuses on qualitative testing or a combination of low confidence quantitative testing with support of qualitative testing.

4.6 Interviewing Methodology

Ethnographic interviews is a method proposed by Cooper et al. [61] to be used to collect qualitative data during interaction design development. They describe many basic methods that should be followed when conducting ethnographic interviews. Some of the methods described are: Avoid a fixed set of questions and instead rely more on using the questions to direct the discussion. The designer should assume the role of an apprentice and not the expert. The interview should focus on finding the problems with the design and not asking for solutions. The interview should also avoid discussing the underlying technology of the artifact. Cooper et al. also writes that the focus of the interviews should change during the development process. Early interviews should explore and gather knowledge about the domain, interviews in the middle of the design process should be focused more on the specifics of the domain, and the final interviews should focus on confirming previous design and making fine adjustments to the design.

4.7 Guidelines and Frameworks

As the field of game development, serious games and gamification have already been established from previous guidelines and frameworks for how to design and develop these games and artifacts have also already been created. As discussed previously in 3.1, both the fields of game development, gamification and serious games are closely related to the field of applied games. Therefore, making use of and evaluating these previous guidelines can be of great use for answering the research question of this thesis.

4.7.1 Gameplay Frameworks

One framework that is commonly referred to and used when designing and researching games is the MDA framework developed by Hunicke, LeBlanc, and Zubek [2]. The MDA framework breaks the games into components that can be categorized into one of three categories: Mechanics, Dynamics, or Aesthetics. The mechanics are the particular elements that exist in the game, these then combine into the dynamics, the behaviors of the game, during runtime. Lastly, the aesthetics is how the player perceives these dynamics. The MDA framework does also propose two different perspectives to look at a game, the designer's perspective is often looking at the mechanics first and then seeing how that builds into the dynamics and aesthetics while the player perceive the aesthetics first and can from that learn how the dynamics and mechanics of the game work. This notion of different perspectives is important when designing an applied game, because it is through aesthetics that the game can translate the characterizing goal. Therefore, the MDA framework describes a formal way of how the gameplay mechanics and dynamics can be used to build an aesthetic that promotes awareness about a topic. It is here also important to note that the gameplay aesthetics described in the MDA framework is not the same definition of aesthetics as the narrative and graphical aesthetics used by *Planning Report - Aesthetic Design of Applied Games* [1].

Formal analysis of gameplay is also an interesting tool to use when analyzing and designing gameplay for games. Lankoski and Björk proposed a framework of primitives when doing formal analysis of games [63]. These primitives are components, actions and goals. The components are described as entities within the game that can be manipulated by the player. Lankoski and Björk further divides the actions into smaller components of; *Player actions*, actions that the player initiate, *Component actions*, actions that are perceived to come from the components, and *System actions*, actions that are not perceived to come from players nor components. Lastly, they define the goals as: *"... descriptions what overall conditions of the game state have specific significance for the gameplay"* [63, p. 26]. Lankoski and Björk describe that their definition of goals focuses on the players, or game's goal of reaching a specific game state and other, less concrete, goals that the player might have such as having fun, socializing or learning something. This does somewhat limit the frameworks use when designing applied games, because the entertainment goal and characterizing goal does not directly fall into the definition of goals in formal analysis. However, if other methods or frameworks can bridge that gap the formal analysis might still be

of use when evaluating and analyzing the game that is being developed.

Gameplay design patterns serve as a framework for supporting design and analysis of all types of games [4]. A Gameplay design pattern describes a design choice and serves as a way to identify several aspects of gameplay for things such as design documents or when describing games themselves. It also serves as a bridge for people with a lot of experience playing games to describe and express their knowledge as well as bringing awareness to and helping them identify what knowledge they have. Gameplay design patterns are especially useful as a tool to model the relations between gameplay elements and dynamics to analyze how they affect each other.

4.7.2 Serious Games Guidelines

Several guidelines for the general development of serious and applied games have already been proposed in previous papers. It is important to analyze the guidelines developed for both serious and applied games, because as discussed in 3.1.4 the differences between serious and applied games are insignificant. It is however important to note that the guidelines for serious games discussed in this chapter do not specifically focus on the particular question of how gameplay should be designed to promote awareness. Instead, they are more general guidelines for designing applied and serious games.

From analyzing several papers of guidelines two lists of guidelines could be created, separated into guidelines for the development of serious and applied games and guidelines for the design of serious and applied games. These lists of guidelines are summaries of the full guidelines, created for ease of readability in this thesis. The exact definitions of the guidelines are defined in the corresponding sources.

Development of Serious and Applied Games

- Research the application area [64], [65] (Appendix B.1).
- Ideate and gather knowledge about gameplay mechanics that might fit application area [64], [65] (Appendix B.1).
- Evaluate and research additional domains that might be beneficial to achieve the entertainment or characterizing goal [64], [65] (Appendix B.1).
- Adopt the game to important stakeholders (e. g. incorporate the curriculum if you are designing a game that is supposed to be used in schools) [28].
- Research and adopt to the target audience of your game [64].
- Use concepts that make normal games appealing [28], [29].
- Use multidisciplinary tools to assist the development of serious games [64].

These guidelines clearly have a large focus on the fact that doing proper background research into several domains is an important part of the development process for serious games. Something to note is that many guidelines seem to focus more on what domains need to be researched before starting the development rather than the actual development process itself. These guidelines do however note that it is

important that the development of serious and applied games adapt to the specific stakeholders involved in the project, both with the design of the product and how that product is developed. As noted in the guidelines it is also important to note that the development of an applied or serious game is still a game development project, meaning that guidelines for how to develop normal games still apply.

Design of Serious and Applied Games

- Make the games audiovisual and narrative aesthetics appealing [28], [29].
- Make the game engaging to play [29], [30].
- Allow the player to explore by themselves and make mistakes [29].
- Ensure that the player has meaningful choices [29].
- Provide guidance to the player [28].
- Give the player regular feedback [29].
- Add challenges to the game, but avoid negative consequences because of players low performance [28].
- Minimize the cognitive load [30].
- Adopt the environment and interactions to suit the characterizing goal [30].
- Incorporate an explicit debriefing phase into the game [64].

The guidelines for the design of serious and applied games do clearly state that it is important that the game that is designed still is appealing and engaging for the player. This is something that is supported by the definition of applied games developed in 3.1.4. The guidelines do also state the importance of giving the player agency to explore and make their own choices, even if that means that they can make mistakes and fail. However, it is still important to give the player guidance and feedback so they do not feel lost. These guidelines are important because they also apply to Cziksentmihalyi's list for enjoyment discussed in 3.3.1. The advice of letting the player fail might be especially important when designing educational or awareness games that aim to teach the player because making mistakes is an important part of learning [66].

> *"I wonder if the folks at NASA would find their shuttle simulators as valuable a learning tool if the astronauts could only make the 'right moves' and never crash?"* - Becker [29, p. 43].

Finally, as Catalno et al. writes in their paper about serious games a dedicated debriefing phase can help consolidate and transfer any learning experiences from the game to the real world [64]. As they discuss in their paper this is easier to do in a workshop scenario than making a game do standalone by itself. However, they do propose that implementing mechanisms to support reflection within the game itself could potentially have a great effect for the game's ability to create a lasting effect on the player.

4.8 Software

In both game development and in interaction design there exists several software's at one's disposal to aid all parts of the process. In the following section several software's related to different purposes are mentioned that could prove useful and with different strengths.

4.8.1 Communication

For communication several software exist depending on what is needed and the preferences of those involved.

- *Discord* [67] is a voice, video, and text communication service which allows one to host their own community with several text and voice channels in categories and more community friendly features.
- *Zoom* [68] is a voice and video application primarily used for digital meetings. It is commonly used within learning and work disciplines for meetings, lectures, and more.
- *Google Meet* [69] is just like Zoom a voice and video application used for digital meetings. Google Meet provides the additional convenience of being coupled with other Google services if those are also used.
- *Slack* [70] is a software aimed at team communication with organized conversation through multiple means. It also provides integration with several other software for increased workflow.

4.8.2 File Sharing and Storage

When working on any project the need to sharing many different files of various types exists in order to effectively work together.

- *Google Drive* [71] is another service provided by Google that allows for online storage of most files. Then through other Google services it allows for real time collaboration and also allows for sharing on various levels through links or invites.
- *Dropbox* [72] is another cloud storage service similar to Google Drive that allows for online storage of most sites.
- *GitHub* [73] is a repository service allowing for easier access to Git functionality. *Git* [74] is a version control system primarily used for collaboration when programming that allows for version control and non-linear workflow through branches.

4.8.3 Document Creation

For creating text, whether it be for thesis creation, note-taking, or other applications, several programs exist that excel in different ways.

- *Google Document* [75] is an online text editor that allows for quick setup so you can start working right away. This means though that less control is given to the user over the details and thus is not as suitable for larger scale documents with specific requirements.
- *Microsoft Word* [76] is another text editor and provides more control to the user, but from personal experience is not as fast to set up.
- *Overleaf* [77] is another powerful text editor, utilizing the latex document format which allows for incredibly high degree of control but is not as quick to set up. Thus, it is more suitable for larger scale documents with specific requirements and a specific structure.

4.8.4 Game Engine

When developing a game multiple powerful game engines exist that allows for game creation.

- *Unity* [78] is a popular game engine with a wide and powerful tool set. Unity utilizes a big version library and does not force one to update if one does not wish so, avoiding potential incompatibilities with version differences. Unity also has a vast online library of tutorials and assets to use and is mostly free to use in private or small-scale monetized projects but will eventually require payment if one makes enough money making a game using their engine.
- *Unreal Engine* [79] is another powerful game engine especially tailored towards 3D creation and photo-realistic visuals. This engine also follows a similar monetization model as private or small-scale projects are free but require payment as the game becomes successful enough.
- *Godot* [80] is a lighter game engine while still providing powerful tools and is open-source and free for anyone to use. This means that anything made in Godot, no matter the scale is completely self-owned and no fees or other monetization will occur. This engine is a fair bit newer compared to the other engines in the list, meaning some tasks might not have as much coverage in terms of tutorials but is quickly growing and has a helpful community.

5

Process

This chapter describes the process of the development of this thesis and of the game. This chapter can generally be divided into four larger phases: the project startup, the prestudy, the development of the game, and finally the development of the guidelines.

The project startup phase contains the original plan for the project, initial ideation and initial paper prototyping sections. All these happened before or at the very start of the development process. The prestudy was conducted after the project startup and it contains the prestudy plan, research question update, initial frameworks and initial guidelines sections.

The game development phase contains the minimum viable product, game development process, interview and playtest processes and details on gameplay system development. The minimum viable product (MVP) was conducted after the prestudy while the interview and playtest process describe how interviews and playtesting were conducted during and after the development of the MVP. The details on gameplay system development divide the game into its different gameplay systems and describe a detailed overview of how each system was developed from start to end.

The development of the guidelines phase contains the section's summary from final interviews, summary of final playtesting, and guidelines development. This phase describes how the initial guidelines were implemented during the development process, the response to the final game and an analysis of the effect and usability of the initial guidelines. This analysis would then be used to create the final resulting guidelines found in 6.2.

5.1 Original Plan

The initial plan for the project was divided into three main phases; first to have a startup phase where we would ideate and paper prototype the project as well as explore the topic of the game. This phase would also contain the research for the prestudy and writing of planning report. The second phase would be the development phase where we would use an iterative agile development process to develop the actual game. During this time, we would also start working on the report and continue the research of the final guidelines. The plan was to alternate research and writing on the report. The final phase of the project would be focused more on finishing the report and doing evaluative testing. During this phase we would also have our final

hand in and presentations. During the development of this original plan, we were aware that many of the dates and times would probably change. Therefore, our plan was to focus more on creating a good structure than to pinpoint the exact dates.

Week	Start Date	End Date	Sprint	Deadlines	Milestones	Suggested work			
3	2024-01-15	2024-01-21	1		Group contract		Ideation	Explore applied games	Group contract
4	2024-01-22	2024-01-28	2		Ideation finnished	Paper prototype		Explore topic	
5	2024-01-29	2024-02-04	3		Paper prototype		Paper protoype testing	Research Prestudy	Planning report
6	2024-02-05	2024-02-11	4			MVP			
7	2024-02-12	2024-02-18	5	Planning report					
8	2024-02-19	2024-02-25	6						
9	2024-02-26	2024-03-03	7		MVP Done		MVP Testing		
10	2024-03-04	2024-03-10	8			Product development	Product iterative testing	Guidelines Research	
11	2024-03-11	2024-03-17	9						Writing report
12	2024-03-18	2024-03-24	10					Guidelines Research	
13	2024-03-25	2024-03-31	11						Writing report
14	2024-04-01	2024-04-07	12					Guidelines Research	
15	2024-04-08	2024-04-14	13						Writing report
16	2024-04-15	2024-04-21	14					Guidelines Research	
17	2024-04-22	2024-04-28	15						
18	2024-04-29	2024-05-05	16					Guidelines Research	
19	2024-05-06	2024-05-12	17						
20	2024-05-13	2024-05-19	18	Master thesis repor	Product Done		Evaluative testing		Fix presentation
21	2024-05-20	2024-05-26	19	Final presentations					
22	2024-05-27	2024-06-02	20	Final presentations					Final report revisions
23	2024-06-03	2024-06-09	21	Final presentations					

Figure 5.1: Image shows the original plan that was proposed in the project proposal.

5.2 Initial Ideation

During the initial ideation of ideas for the game we aimed to decide the core concepts of the game and the application area. Psyon games (2.3.2), who helped advise the project, preferred if the application area was within or linked to the medical or healthcare field. To be able to use the game to answer the research question of the two theses we also knew from the beginning that the game would revolve around spreading awareness about a topic. Other than the core concept of making a game that spreads awareness about a medical or healthcare related topic, we did not have many constraints for the ideas themselves.

We had multiple ideation sessions and during ideation a modified version of Crazy 8's was used repeatedly with a timer of 8 minutes where everyone wrote down as many ideas as they could on post it notes. Between each iteration every group member would present their current ideas and allow for discussions to talk about them. We picked this method as everyone was familiar with it as well as providing us with many small ideas we could build upon which is what we were looking for. If two ideas, or more, seemed very similar in nature or otherwise felt compatible they would then be grouped together to form bigger ideas and in future iterations one could either create new ideas or build upon existing ideas.

Figure 5.2: Whiteboard showing the different ideas created and their approximate categorization.

When we believed we had a sufficient number of ideas (ca 100) we used dot-voting in order to figure out what ideas the group had any interest in. It was important to find ideas that the group felt passion towards and had genuine interest in in order to help with motivation for the project. For this, multiple rounds of dot-voting worked well to highlight and narrow down on what the group really liked and wanted to pursue further. In the end we ended up with four distinct ideas that we then brainstormed over again and developed further. These ideas where presented to our supervisor and our advisor from Psyon Games to get their insights and feedback for the ideas before making a final decision. After that the ideas were reconsidered and looked at again as we ranked them and ultimately removed the two least popular ideas among the four.

The two remaining ideas had several similarities to one another as they were both based on the same setting about gathering ingredients and creating potions. Where they differed though were in their application area. One idea was focused on exploring the environment as someone that was visually impaired and the other was focused more on the potion making process for someone with dementia.

5.3 Initial Paper Prototyping

After the initial ideation we created multiple paper prototypes for the different ideas with the aim to get a better understanding of how the games would look in practice as well as testing some potential basic gameplay to understand how they feel. Paper prototyping fit well in this case as we wanted to get a quick overview of the overall ideas and gameplay without delving too much into details and wanted something to play around with (4.4). We also desired some minor testing, mostly amongst ourselves as well as with a few outsiders to understand which of the ideas felt more feasible to further develop. As both ideas centered around the same setting multiple parts of one paper prototype could be reused in other for even faster development. In the end two prototypes of the idea surrounding visual impairment were developed, as well as one prototype for the idea related to dementia.

5.3.1 Game about Visual Impairment

This idea was based around the concept of navigating the environment and exploring to find ingredients for creating potions. Throughout the world there would be set locations or spots where one could gather each ingredient, with each ingredient being native to a certain environment. When receiving information on which ingredients to gather the player could get some sort of visual representation of each ingredient, but when finding the actual ingredients in the wild they would instead get a description based on the perspective of someone who is visually impaired. The player also had the possibility of marking a certain location with what they believe is the correct ingredient in order to remember where they have been before, but that was not a necessity.

In one version the player was placed on a large empty grid with only their home location marked for them. As they explored lines indicating boundaries would emerge in a close to the player to show where one could and could not go. The test leader would notify the player if any ingredients were in close proximity, and the player themselves could mark the location as they see fit to represent the resource. This version required a lot of work on the test facilitators as they had to be very active when looking where the player where and if there's anything they should be notified of. The first iteration had the facilitator draw the boundary lines themselves, requiring them to constantly step in and interrupt the players exploration to note things down. The second iteration instead had the player draw the boundary lines with the facilitator simply notifying them each time they walked into a wall. This sped up the game somewhat and also felt less tedious for both parties involved, but still required a lot of work from the facilitators' side and interrupted the player's actions. Another issue found with this prototype was that after playing the game for a while a large part of the game world was drawn. This reduced the feeling of being visually impaired as the game progressed.

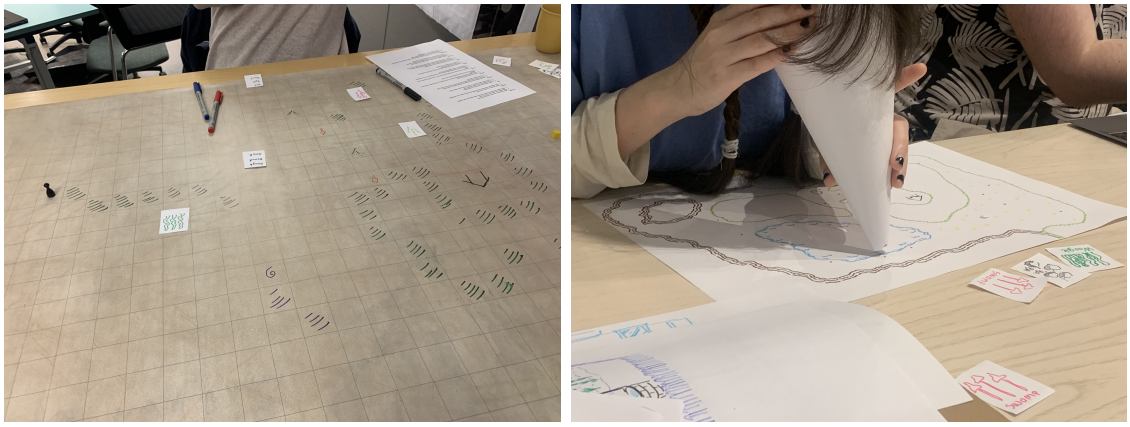

Figure 5.3: Two images showing the two different paper prototypes for the idea based around visual impairment.

In the other version the map was fully drawn out, but the player could only navigate and see things through a narrow hole in a paper cone. The map had each area marked with colors, such as brown for the mountain range, green for the forest and blue for the water. This gave the player some indication of in what area they were located. Red spots were drawn across the map to indicate where resources could be collected. In this version the player could not get an overview of where they had previously been. This version of the game let the player move the character and explore the map by moving their whole body. This let the playtesters remember how the character moved through muscle memory, something that was also reflected by the testers themselves. However, in a digital standalone game the player potentially would not have the same experience as it would no longer be relying on body movements but instead on input controls. This would risk that the tactile muscle memory would be lost in the digital version.

Something worth noting was that the first version of this idea would probably gain a lot from a digital version as the main drawbacks with the paper prototype was the slow interaction between the facilitator that the player had to rely on that could be sped up and automated. The second version of this idea would instead potentially feel like a completely new experience through a digital version as the fundamental controls change drastically.

5.3.2 Game about Dementia

This idea was based around the concept of the player creating potions from ingredients found in their house and garden. Each day they were given instructions for a specific potion to craft along with a list of ingredients needed for it. The test itself was run like a role-playing game with a game leader that kept track of all possible resources as well as the players inventory and more. The player had two different areas they could navigate in, one being inside their house and the other being their garden and could only be in one area at a time and had to move between them to gather and mix ingredients.

In the house the player could access their mail where they get their instructions, a cupboard with some ingredients, a shelf with different glass bottles, and a workstation where they could mix ingredients. They also had access to a cat they could pet and give food to and in some instances also a goldfish. Outside they had access to a well for water, a couple of seedbeds housing different plants, and a chicken coop that could all be interacted with in some way.

The application area was implemented by making things change or disappear as the player navigated trough the different areas doing their tasks. For example, if the player first went outside to fetch a couple of ingredients and brought them back in for mixing, then went out to fetch some water they could come back to an ingredient missing or being swapped out for another. If these small alterations were not noticed it could lead to them creating the wrong potion in the end. These small changes that occurred while the player was playing the game were meant to reflect that the player played a character with an unreliable memory.

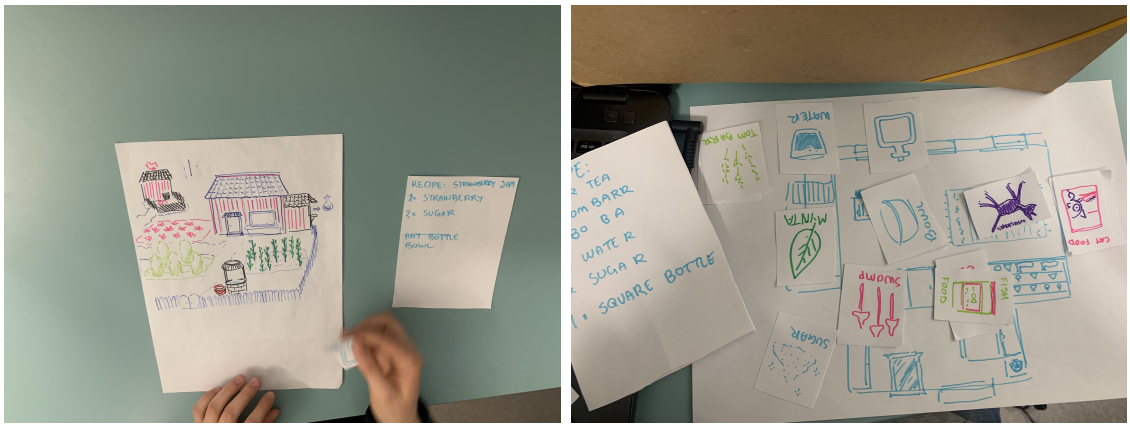

Figure 5.4: Two images showing the paper prototype for the idea based around dementia.

The overall experience the testers had was mostly filled with positive frustration as these small things could lead to fun or interesting moments or consequences. Some testers were, however, worried that the same frustration would not be as positive if caused by the game itself instead of the game leader. We noticed that negatively tinkering with what the players had done could lead to a fairly bad experience if not handled properly. The idea was also discussed that the player received both negative and positive alterations to make it feel less like the game is actively working against the player to help with potential frustration.

5.3.3 Paper Prototyping Results

From the results of testing done with both game ideas it was decided to proceed with the idea about visual impairment. We felt that the idea regarding visual impairment felt more promising and generally enjoyed the idea more when discussing it. We also felt that the theme of the game came through more effectively and that the obstacles this idea presented felt more plausible to solve in the given time we had. This idea also felt like it came through to the player more and that would be a more effective way of conveying the topic we want to spread awareness about. Our sister thesis did also mention that this idea proved much more interesting to tackle which would hopefully lead to a more interesting and better thesis for them.

5.4 Prestudy Plan

The plan from the prestudy was very similar to the original plan (5.1) with some minor changes made to it. We realized in the beginning of the project that we would need more time for researching and writing the prestudy itself. Therefore, the development of the MVP was delayed so it started after the prestudy was completed. To compensate for how this would reduce the development time for the MVP a week was cut from the product development and instead allocated to the MVP. This resulted in the research and prestudy getting more dedicated time while the product

development and MVP got less time. The prestudy also allowed us to research and decide on methods and tools to be used during the development process.

It was also a part of the plan to reach out to people from multiple organizations related to visual impairment in order to make sure we were basing the work on real experience and portrayed the topic appropriately. It was also planned to keep the majority of the work done remotely after the ideation and paper prototyping were finished due to easier management of schedules and reduced travel distances, therefore saving more time. The development process of the game was also identified as a wicked problem, and therefore we planned to work with an agile development process through scrum.

Week	Start Date	End Date	Sprint	Deadlines	Milestones	Suggested work			
~~3~~	~~2024-01-15~~	~~2024-01-21~~	~~1~~		Group contract		Ideation	Explore applied games	Group contract
~~4~~	~~2024-01-22~~	~~2024-01-28~~	~~2~~		Ideation finnished	Paper prototype		Explore topic	
~~5~~	~~2024-01-29~~	~~2024-02-04~~	~~3~~		Paper prototype		Paper protoype testing	Research Prestudy	Planning report
6	**2024-02-05**	**2024-02-11**	**4**						
7	2024-02-12	2024-02-18	5	Planning report 16th					
8	2024-02-19	2024-02-25	6			MVP	Paper prototype testing		
9	2024-02-26	2024-03-03	7						
10	2024-03-04	2024-03-10	8		MVP Done		MVP Testing	Guidelines Research	
11	2024-03-11	2024-03-17	9			Product development	Product iterative testing		Writing report
12	2024-03-18	2024-03-24	10					Guidelines Research	
13	2024-03-25	2024-03-31	11						Writing report
14	2024-04-01	2024-04-07	12					Guidelines Research	
15	2024-04-08	2024-04-14	13						Writing report
16	2024-04-15	2024-04-21	14					Guidelines Research	
17	2024-04-22	2024-04-28	15						
18	2024-04-29	2024-05-05	16					Guidelines Research	
19	2024-05-06	2024-05-12	17						
20	2024-05-13	2024-05-19	18	Master thesis repor	Product Done		Evaluative testing		Fix presentation
21	2024-05-20	2024-05-26	19	Final presentations					
22	2024-05-27	2024-06-02	20	Final presentations					Final report revisions
23	2024-06-03	2024-06-09	21	Final presentations					
24	2024-06-10	2024-06-16	22						

Figure 5.5: Showing the plan developed in the prestudy.

5.4.1 Tools

Communication was planned to primarily be through Discord as it was software all members of the project were highly familiar with and had been used before for similar purposes with high success. Other tools like Zoom and Google Meet would be used when having supervision and mentor meetings as they provided better convenience for the other participants. Google Drive would complement Discord for file storage which included files like logs, meeting protocols and other text documents. For shorter or smaller scale texts which will not be public Google Document was planned to be used to quickly set up and write down what is needed, while Overleaf was planned for creating larger scale documents such as the planning report and final thesis.

For code storage GitHub along with its desktop application would be used as it is the primary version control and collaboration tool for code that members had used before, and everyone was familiar with. GitHub also provided a built-in scrum board which had the added functionality to link different tasks to pull requests, automating the process and keeping it less spread out. For game development Unity would be used primarily because it is the engine the group is most familiar with, leading to the least amount time spent learning and instead more time spent on working and developing.

5.4.2 Expected Result

The expected result of this report was a set of guidelines on how to design gameplay to promote awareness through an applied game. The guidelines were to be developed by using already existing guidelines and frameworks in the development of an applied game, and through that be able to analyze what guidelines are useful for designing the gameplay. We also expected that the development of a game would give us some insights. Together this knowledge would be used to create a set of new guidelines that answered the research question.

5.4.3 Agile Workflow

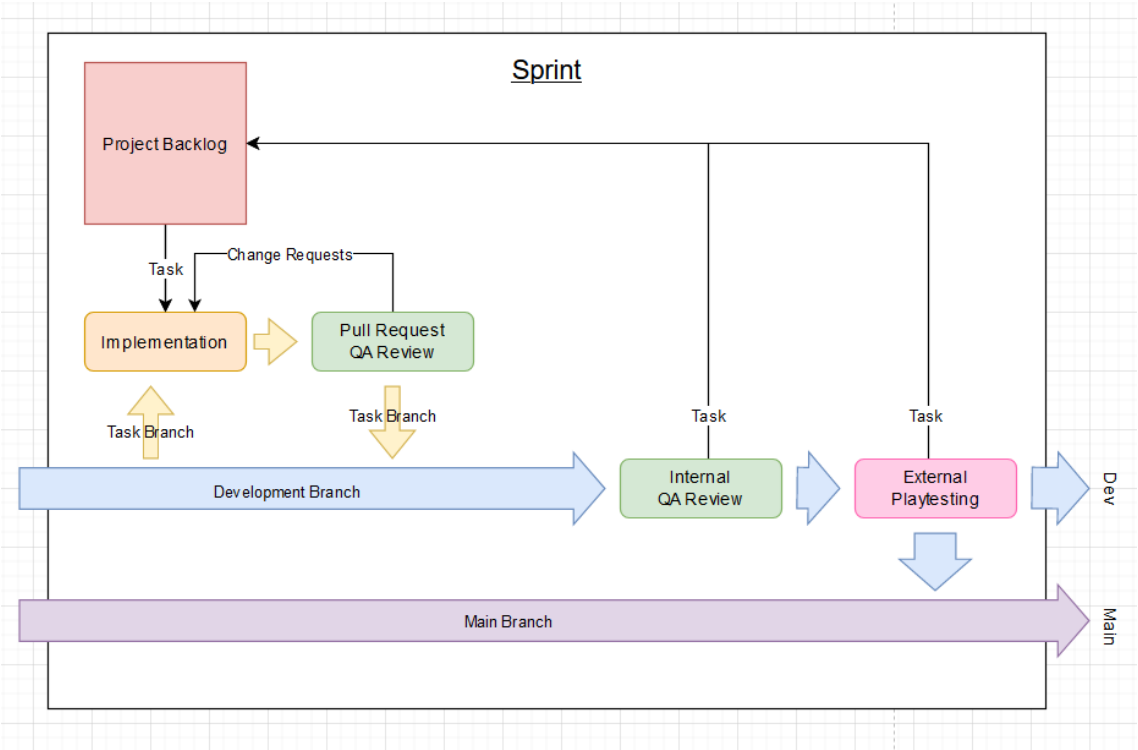

Figure 5.6: Plan for development sprint.

The plan for each sprint of the development process can be seen in Figure 5.6. This plan included internal quality assurance and external quality assurance through testing. It would be preferable if both qualitative and quantitative playtests could be conducted. However, we did not plan that any quantitative tests would be achievable, as it would be very difficult and time consuming to find a large number of testers. Therefore, a more realistic approach was to focus primarily on doing several qualitative tests.

The plan also included continuous deployment to the main branch. This plan was chosen because the various stages of testing ensure that the project maintained a high quality and allowed us to monitor what changes were beneficial for the project, something that is important when creating the guidelines. This pipeline had also been tested by the group in a previous project where it proved to work well [81].

5.4.4 Scrum

The decision to work with scrum was made because of the limited size of the development team, four people, and the limited time scope for the project. It was decided that each sprint would be a week long for the project development. Some adaptations of the roles in the scrum methodology were however made to better fit the structure of work for the two theses written around it. We opted to not have a dedicated scrum master and product owner, and instead treat all four members as a bit of everything. With only four people working on the project, it did not seem beneficial to divide the scrum roles further but instead keep everyone on the same level and open up for more discussion.

5.4.5 Meetings

Each Monday a weekly print meeting would be held where we would look at what had been done the prior week and assign tasks for the following week. Each member would also put in their planned schedule for the week, notifying other members of any potential interruptions or other events that might be good for the rest of the team to know. The plan was not to force anyone into a rigid work schedule but instead to give a bit of insight to all the members of what was happening and to give everyone a rough estimate of what to expect for the upcoming week.

Each day a daily recap meeting was also planned to be held where around five minutes would be given to let all members quickly describe what they had done since the last daily recap meeting. This would allow each member to keep track of what was happening in the various different parts of the project. It could also be used as a small space to have small discussions or to keep up communication about any concerns or opportunities someone might find.

Each week we also planned a supervision meeting with our supervisor to get updates from them and get feedback on the thesis and project. A meeting was also scheduled to be held every other week with Psyon Games in order to get advice for the development process.

5.4.6 Git Pipeline

The Git pipeline is as seen in 5.6 where a task would be taken from the backlog and implemented on a new branch dedicated to it. When that task was considered done a pull request to development was to be made and someone other than the creator of that branch was notified and would go through the pull request. They would then either point out things that needs to be changed, if something is not working or accept the pull request and merge it into the development branch. Before each external playtest a push from development into main was to be made which was internally tested with the intent of providing the playtesters a more stable build without big systems in development.

5.4.7 Iterative Testing Plan

The plan was to have iterative testing done on the current development of the game each week after the MVP was done to provide stable and continuous feedback on what worked and felt good and what needed more work or changed from the target audience's perspective. Due to holidays and other important events the group expected to miss a few test opportunities, but the goal was to have as many playtests as feasibly possible. Due to the limited amount of time and limited amount of people testing it was expected that qualitative testing (4.5) was primarily to be used. It was estimated that qualitative testing would be more time efficient and could be more reliably conducted throughout the whole design process.

5.5 Research Question Update

During the paper prototyping and initial ideation, the goals of the game were discussed, and they were decided in conjunction with deciding which of the game ideas we would continue working on. The application area was further defined within the general healthcare domain to be specifically the domain of visual impairment.

We realized that only one game would be able to be developed during the time scope of the project. This would be problematic for answering the research question, as it would be hard to determine if the resulting guidelines would fit the general research question of: *What should be considered when designing gameplay to promote awareness through an applied game?* To address this issue, we decided to narrow down the research question to the specific application area of visual impairment. This would allow us to test and develop the guidelines through the development of an applied game without risking that the guidelines would be unfitting for other application areas. Therefore, our new research question is defined as: *What should be considered when designing gameplay to promote awareness about visual impairment through an applied game?*

5.5.1 Characterizing Goal

The characterizing goal of the game was to promote awareness about how it feels to live as someone who is visually impaired. The game focused specifically on the representation of how it is to live as someone who is visually impaired. This means that the game did not focus on giving an accurate visual simulation, but rather to focus on the experiences. That being said, some level of simulation of how it feels to be visually impaired was important.

The game also specifically focused on how it feels to navigate and explore as someone who is visually impaired. Exploring a new area is something that can be especially challenging and daunting for people with visual impairment, however this issue can be addressed by making detailed mental maps and memorizing routes through the environment (3.2.3). Going from being uncomfortable with exploration and the character's visual impairment to becoming familiar with and adapting to it was one of the core experiences that we wanted the player to have.

The core message of the game was that visually impaired people might interpret the world around them differently to fully seeing people, but that they often handle themselves better than what many sighted people think. This statement is something that was confirmed by people with visual impairment during the interviews that were later conducted (5.10.1).

5.5.2 Entertainment Goal

The game's entertainment goal focused primarily on exploration and analysis of different objects. One of the core experiences that we wanted the player to have was about being excited to find new things and places. We also put an emphasis on a lighthearted narrative with a slow and cozy feeling within the game. One reason for this was that during our initial prestudy of other games about visual impairment we found that many of the games had aspects of horror in them. Therefore, we wanted to make a game that portrayed a different perspective. This might also be beneficial as some people have a problem with the large correlation between games about visual impairment and horror games [82].

5.6 Initial Frameworks

The initial frameworks we wanted to use when developing the game were the MDA framework [2] and Gameplay design patterns [4], as well as the combination of the two. When used together these two frameworks could then be used to create a model of the gameplay that allowed us to analyze how different parts of the game affect each other.

We could also define our entertainment and characterizing goals as aesthetics in the MDA framework. For the characterizing goal we wanted the player to feel informed and aware about visual impairment and for the entertainment goal we wanted the player to feel invested in the story, a sense of discovery, and a sense of exploration. These aesthetics were not directly labeled as aesthetics in Hunicke, LeBlanc, and Zubek's paper about the MDA framework [2], however they could be described as an emotional response evoked in the player which is the core concept of MDA aesthetics.

Using the MDA framework and the Gameplay design patterns together could then be used to map how different dynamics and mechanics related to the aesthetics and therefore also the goals of the game.

5.7 Initial Guidelines

These guidelines were developed during the initial research for the project. The guidelines themselves are similar to the guidelines found in 4.7.2 but with some changes to fit this specific project and its application area of visual impairment. These guidelines were then used and analyzed during the development of the project.

- Research the application area of visual impairment.
- Ideate and gather knowledge about gameplay mechanics and aesthetics that might fit application area.
- Adapt the game to important stakeholders, including people with visual impairment and the target audience.
- Use concepts that make normal games appealing and engaging to play.
- Allow the player to explore by themselves and make mistakes.
- Provide some guidance to the player.
- Give the player regular feedback.
- Add enough challenges to the game to fit target audience expectations.
- Minimize unnecessary cognitive load in the game.
- Adapt the environment and interactions to suit the characterizing goal of spreading awareness.
- Incorporate an explicit debriefing phase into the game.

Many of the previous guidelines (4.7.2) were slightly adapted to the specific application area of visual impairment and the characterizing goal of spreading awareness about visual impairment. As the project is a rather small project with a limited time budget some of the guidelines were also adapted to specify that we only needed to try and achieve them for our target audience. This made the guidelines easier to define and achieve.

5.7.1 Discarded Guidelines

Some of the previous guidelines mentioned in 4.7.2 were also ignored completely. This does not mean that we found them unimportant or wrong, instead they simply did not fit our specific project and therefore it would be misleading to evaluate them throughout this project.

Evaluate and research additional domains that might be beneficial to achieve the entertainment or characterizing goal. Because of the limited time and resources we had for developing the project we aimed to make a stand-alone game that was within the domains of game design and our application area of visual impairment only. Adding an additional third domain would not help us answer the research question.

Use multidisciplinary tools to assist the development of serious games. As described by De Troyer [64] this guideline is important because development teams of serious games are often multidisciplinary, and therefore the tools used should be adapted for that. However, this did not really apply to our group. The main reason for this was that our development team was small, and the members were from the same discipline of interaction and game design.

Make the games audiovisual and narrative aesthetics appealing. The audiovisual and narrative design of the game was not a part of the scope for this thesis, instead it is the scope of our sister thesis [1].

Ensure that the player has meaningful choices. This guideline was not added to the initial guidelines because it did not really fit the game. Most meaningful choices in the game were how the player explored the world, however, this was something that we already had a specific guideline about; *Allow the player to explore by themselves and make mistakes*. Therefore, this guideline was removed in favor of the other guideline.

5.8 Minimum Viable Product

The first step in digital game development was to create an MVP. The MVP encompasses the very core of the game, the minimum number of systems needed to still recognize it as a specific game, but not more. The main reason to complete the MVP early on was that it would then be possible to start testing continuously as progress was made. Before the MVP was done there were not enough core systems in place where external tests would provide much meaningful information and the time was instead better spent on developing the MVP.

Early on in the development of the MVP it was decided that the game would be a 2D game, instead of 3D. Creating a 2D game had some benefits. First of all, both we and the members of our sister thesis had more experience working and designing for 2D, therefore it was predicted that working with 3D would take more development time because more resources needed to be allocated to learning about 3D design. 3D models are also more complex to create and animate, as they require several steps such as modeling, creating textures and materials, creating the UV map, and rigging the models. This would take significantly longer time for the audiovisual group to do. Creating a 3D game also requires that a bit more thought is spent optimizing the game to make it able to run on low-end devices as 3D graphics often is more demanding for a computer to render than 2D. This would be especially important if we would want to be able to port the game to mobile at some point. There would be one main benefit of making a 3D game, and that would be that we could potentially be more accurate with simulating what a person with visual impairment could see. However, as discussed in 1.2, creating an exact simulation of the game is out of the scope of the project because it would require medical expertise within the field of visual impairment that would be unfeasible for us to gain during the limited time of the thesis. Because the game only needed to represent, and not simulate, visual impairment this could be achieved using a 2D game as well as a 3D game, but a 3D

game would require more development time and resources, that could otherwise be spent on conducting research, developing the game, or research question.

Some systems included in the MVP were basic systems found in most games like player movement and player input, sound, initial UI, some initial sprites, and some sort of game world to exist in. For the purposes of the MVP not all sprites or a complete game world was needed and only a few components were used to create a temporary starting zone. Other systems or mechanics that were deemed necessary for our MVP were the limited visual field, a footstep system, dialogue, object fading and the re-imagination system. All of these systems were based on paper prototypes. The visual field was based of the paper cone and cover of the map and the footstep system was the initial solution to imitate the muscle memory that was mentioned during the paper prototyping, while avoiding the issues found when the player could see all the places they had previously been to. The re-imagination system originated from how the player could assign one of many different plant images to a plant they found, and dialogue laid the foundation to communicate with the player through various means. The dialogue system allowed for very flexible use through using the *Ink* plugin [83]. It also allowed for multiple choice questions to be used in the dialogue, which opened up options to use it together with other systems such as the investigation of ingredients.

During the development of the MVP, we decided to primarily focus on developing the game for a PC, and not mobile. This decision was made because it made it easier to quickly implement controls and create builds that we could easily share. If we would have developed the game for mobile first that could have made it harder for us to find playtesters as it requires more work to port to a mobile device, especially IOS devices. This could potentially limit the available testers to participants who had android devices, or requiring on site tests where we could provide an android device to be used during the testing. In both circumstances it would have significantly restricted and limited our ability to conduct playtests. The decision was discussed with our advisor from Psyon games, as they were keen on us making a game on mobile, and they were fine with the decision, but they would appreciate if we could port the game to mobile at a later stage during development.

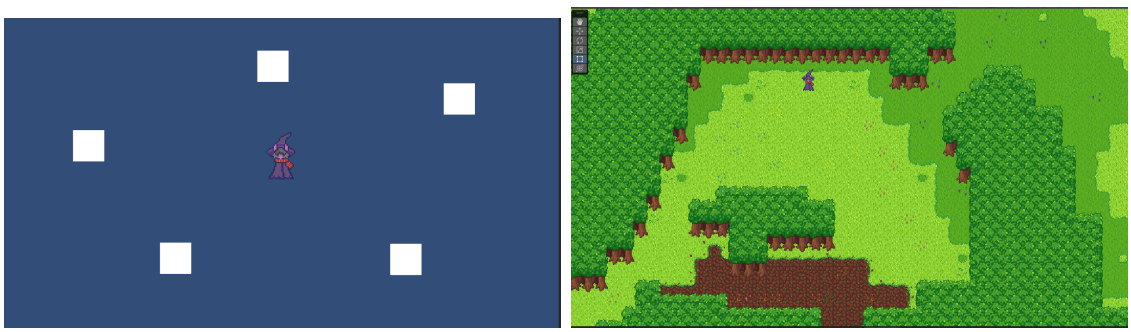

Figure 5.7: Image on the left shows the game during early development and the image on the right shows parts of the MVP map.

5.9 Game Development Process

This section describes how we worked during the development of the game. In general the plan proposed in the prestudy (5.4) was followed, with some tweaks. The game was developed through an agile development method using scrum, where one sprint was about one week long. We also conducted our meetings as planned throughout most of the development process and the git pipeline was followed with some minor changes.

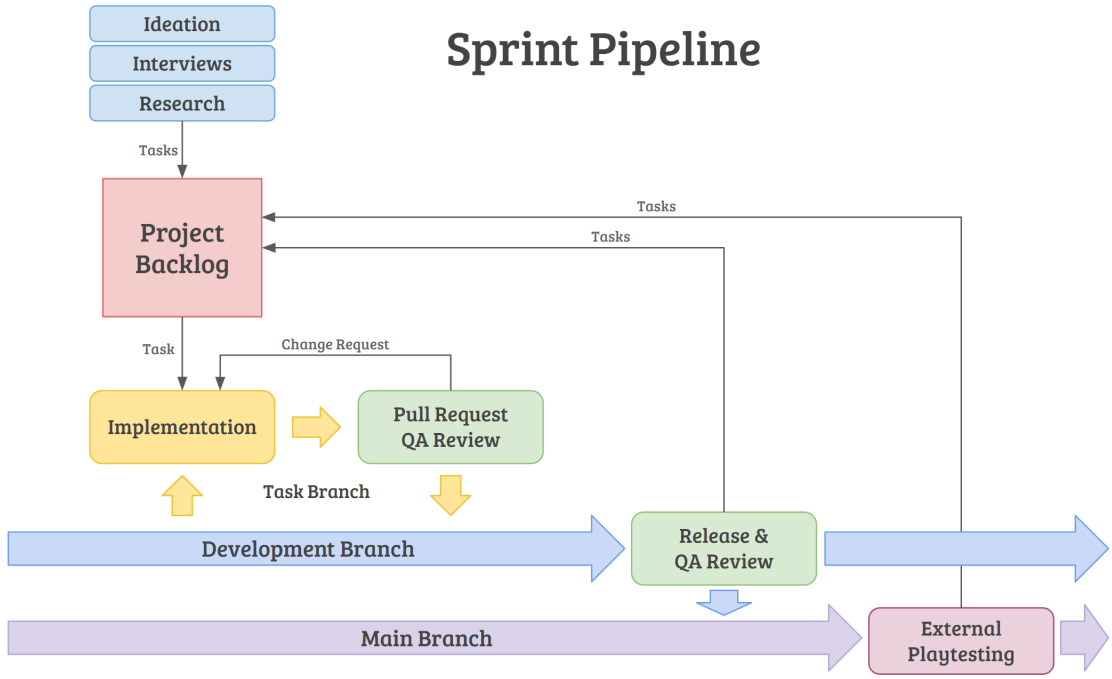

Figure 5.8: Image showing the pipeline used during each sprint in the development process.

One change to the git pipeline that was made was that we decided to make a release to the main branch before doing external playtesting. The main reason for this was that it made it easier for us to share the files to the playtesters, as we could just send them a link of the release.

During the development of the game, it was decided that we would not have a single person being the creative director. Having a creative director can be a good decision because as described by Masahiro Sakurai, making all decisions using voting results in the most mediocre option, which is not necessarily the best option [84]. For our team and project, a creative director would, however, not fit that well. One reason for this is that to be able to efficiently answer the research questions both groups needed to have creative control over the areas of the game that was connected to that part. Each master thesis group also only had two members, meaning that both the respective groups and the whole development team at large were small groups. This made it naturally easy to discuss and decide things within the groups.

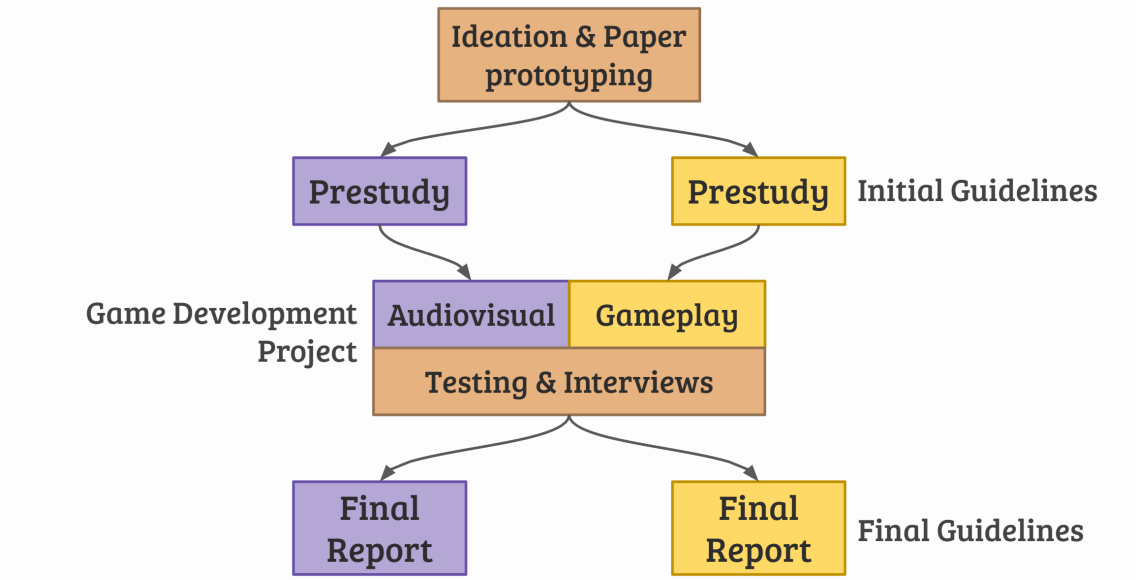

Figure 5.9: Image showing when the groups worked together and when work was done separately.

During the development of the theses, it varied a lot on how much we collaborated with our sister thesis. As discussed in 5.2 and 5.3 the initial ideation and paper prototyping was done in collaboration with our sister thesis. However, the prestudies themselves were mostly conducted separately as the two reports focused on different things. The main thing that was done together in the prestudies was the planning for the development of the game. During the development of the actual game, we and our sister thesis worked on different parts of the development. We focused on the design and implementation of the gameplay and systems, and they focused on audiovisual and narrative design. Even though the two groups worked with different things we discussed a lot between the groups regarding the development of the game. We also collaborated on some parts during the development of the game itself, as for example conducting interviews and playtesting. When writing the final reports and doing the final analysis we worked as separate groups, because we had different research questions and different ways of answering those research questions.

5.10 Interview and Playtest Processes

In this section both the interview and playtest processes are described in detail. The interviews and playtests were conducted during the MVP and then throughout the rest of the development process. This section focuses on methods used and the aim of conducting interviews and playtesting.

5.10.1 Interview Process

To be able to get more information about visual impairment as well as to be able to ensure the correctness of the representation shown in the game, interviews were conducted with people that are visually impaired. These interviews were complimentary to the research done about the topic through other means, such as reading papers. The basic methods discussed in 4.6 were used during the interviews, but we would not define the interviews themselves as fully ethnographic interviews [61]. One reason for that is because we had limited resources, which meant we could not obtain a large diverse set of participants. These interviews were also not part of an actual playtesting of the game, instead they were aimed towards the application area in general and its connection to the game.

In total we were able find three people who agreed to participate in interviews and two of them joined for two interviews each. In total we conducted five interviews. Three of the interviews were formative interviews done in the early and middle part of the development process. The focus of the formative interviews was getting more information on particular situations and experiences people with visual impairment commonly face. This gave us more information about the topic that could then be used during the ideation and development of the gameplay and audiovisual design. One example of this is the smell system, which was added because one of the members outspokenly said that smell was more important than what we had originally imagined. During the formative interviews we also discussed some of the gameplay mechanics that we had planned to hear the opinion of someone who is visually impaired on the initial design.

The aim of the final two interviews was to evaluate the game and if the game design represented visual impairment. During these interviews the game was first shown and described to the participants and then questions about how well specific parts of the game represented real world scenarios as well as how the game as a whole represented visual impairment were asked. One thing that complicated these interviews was that because of the participants' visual impairment it differed how much of the game they could actually perceive by themselves using vision. Therefore, the game was also described to the participants at the same time as it was shown. This might have slightly tainted the participants' experience of the game, even though the descriptions of the game aimed to be purely objective and factual of what was shown on the screen.

5.10.2 Playtest Process

Playtesting was conducted throughout the development process of the game. Playtesting was generally done once each sprint (one playtest per week) after the initial MVP was done. However, a few sprints were shorter than normal because of national holidays which meant no playtesting because of time constraints, something that was expected in the prestudy plan (5.4.7). In total six separate playtests were conducted.

At the start of the development process testing was done on a smaller scale, usually only 2-3 people per test. Then as the development progressed the playtests were scaled up with more playtesters and at the end each playtest had about seven participants. This was done because of two reasons; first the game itself was smaller and less complex in the beginning meaning we had less things to test. The second reason was that we predicted that it would be difficult to get a lot of different playtesters for the game and we knew that we wanted to test the game with new players even at the end of the development cycle. Therefore, we limited the number of testers at the beginning to ensure that we always had some new people who would be interested and had not tested before throughout the whole development cycle. In total 19 people tested the game and some of them tested the game multiple times. Because of the limited number of testers available it was decided to only use qualitative testing (4.5) throughout the development of the game. This was also expected during the planning of the development process (5.4.7).

Each playtest was 1-1.5h long and consisted of the playtesters first playing the game on their own while the facilitators made observations, followed by a group discussion where the playtesters discussed and answered questions in small groups of 2-4 people. This is similar to the method of observation and interviewing described in 4.5. For later playtests with more playtesters the playtesters were divided into smaller groups during both the observation and discussion phase. This made it easier for the facilitators to keep track of the players and ensured that all players' opinions were heard in the discussion phase. If a playtest contained both new playtesters and experienced playtesters the new playtesters were usually separated into a group of their own. If this could not easily be done, then the facilitator ensured to hear their opinion first during the discussion phase to ensure that the answers from the new testers were not tainted by the answers of more experienced players.

Using small group discussions for the playtests was useful for conducting qualitative testing as the playtesters did not only state their opinions but could also react to other players' opinions. During testing we often found that a question about the game opened up a discussion within the playtesting group, these discussions gave a lot of good feedback as they often gave several points of views on each answer. It is however important to note that by conducting testing in small groups the players answer of the questions might be slightly tainted by the answers of other testers in the same group. To combat this slightly the players were asked to not discuss with each other during the observation phase of testing where the players played the game. This ensured that the players' experience with the game was completely their own.

During some playtests the players were given slightly different versions of the game. Often a single, or a few mechanics were slightly different between the versions of the

game. One example of this is when testing the initial footstep system, the players were given versions with different number of footsteps printed out after them, and one player got a version with the system completely removed. During these tests the facilitators were extra careful with letting each player answer questions about the mechanic by themselves first before having a group discussion about the topic, as it was especially important to hear all participants' opinions. These tests were very useful for the design and balance of specific mechanics because they often gave a good overview of the pros and cons of different versions of mechanics.

The goal of the playtests slightly changed during the development process of the game. At the start and during most of development the playtests' primary focus was to test the core mechanics of the game. The playtests were also used to find issues in the design that needed to be addressed throughout development. At the end the playtests were focused more towards evaluating the effectiveness of the game with regards to the game's characterizing and entertainment goals. The playtests were not only important for finding issues and evaluating the game, but they also provided information on what we needed to prioritize when developing the game. This was especially important because we knew that we had limited development time, and we would not have time to fix all issues in the game. Because we only conducted qualitative playtests none of the playtests can be used to prove anything about the game (4.5). However, the playtests did give us some general insight and understanding of how the players perceived the game.

5.11 Details on Gameplay System Development

In this section all the main gameplay mechanics and systems are described as well as how those systems were developed and designed. In this section the complete development cycle of each system is described separately. This is done to ease readability and make it easier to follow the full design process of each part.

5.11.1 Visual Field

As one of the main goals of the game is to inform the player about visual impairment, the amount of information of the world that the player could actually see in the game needed to be controlled. This view of the game is referred to as the players visual field of the game, and in this game, it was significantly restricted through a mask that was layered on top of the game world. This reduced the player's view of the world to an area directly around the player character.

How much the player could see in the game was discussed from the start of the development process. From the early research done in the application area it was decided that the player would have some vision, even if the vision were restricted. This decision was made because most people with visually impairment do still have some vision, only approximately 15% are totally blind [85].

Figure 5.10: Image shows the view of the game for the player. A mask is placed over the game world restricting the view for the player and objects fade out depending on distance from the player.

As described in 5.3.1 two versions of reducing the players vision were tested during the paper prototyping. During the first method the area around the player character was drawn, meaning that the player could see a small area around the character and see the areas the player had previously been to. In the second method the players vision was reduced by only letting the tester view the game world, which was drawn on a paper, through a small hole in a cone. With this method the player could not see where they had previously been.

As previously mentioned in 5.3.1 one major drawback of one of the prototypes was the demand on the facilitator to constantly make sure they knew where the player was to inform them what happened when they moved. This was something that a digital version would greatly improve as the facilitator was no longer needed and the player would not be interrupted as the game could instantaneously handle any updates to the environment. The visual field system that was implemented behaved much like it behaved in the paper cone prototype. From the paper prototype testing as previously mentioned in 5.3.1 being able to see where you had been previously and see how it looked like proved to be too much visual information which meant the player relied too much on their sight and less on their memory and other systems in place. This in turn led players further away from how people with visual impairment had described their experiences and so the equivalent to what was used in the paper cone prototype seemed more fitting.

Another component of the visual field system that was implemented was how large objects would show up even if most of their sprite was outside the player's normal vision. This would happen when a point of the sprite came close enough to the player. The point was located at the base or bottom of each sprite to imitate its

ground position compared to the player. This was added to give a better experience for the player towards the entertainment goal as without it a player would never be able to see the bigger objects in one piece. This also served as a middle ground between the characterizing and entertainment goal as you do not have full vision of everything around you but can see individual objects clearly even if they are too big for your field of vision.

Figure 5.11: Image shows how the large building shows up even though only it being partly in the players field of view. Note that the large building is faded out because of its distance to the player.

The mask was designed so the player had a fairly limited vision of what they could see in a circular field around the player. Objects would when close enough be put above the visual mask and instead have their opacity changed, starting at barely visible to becoming completely filled when close enough. Another problem we were faced with was how large objects like trees that are bigger than the player's visual field also had to be both behind and in front of the player, depending on where the player was in comparison to the object. This was solved used the same point using when displaying large objects and comparing their relative position to the player's point located at their feet. If the player's point was above the object, it meant the player was behind the object and thus the object should be put in front of the player. In the same way if the player's point was below the object, it meant the player was in front of the object and should thus be rendered above the object. It is worth noting that the final visual mask used is not representative of all visually impaired people. From one of the interviews, we also learned that even though having a limited range for the vision is common for visually impaired people, it is also common that the view they have within that range is reduced as well, something that is not represented too well in the game.

5.11.2 Footsteps

Early on in the ideation process one idea of a mechanic was to let the player discover the map and when the player had discovered that part of the map a visual representation of what the player had discovered would stay on the screen, even when out of range of the visual field. The purpose of this mechanic was to give the player a visual representation of what the character could remember as well as work as a representation of muscle memory on how the player had previously moved. Similar mechanics to this are the FOG OF WAR effects found in games such as *Civilization VI* [86] and in the way the map is painted in in the adventure game *Beyond Eyes* [87].

Figure 5.12: Image on the left shows how the map is displayed in *Civilization VI* [86] and the image on the right shows how the world is displayed in *Beyond Eyes* [87].

This was one of the mechanics that were playtested early on in the paper prototyping stage. During the paper playtesting we discovered that the aspect of fully painting in the map where the player might be problematic, because even though the mechanic was interesting in the beginning, the players started to rely heavily on their vision after they had filled in large parts of the map. During testing with the paper prototype where the players did not have this mechanic one player stated that they relied heavily on their muscle memory and movement to determine where the character was located. This was an interesting aspect of the game that we wanted to keep, but we knew that we needed to implement it in another way in the final game, as the actual movement controls would not be as closely synced to the movement of the character on the screen.

To address the problems found during paper prototyping the digital MVP was first developed with a footstep system, a system that visually displayed where the player had previously been by adding the players footsteps into the game. These footsteps were handled differently to other elements in the game because they were not affected by the players field of view. This combined with giving the player the controls to zoom in and out allowed the players to see how they had moved through the game. Using the pattern the footsteps provided the players could puzzle together a mental map of what the layout of the world looked like without us actually showing any part of the world outside of the players restricted field of view. Testing of the MVP of the game showed that this somewhat solved the issues found during paper prototyping.

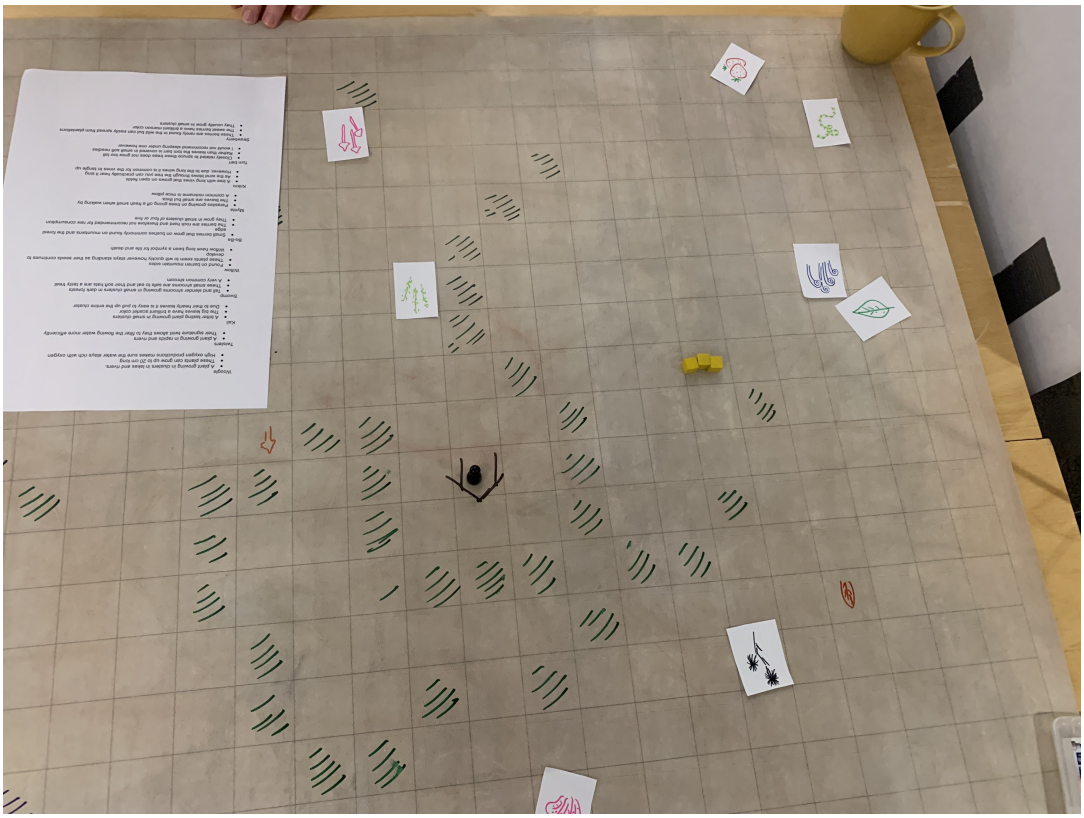

Figure 5.13: Image shows the paper prototype of the drawn map. This image illustrates the problem with the map showing too much information after the player had played the game for a while.

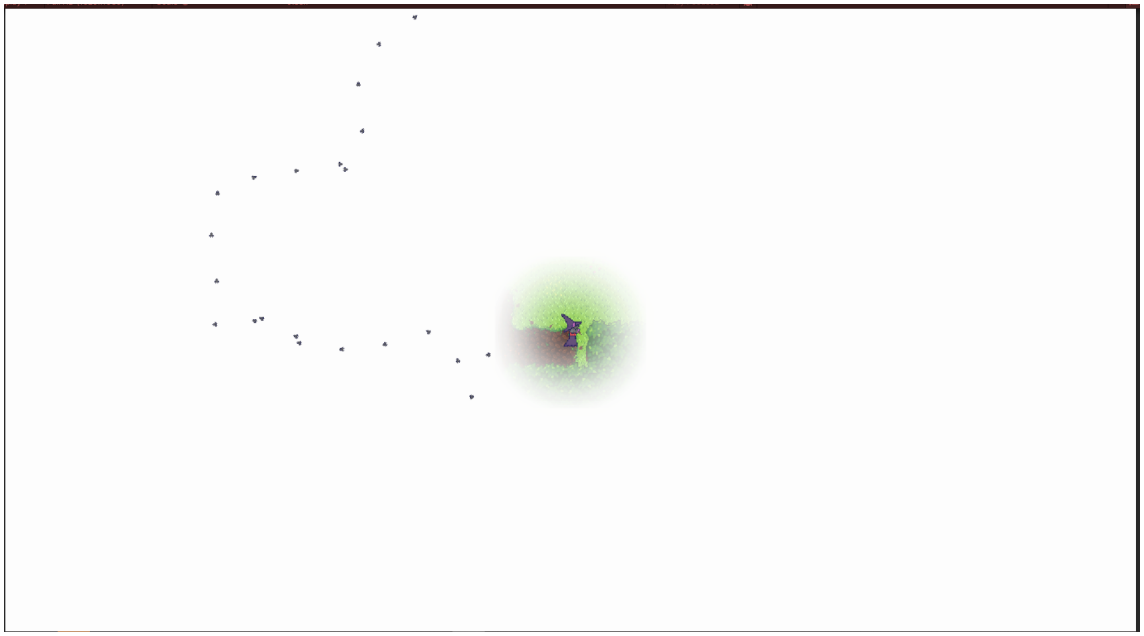

Figure 5.14: Image shows the footstep mechanic in the MVP. The player has zoomed out slightly.

The issues with the footstep mechanic were however not completely solved. During our initial interviews with people who are visually impaired one of the aspects that was discussed was the aspect of how unsettling and easy it can be to get lost when being visually impaired. As one of the core aspects of the game was exploration this aesthetic of feeling that you need to be careful that you do not get lost is important to convey to the player to properly inform them about visual impairment. The main problem with the footstep mechanic was that the player could use the footsteps to fairly accurately locate where they are without needing to care too much about keeping tracks of landmarks or similar features in the game. It also reduced the consequences of when the player actually got lost because the players could always use the footsteps easily to backtrack to a point where they did not feel lost anymore. One of the interviews mentioned that as someone who is visually impaired, they do not know exactly where they have previously been, but they know from what direction they recently have come from.

These problems were solved by only showing a few footsteps behind the player and removing the zoom mechanic. This in practice meant that the player could only backtrack a very short distance before the footsteps disappeared and the player could not zoom out to see all the places they had been to. Playtesting showed that these changes increased the risk of the player getting lost and increased the consequences of getting lost to better suit the aim for the aesthetics of the game. In order to test this mechanic three further versions were created, the differences between the versions were how many footsteps were shown after the player until the oldest footstep disappeared. The result of the playtesting showed that the players preferred the version with almost infinite footsteps because that reduced the chance of them getting lost, and getting lost could be frustrating for them. However, this frustration of being lost was also something that was highlighted during the interviews with visually impaired people. Therefore, in this case even though our playtesters outspokenly wanted a lot of footsteps in the end the system was heavily limited. This also shows some of the difficulties that development of applied games can face where the characterizing goal and entertainment goal do not match.

Figure 5.15: Image shows the footsteps in the final game. In the final game only a few footsteps are displayed after the player and the player can not zoom out.

The final version of the footstep mechanic is significantly different from the mechanic that was suggested at the beginning of the development process. However, even though this mechanic ended up being a less important mechanic it does serve its purpose of allowing the player to kind of feel their way forward in areas of the game where the player's sight is even more restricted. This was also something that some of the playtesters reflected upon and enjoyed during the playtesting of the mechanic, and therefore the main reason for why the mechanic was not completely removed.

Figure 5.16: Image shows how the footsteps can help when navigating an area of the game where the players vision is even more restricted.

5.11.3 Game World Navigation and Layout

The game world layout was mainly designed with player driven exploration in mind. Because of the player's limited view and lack of ability to get an overview of the game it was also important for us that the player was able to make a mental map of the game. Making a mental map of the world is also similar to how many blind people navigate spaces. From previous research of visual impairment (3.2.3) and the interviews conducted with people with visual impairment we can also conclude that this mental map of objects is also important to simulate how blind people navigate the world.

The world layout is also needed to motivate the player to explore the world. Traditional open world games such as *Elden Ring* [88] and *The Legend of Zelda: Breath of the Wild* [89] us large landmarks visible from a distance far away to encourage and motivate the player to explore the world towards a specific goal. This method was hard to adapt to our game because the core game mechanic of the game was that the player could not see things far away. Another way to encourage exploration through game world layout is to make different areas within the game world feel and function differently. This can for example be found in the game *Outer Wilds* [90] where each planet that you explore both functions and feels differently.

From the initial paper prototyping playtesting we discovered that players usually had an easier time to explore areas that were very dense and crammed instead of completely open areas, especially in the prototype where they could not see where they had previously been. This experience was tested again in the MVP where the response remained the same. The players stated that this was because they preferred to follow walls and objects in the game, and moving across a large open area did not provide such guidance to the player. This experience, that open areas are harder to navigate than crammed areas, is similar to how many people with visual impairment also experience navigation (3.2.3). Therefore, this feeling was something that we wanted to keep in the final game as well.

By investigating how other games encouraged exploration through map layout, how visually impaired people experienced navigation and from our initial testing using paper prototypes a list of requirements could be made for the game world layout:

- The layout needs to encourage exploration by using points of interests that can be detected from afar.
- The layout needs to encourage exploration by adding different areas that feel and function differently.
- The game world needs to include distinct features and landmarks that can help the player to make a mental map of the area.
- The game world should aim to be dense and crammed to help with navigation, and in areas where that is not the case it should be considered a challenge for the player.

These requirements then provided guidance for how the game world layout was designed.

The general layout of a full game world was then sketched to get a good overview of the general shapes of each area. An initial list of features and functionalities was also made for each area to help make them distinct and feel unique. It was important that this early in the development process we knew that we would not have time to implement all areas, but we did not fully know how many areas we would have time to implement. Therefore, several areas were sketched, and we made an initial plan that allowed us to later come back and flesh them out when we knew if we had time to implement them. In the end we had time to implement about three out of the initial ten sketched areas that were planned.

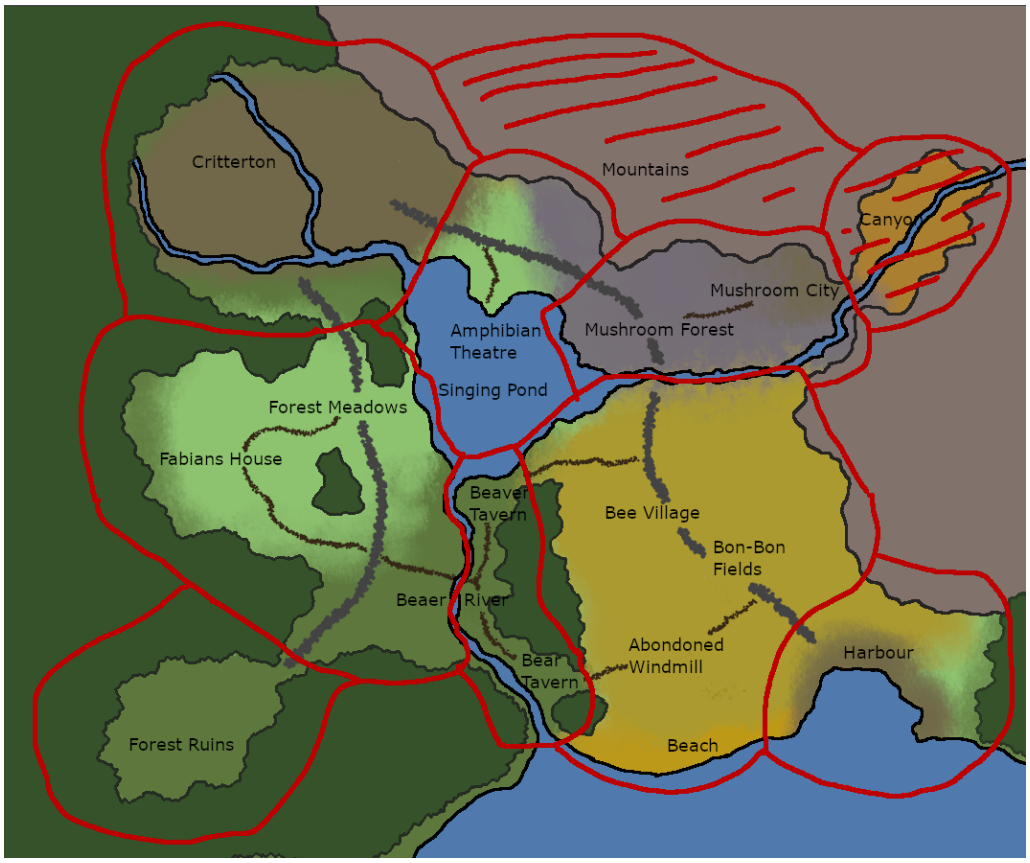

Figure 5.17: Image shows the initial sketch of the game world. The red markings shows the division of the areas.

The first area that was developed was the *Forest Meadow* area. This area had the important feature of being the first area that the player would explore, therefore it was important that it could introduce the core concepts of the game. The area also contained the players' main hub, *Fabians House*, which because of other gameplay mechanics the player would be required to return to often. This dynamic of having a specific area that we knew the player would navigate significantly more often was important to allow the player to learn the layout of the area fully. The aim of this design was to simulate how visually impaired people often can navigate an area fairly well as long as they have previously learnt the layout of the area, something that was discussed during interviews.

To make this area more dense and easier to navigate it was further divided into three subareas. The first subarea around *Fabians House*, the *Forest Road* subarea, and the *Dark Forest* subarea. During playtesting we discovered that many new players usually got lost fairly early in the game. This was not a problem by itself, as getting lost when exploring a new area was something that the people we interviewed also described as a significant risk. However, to reduce the player's frustration when getting completely lost we restricted the player to only being able to explore the *Fabians House* area until they had completed the first quest. The restrictions are showcased in 5.18, circled in blue.

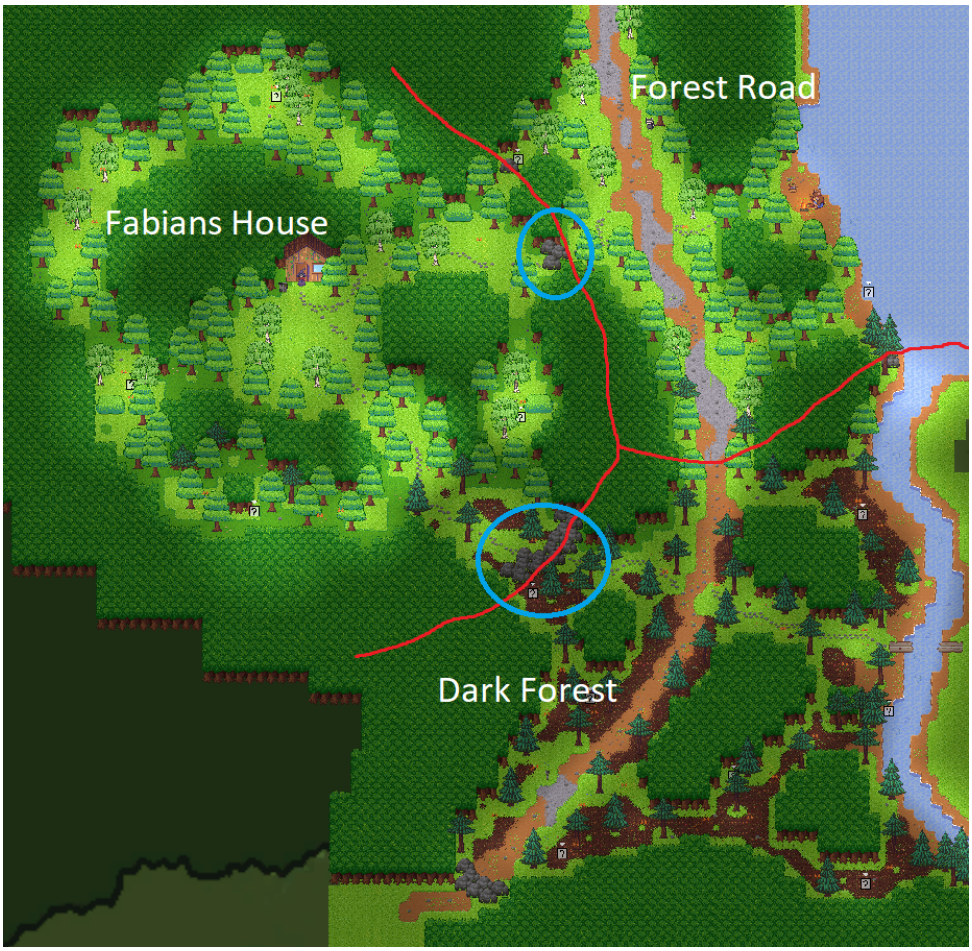

Figure 5.18: Image shows the *Forest Meadow* area. The red markings indicates its division into subareas. The blocking stones circled in blue disappear after the player finishes their first quest.

Throughout all areas various sets of points of interest were added. These points of interest were added both to encourage the player to explore different areas as well as serving as landmarks that could be used by the player to create a mental map. As previously mentioned, the points of interests needed to be detectable from a distance, which in this game meant that they needed to be detectable through other means than what the player character could detect with vision. Systems that were used to create points of interests were audio where the player for example could hear streams of water or an NPC playing music from a distance, the smell system where for example *Fabians house* was detectable by smell in the beginning of the game, and dialogue where characters would sometimes give the player a direction of where to locate a specific landmark. Roads and paths could also be considered as points of interest, because even though the roads and paths were not that interesting themselves, they usually led to an interesting landmark. It is also important to note that other landmarks that were not detectable from a distance were also added, as for example NPCs, houses, and structures. The most important thing about these landmarks was that they were noticeable and memorable.

Figure 5.19: Image shows a NPC that can be detected from a distance through sound. The NPC does also use dialogue to point out another point of interest.

To make the regions and sub-regions feel more unique they were designed slightly differently from each other. This could for example be done by using different trees, different tile-sets, different densities of trees or buildings, or using different sounds and music. In one subarea, the *Dark Forest*, we also added fog as a game mechanic. This fog heavily restricted the players' already limited vision. This mechanic was especially interesting because it encouraged the players to use senses other than vision even further. This included listening to their footsteps to hear what material they were walking on, trying to feel their way around using the footstep mechanic, and finding ingredients by purely using the smell system. Therefore, the fog mechanic did not only make the subarea feel more interesting and unique for the players to explore, but it also allowed the player to test other variations of visual impairment.

Figure 5.20: Image shows the player exploring the *Dark Forest* subarea which is covered in thick fog. The fog restricts the players vision further and therefore requires them to use their other senses more.

When conducting playtests, we aimed to test if the game world layout fulfilled the criteria that was initially stated. During both observations and discussions, we concluded that the points of interest worked well to encourage the players to explore specific interests. Players often followed roads and paths when exploring, throughout the world sounds often caught the players attention and motivated them to find the source of the sound. The players also often expressed excitement when finding a new and unique area.

To test if the player could make a mental map of the layout of the game, they were asked during the end of the playtesting to draw a map of the game from memory. By analyzing these maps, we could draw some interesting conclusions on how the players understood the world layout. Common trends found in the drawn player maps were that the player usually draws the area close to *Fabians House* more correctly than the areas far away from it. We could also see that the players clearly made use of landmarks such as roads, NPCs and unique houses as they were often marked on the maps. One thing that was often wrong on the maps were distances to objects and angles on some roads and waterways. This is interesting as it reflects the issues visually impaired people have with remembering euclidean distances between objects (3.2.3).

5.11.4 Ingredient Identification and Potion Brewing

The reason for the ingredient identification process to exist was to clarify the differences in perspective when describing an object as it could vastly differ between sighted people and people with visual impairment. In the very early paper prototyping stage, there was a point when ingredient identification and re-imagination was coupled together. The player would have the description from the brewing book which contained how a seeing person describes the ingredient together with an image and a name of the ingredient. They could then compare the description they got from investigating the ingredient with both the image and brewing book information. This was separated though so that the player never got a visual identification from anywhere and instead allowed them to pick their own visual representation. The potion brewing consisted of putting ingredients into a fictional bowl which then turned them into a potion and was mainly there to give the player a goal to work towards. A smaller test was also made that only focused on testers pairing the investigation descriptions to ingredient images and nothing else. From this we found out that around ten ingredients were a good amount to keep track of, and when adding more it became increasingly difficult and more difficult than we wanted.

In the MVP both the brewing book description and the investigation description were accessed through dialogue. This worked well for the investigation description as it was accessible from the plant the player was trying to identify and could be read as many times as desired. However, the brewing book description was very annoying to access as it was tied to a specific NPC's dialogue which meant the player had to go to the NPC who could potentially be far away each time you wanted to read it again. To alleviate this the brewing book descriptions were instead put into a menu accessible at all times from anywhere for the player which now meant the player

Figure 5.21: Image showing material used for testing pairing investigation descriptions to ingredient images.

could have both descriptions close by when investigating a plant. This new menu was a bit out of place as it is not really diegetic as many visually impaired people, however not all, has a hard time reading text. This could be improved upon in future work but for now the menu served its purpose even if it was hard to diegetically fit into the application area. The menu for viewing brewing book descriptions was also later adapted to include known potion recipes for the same purpose of not having to walk back to an NPC each time they wanted to know what was needed.

Figure 5.22: Image on the left shows the brewing book UI and the image on the right shows parts of Fabian's investigation of the same ingredient. Fabian can also investigate ingredients in the players inventory.

In the MVP stage the potion brewing system did not exist and instead the player handed in the required ingredients for a potion instead of creating the potion and then giving it. The purpose of the brewing system was not to make the brewing of potions complex and interesting by itself but was instead a way of letting the player be able to make mistakes they could learn from. This was later developed into a system that let the player put any ingredients into a cauldron and then click brew once they were happy with what was in it. If the ingredients in the cauldron matched a recipe it gave them the respective potion back. If an incorrect combination was put in the player would instead receive a failed potion which currently is not usable for the player except informing them that they had used the wrong combination of ingredients. In the MVP one of the bigger problems was that the player could brute force the right ingredients by continuously checking with the NPC if they had the

right ingredients without checking anything themselves. This system made brute forcing harder as ingredients were consumed even on a failed potion being brewed while also providing information to the player that something was not correct.

Figure 5.23: Image shows the potion brewing cauldron UI.

Both the brewing book description and the investigation description were text based which were sufficient to tell the player the difference between the perspectives but did not let the player experience the difference. For us this was a step in the right direction, but we also felt that it had more potential that could be expanded upon. The aim with the ingredient identification was to clarify the differences in perspective when describing an object and the interviews showed that the system itself had potential. The interviews also taught us that it needed more work as the descriptions were not completely wrong but could definitively be reiterated upon and improved. Many descriptions could for example make use of more details, for example what shape the objects had and the area where they were found.

What was discovered during the later playtests was that several players independently told us that they really enjoyed going through the brewing book descriptions and trying to find the correct ingredient by comparing them to the investigation description. The menu for the brewing book descriptions required too much exercise at times and did a decent job at reaching the characterizing goal but would require more development to do a good job. However, it did a surprisingly good job at reaching the entertainment goal, especially for our target audience.

5.11.5 Re-imagination

One of the first systems brought up in the ideation process was a system that let the player pick their own visual representation of an object, regardless of what the object is. In the beginning this included most objects in the world and was not limited to plants and herbs the player could pick up. It was also at first intended to allow the player to pick between a variety of different visual representations such as coffee cups, a spoon and a house. A first iteration of this can be seen in the first paper prototype that put the tester on a empty grid they could explore. In that prototype the tester was free to draw whenever they were given new information to populate their world but also had access to a set of plant images.

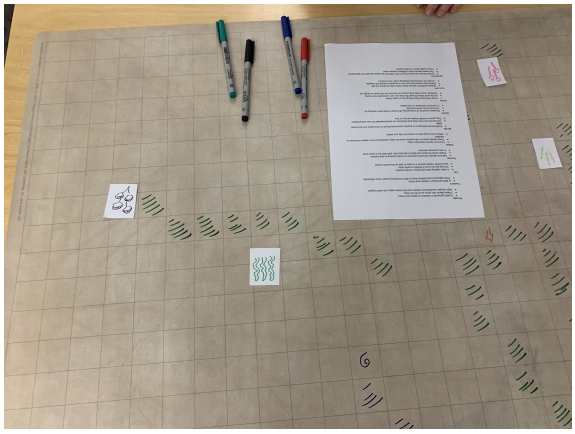

Figure 5.24: Image shows an early paper prototype where the player could draw what they wanted and had access to a set of premade plant images.

The first iteration of the system that made it into the MVP was a severely limited version that only allowed the player to set a visual representation on the various plants. The set of images they had access to was also limited to different sprites of plants, but this still allowed the player to choose which one they wanted and allowed the player to change them afterwards as they found more plants. Any plant of the same type that they had previously found would also have its image updated to the one they chose, so even if they did not know that they had the right plant, they did know they had the same plant as one they had previously seen. We quickly discovered during development of the MVP that implementing the full version of this system was not feasible for the MVP due to the sheer scale it would require both from development and sprite creation.

From interviews we realized that while the full version of the system sounded interesting and unique it did not fit the expectations and representations we originally envisioned. That coupled with the realization that the system was too big and complex for our limited time span meant that we decided to not expand on the re-imagination system and instead refining what we currently had to make something that felt enjoyable. Thus, the system was kept limited to re-imagining plants with different visual representations of plants.

Figure 5.25: Image shows the re-imagination UI. In the image the unknown ingredient representation is chosen.

From playtesting we learnt that players found the limited system interesting because of the freedom given in that they could put in whatever visual representation they deemed appropriate, there was no right or wrong. They also described how in the beginning they sought to match the plant to the correct visual representation but as they became more comfortable with the system, they realized it did not matter what they picked as long as they were comfortable with their decision themselves. It seemed that players enjoyed having this limited freedom in how they could choose whichever visual representation they wanted, but all alternatives were in some way or another relevant as they were all plants. This meant that the resulting system was limited compared to its original idea. It did nevertheless achieve its goal of letting the player be in control of how they interpreted the different ingredients. Therefore, we decided not to develop this system further, as it would require more time and effort without any guaranteed improvement.

5.11.6 Sounds

We knew from that the point we had decided on an application area that sounds would play an important role in the game. A problem we faced with sound is that while everyone found it important for the game, no one had significant prior experience with creating sounds or music. Because of this creating new sounds was unfeasible due to the time constraints and instead we relied heavily on an expansive bundle of music with some sound effects a member had previously bought [91].

Sounds were first introduced in the MVP and can be put into three different categories: footstep sounds, environmental sounds, and music. Footstep sounds are the sounds made when the player walks on any given surface and changes depending on what is walked on. From playtests we learned that these footstep sounds were not always needed, but that they were important in specific areas. An example of this was when moving around in the dark forest part of the forest meadows that features thick fog moving around. When the fog was over the player, they could not see anything at all in the world and in those cases, they relied a lot more on sounds to know if they

were following the correct path. Even if not always needed it was still considered a good feature by the people interviewed as in reality the sound of footsteps is used. However, the sounds are often used in conjunction with feeling the material you are walking on.

Environmental sounds' main trait is that they can be directional, and distance based. This means that the player is able to hear the direction a sound is coming from, as well as the volume changing based on distance were being closer increases the volume. It is important to note that the directional sounds only work when the game is played with headphones or similar as they rely on stereo sound.

Music is always heard by the player and at the same volume, but each area has a different music track. Something we were worried about when adding music to the different areas was that it would make the game less representative of the intended experience we were aiming for with the characterizing goal. This is because it allows the player to associate different music to different areas and in doing so create a connection to where they are, but it was still something we felt was needed for aesthetic appeal. When this was brought up in interviews though it was described as not being a problem and that the interviewees themselves describe how visually impaired people often had a similar sound profile to know where they are. Their sound profile was not based on music but on other sounds as it was still used. This let us know that while it might not be perfect it still has support from the characterizing goal while still increasing the aesthetic appeal significantly.

The biggest strength of sound is that it provides information to the player through other means than vision, which means it is not limited by the same representations and expectations. This allows us to explore new options of providing long distance information while still keeping the vision field limited for the characterizing goal. Because of this sound became one of the primary sources of informing the player that something interesting exists. Two examples of this include the river making distinct sounds when the player is in the vicinity and the bear *Grizzly Paw* who sits in the upper right corner of the forest road area. His guitar can be heard all the way from the road as the player is moving towards Critterton and draws players in.

5.11.7 Smell System

During our first interview with a person that is visually impaired, one aspect discussed was the use of smell when navigating a space. They described that for them smell could in some circumstances be an important sense to locate objects in the vicinity. For example, smell could be used to identify that a perfume store or bakery is close by. This was something that later was confirmed during research about visual impairment (3.2.3). Therefore, adding a system or mechanic that could be used to simulate smell would be beneficial for achieving the games characterizing goal of representing visual impairment.

The smell system was designed with this criteria in mind, but during development we also realized that the system could be used to solve another problem. Finding the ingredients was at times frustrating for the players because it was easy to move

past ingredients without noticing that they were close by. This led to one of the more efficient ways of finding resources being to just scan an area by going back and forth until an ingredient was found. This strategy was not very fun or interesting for the player. Adding smell to the ingredient plants and the smell system to the game could therefore be used to indicate that an ingredient was in the vicinity to the player. Therefore, the addition of the smell system did not only allow us to better represent visual impairment, but it could also potentially solve issues with reaching the entertainment goal.

The first iteration of the smell system used particles that could float around the player whenever a source of smell was nearby. The number of particles could change depending on the strength of the smell source and the distance to the smell source which gave the players an indication of when they were moving towards or away from the source. Other than that, the particles did not indicate in what direction the source of the smell was, this was intentional as we wanted to differentiate the system from sound systems which had directional indication. We felt that this also better represented our sense of smell in real life. The image used on the smell particles could change depending on the type of smell, for example a fresh smell would use a different image to a flowery smell. This meant that even though the players did not know the exact source of the smell they could get some rough indications of the source of the smell.

Figure 5.26: Image shows the initial smell system. The smell was shown through particles in the air.

When playtesting the first iteration of the smell system we noticed that it had one major flaw. Many players did not notice the system at all, and if they did, they did not connect the particles to being a representation of smell. Some players did, however, comment that they noticed that the particles usually indicated that an ingredient was in the vicinity. This issue was first addressed by adding a trashcan that smelled a lot close to the players starting point and adding dialogue to the nearby NPC where the NPC commented on the smell of the trash in the air. Even though most playtesters noticed both the trash and talked to the NPC this was still not enough to make most people understand the connection between the particles being a representation of smell.

Figure 5.27: Image shows the inclusion of a trash can that smells at the start of the game.

Therefore, more guidance was added to the system by adding a UI component in the top right corner of the screen that showed the images that were used for the particles and the word *"smell"* underneath. The alpha value of the image was also matched to the strength of the smell, meaning that the image would fade in more when the smell got closer and fade out when walking away from the smell source, similar to how the number of particles in the air also depended on the strength of the smell. After adding this UI component, the results from the playtesting showed that many playtesters now connected both the UI and the particles to represent what the character could smell. The new UI component also significantly increased the number of players that used the smell system to detect if an ingredient was in close proximity. In some cases which ingredient was nearby based on how the smell particle looked like was also used as players learned more about the system.

Figure 5.28: Image shows the final smell system. The UI in the top right corner of the screen indicates what smells are in the air and the fading of each image indicates the distance to each smell source.

During the final interviews with visually impaired people the smell system was well received. The general opinion of the interviewed was that the system seemed to represent smell well. One person commented that smell was a sense that they did not always use that often, but that when used it could be used in a similar way to the system described in the game. For example, when foraging for mushrooms they could tell when some specific mushrooms were close by their strong smell.

The development of the smell system showed that in some cases it is important to give the players enough guidance so that they can properly interpret and use the systems in the game. It also showed us that designing a game mechanic from an aesthetics first perspective could be difficult, but it also showed that the final result of the mechanic turned out well and achieved all of its aesthetic goals.

5.11.8 Quests and Dialogue

Quests first appeared in both paper prototypes where they existed as motivation for the player to interact with other systems and mechanics like exploration, ingredient investigation, and potion brewing. They acted as the main way to make the player want to do something and to act as small goals the player could work towards. These quests were simple and consisted of requests for different potions and their ingredients required. The player would then seek out the ingredients to these potions in the world by exploring, identifying and then walking home to brew the potions.

Both quests and dialogue were systems that were implemented for the MVP as quests served as one of the main ways of motivating the player to interact with different mechanics in the game, while dialogue served as a way to converse or deliver information to the player. Worth noting is that quests and dialogue also served as the main way to provide storytelling to the player and immerse them into the game world. This is however not the focus point of this research, and it is instead

recommended to read our sister thesis which focuses on aesthetics [1]. The dialogue system proved to be more robust and useful than we initially thought, which led to the dialogue system being used in more ways than originally intended. It was used both to converse or relay information to the player through NPCs but also used to give them information when they were interacting and investigating the different plants that existed.

As both systems were further developed and iterated upon a variety of quests were created with different purposes. There still existed the same simple quests which acted as motivation for the player to explore and interact with the other systems, but now other quests also existed which served as world building, storytelling, or as experiences for the player to react and reflect upon. These new quests were a potential new way to achieve the characterizing goal by adding quests that simulated situations that were commonly experienced by people with visual impairment.

When designing quests, we started by deciding what experience we wanted the player to have and then tried to use and design the quest steps and dialogue thereafter. The experiences we wanted the players to have could either be based on our entertainment goal (5.5.2) or experiences described by the people interviewed. It is important to note that a quest could have a goal of promoting multiple different types of experiences and not just one or the other. Results from playtesting showed that using quests for representing experiences of visually impaired people was a useful tool for making the player aware about specific situations within the application area.

5.11.9 Day Night Cycle

The day and night cycle system were not introduced until later stages of development and was added because of multiple reasons. One reason was to create different lightning environments for the player to discover and explore. People with visual impairment have the possibility to be very sensitive to light and different lighting can have a significant impact on how things are perceived [7]. Another reason is that some regions make use of the day and night cycle to change their environment throughout the day. The fog in the dark forest area disappears as the night comes and instead the region becomes very dark, with places that have no light meaning the player is not able to see their character, further limiting the player's vision in another way.

The day and night cycle were also important for story elements as some quests required a new day to be completed to fit in with the narrative. in such cases the day and night system could be used, and the quest would progress when the player went to sleep for the night inside the game. How the system works is that a day is approximately ten minutes long and after that timer is done it starts becoming night gradually until the mask becomes completely dark. It will not become day until the player sleeps and will stay dark until the player does so. The day and night cycle also provided a good opportunity to properly implement the reflection system and so it was added when the player went to sleep.

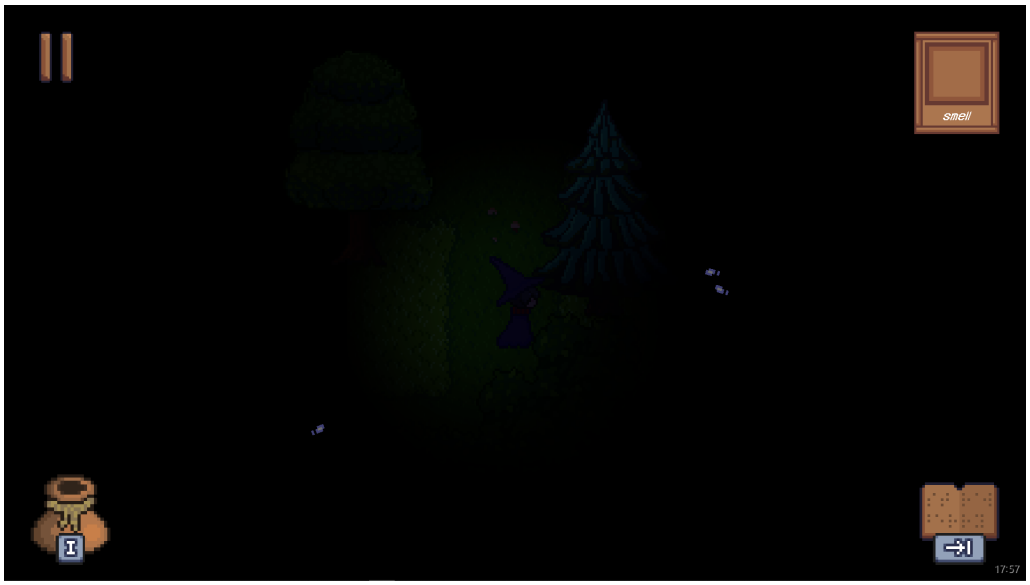

Figure 5.29: Image shows the game during nighttime.

We also learned that it was misrepresenting visually impaired people by painting a view that being blind or visually impaired is scary which it is not. From playtesting we learned that adding the day and night cycle made players a little scared or unnerved, which was problematic for achieving the game's entertainment goal (5.5.2). While it still was not seen as a scary game, we wanted to avoid this if possible. To alleviate this, we added fireflies that would light up small areas when it was dark. They would also start following the player for a bit if they got close enough and were added with the intent to make the game less scary and cozier. We also had to make sure the music in the area did not set the mood in an inappropriate way and thus opted to pick music that we considered to be more cheerful or calm.

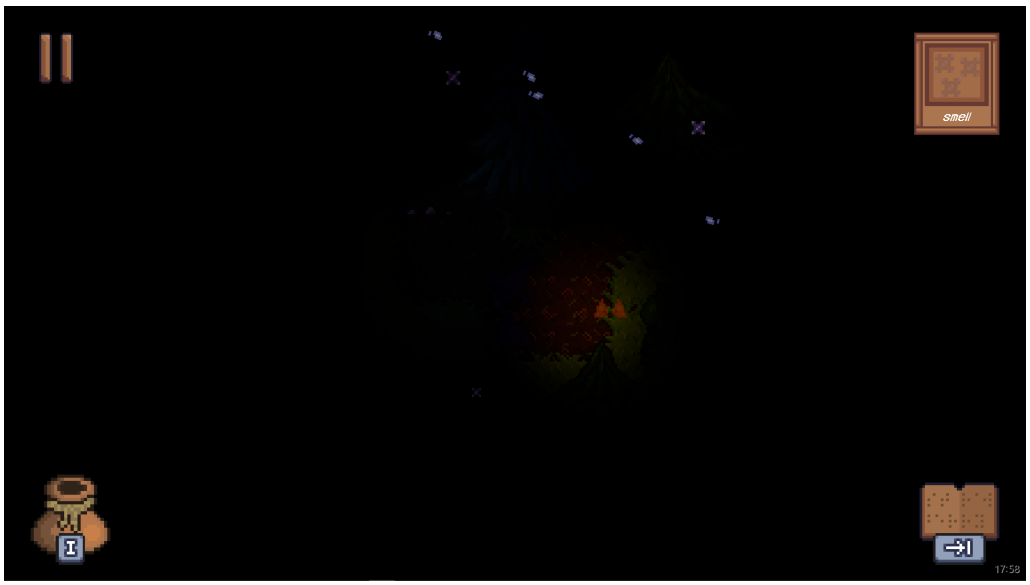

Figure 5.30: Image shows the subarea *Dark Forest* during night. A single firefly can bee seen in the image.

5.11.10 Reflection System

During the research of previous guidelines for developing applied and serious games we found a paper that proposed adding a debriefing phase into the game. They noted that debriefing is usually performed with the help of a human facilitator, but that it is unfeasible for a standalone serious game [64]. Instead, they proposed the addition of an automatic debriefing system into the game itself.

One example of an integrated automatic debriefing system that we investigated was a visualization based debriefing system developed and researched by De Troyer, Helalouch, and Debruyne [92]. Their system focused on showing the player a summary of how their actions had impacted the game using data visualization. Even though their method showed to be effective for their game, we realized that it would not fit our game. The main reasons for this are that our game does not have as complex a relation between the player's actions and the final outcome of the game, as well as the fact that the characterizing goal is primarily achieved through what the player experiences directly and not how the player's actions impact the game. Therefore, we decided to add a reflection based automatic debriefing system into the game instead, that allowed the player to reflect on what they had experienced within the game.

One design choice that was made when developing the debriefing system was to not add it at the end of the game or at the end of a play session. The main reason for this was that the game itself is designed to be played in more than one play session. Therefore, if the debriefing happened at the end of the whole game one or several play sessions could have occurred without any debriefing at all. This risked that the player would not reflect on the early stages of the game. Because the length of each play session is decided by the player, and not the game, it is assumed that the player would end each play session when they were less interested in continuing playing the game for that time, or when they did not have time to continue playing the game because of external factors. Therefore, adding a debriefing at the end of each play session would risk the players skipping it completely. As the game had a day and night cycle, we could use that to determine when it would fit to add a small pause for reflection within the game.

What the reflection system eventually turned into was a debriefing session that happened to the player as they went to sleep in the game. It would provide one question each night for the player to reflect over and some examples of questions presented to the player were: *If you saw a blind person trying to cross a road, what would you do?*, *Have you ever been in a situation where you could not use your vision? How did that feel?* and *Have you ever been in a situation where something was not accessible to you because of an oversight by the designer?*. The player was also given a text field where they could write down an answer if they wanted to and these would be saved to allow the player to look back at their answers at a later time. The questions followed a deterministic order that were set up to allow us as designers to control in which order they were asked and only one question was asked to make it feel less exhaustive and to reduce the player's cognitive load.

Figure 5.31: Image shows how a question to reflect over is presented when the player goes to sleep in the game. The previous question button can be used by the player to see what they answered on the question the previous night.

The result from the playtesting showed that the players reaction to the reflection system varied a lot. The three main reactions the player had to the system were either ignoring it and skipping it completely, thinking through and writing answers on each question, or looking at the questions and then maybe writing a short answer. The playtesters generally expressed that they liked or did not mind that the system was in the game, even though some players ignored the system as they could always skip interacting with it. In that sense, if the system was mandatory to interact with, we expect that the reaction to the system would be more negative by some players, however, this hypothesis should be tested. We did also get comments from some of the playtesters that even though they usually did not write down answers for the questions they did read through and reflected on the questions in their mind. As the questions were generally a lot more direct about the game being about visual impairment than the gameplay mechanics, audiovisual design, and narrative, the questions also worked as a clear indication to the players in the beginning that the game's theme revolved around visual impairment. This helped the players understand the other mechanics of the game and their purposes faster.

5.12 Summary from Final Interviews

Of the five interviews conducted the final two interviews focused on evaluating the game, both from a gameplay and an audiovisual perspective. The general conclusion of these interviews was that the participants were satisfied with the game's result. One participant noted that they liked that the game reflected visual impairment in several different mechanics and from different perspectives. We also got a comment that the game from their perspective seemed to present the most relevant things about visual impairment.

One problem with the project that was noted during the interview is how people experience visual impairment differently. It can be very individual how a person relates to their disability. This makes it harder to evaluate the game properly and to spread awareness about the topic as a whole. Even if our participants had a very positive opinion about the game, it cannot with any certainty be translated to how well the game reflects visual impairment for everyone.

A full summary of the two final evaluative interviews can be found in Appendix C.

5.13 Summary from Final Playtesting

Playtesting was used to determine to what level the game achieved its entertainment and characterizing goal. This was both done during the development of the game and after the development of the game, in this section we will discuss the results from playtests conducted at the end of or after development. This is because these tests best reflect the result of the final game.

5.13.1 Playtesting Entertainment Goal

Playtesting showed that even though the game is not for everyone, many people who tested the game found it enjoyable. Many testers described the game as having a slow but cozy feeling around it. Players also told us that they thought the exploration of the world and identification of ingredients was quite fun and interesting. Therefore, we can generally say that the game did achieve its entertainment goal (5.5.2).

Evaluating the result of the playtests based on Cziksentmihalyi's components of enjoyment [40] found in 3.3.1 we can see that the players response indicated that the game mostly achieved most points of the list:

- Most players managed to complete at least a couple of quests in the game and some players managed to complete all quests. Most players were also able to identify most but not all ingredients that they found in the game and were able to navigate large parts of the game world towards the end of the playtests. This indicates that the tasks in the game had a reasonable chance of completion.
- Most players understood the goals that were proposed by the quests. In some cases, the players did also make their own goals, for example trying to identify all ingredients.

- At the beginning of the development process many players complained about the lack of feedback from some systems, as for example when something was picked up or crafted. This was addressed, and in the later playtests the lack of feedback in systems was not mentioned often by testers. This indicates that this component was mostly addressed.
- The immersion of the game was decent. The challenge-based immersion and learning curve of the game was decent. Most playtesters managed to complete the first introductory quest within 20 minutes. During this first quest the players learnt the basics of the game in a controlled environment where the consequences of their mistakes were milder. Some parts of the game were, however, a bit too challenging, some ingredients, for example, needed an indication in the brewing book of which area they were in negate the need for the player to search through the full map to find them. Another thing that reduced player immersion was also the reflection system, as some players skipped it completely because they wanted to keep being immersed in the actual game. Overall, the players seemed to be involved with the game throughout the whole playtesting sessions, as they were actively playing the game until they were told to stop because we needed to continue to the discussion phase of the playtesting.
- The game lets the player explore the world as they saw fit after completing the initial quest. Some players focused on completing quests, others wanted to just explore the world first, while some players focused on trying to figure out the ingredients they found first. This indicated that the game allowed the players to be in control of how they interacted with it. The main part that reduced the players' autonomy was that the quests were mostly linear.
- No result of the playtesting indicated that the player felt a concern over themselves.
- Alterations of the players concept of time were hard to test through playtesting. What we can say is that the playtesters were engaged with the game until the facilitator needed to stop them because time had run out.

By analyzing the game through Cziksentmihalyi's list of components of enjoyment we can conclude that even though the game is not perfect, it mostly ticks the boxes of being enjoyable. This is something that is also reflected by the playtesters themselves, as most playtesters said that they enjoyed playing the game.

5.13.2 Playtesting Characterizing Goal

Playtesting whether the characterizing goal (5.5.1) was achieved was more difficult. By conducting the final interviews, we knew that the people we interviewed thought that the games representation of visual impairment was quite good. Therefore, the playtesting focused more on whether this representation was noticed and interpreted correctly when players played the game. When asked in the final playtest, all playtesters stated that they thought that the game reflected upon visual impairment. The two main parts of the game that clearly showed that, as stated by the playtesters,

were the reflection system and one of the quests that represented a problematic situation for visually impaired people. Many playtesters stated that after interacting with one of these two parts of the game they could also understand the intent and purpose of the other mechanics and their connection to visual impairment. This showed that the players understood the theme about visual impairment and how the different aspects of the game represented different aspects of being visually impaired.

The playtests showed that when the players explored, they often used strategies that were similar to strategies used by visually impaired people when exploring. Such as remembering and following clear landmarks (5.11.3), using sounds such as the sounds of footsteps to tell what material they were walking on (5.11.6), and using smell to detect when something was close (5.11.7). In some cases, the players did not use these strategies at the start of the game, and this often led to them getting lost at the beginning of the game. However, a common trend was that after the player had made the mistake of getting lost once they were often more careful and started to use the navigational strategies more to not get lost again. This indicated that many of the systems implemented for exploration and navigation achieved their goals, even if it sometimes took a while before the players adopted and started to use them. It also indicated that at least some players became more proficient and confident with moving through the game even though they had limited vision, something that also was reflected by the players in the discussion.

5.14 Guidelines Development

Our guidelines were developed by using the initial guidelines (5.7) when developing the game. The game was then evaluated regarding its effectiveness of promoting awareness about visual impairment. This was done through two steps; The game was first showcased to people with visual impairment so that they could evaluate if they agreed that the representation of visual impairment in the game reflected their experiences in the real world (5.12). Secondly, the game was playtested by people that are not visually impaired to see if the players detected and interpreted the representations in the game correctly (5.13). By analyzing our views of using the game guidelines and their effectiveness, we could then estimate how useful each guideline was and what changes could be made to it. This analysis was then used for the development of the final guidelines found in 6.2.

5.14.1 Implementation of Initial Guidelines

This section describes how the initial guidelines 5.7 were used during the development of the game. The section describes when and how the guidelines were followed and when they were not followed.

Research the application area of visual impairment. Research about visual impairment happened throughout the development process, but the type of research done varied. Early on during the initial ideation sessions less structured research was done, with the main purpose of the research for us as designers to get a good overview and understanding of the application area. This included looking through

interviews, short documentaries and reading articles about visual impairment. After the initial exploration of the topic was concluded, more concrete research was made through reading scientific and conference papers. Here the goal was to ensure that the research done and what we had learnt was based on proper sources. One example of research done was how people that are visually impaired navigate the world (3.2.3). This information was vital for designing many of the gameplay mechanics revolving around exploration and navigation. Lastly during development and final evaluation of the project the main information gathered about visual impairment was done through interviews (5.10.1). The main benefits of using interviews were that we could ask specific questions that we wanted answers to for the development and evaluation of our game.

Ideate and gather knowledge about gameplay mechanics and aesthetics that might fit application area. The main ideation sessions were done in the early development process. This ideation included both ideating about game ideas and application areas that would be interesting to work with. As discussed in 5.2 the initial ideation resulted in us paper prototyping two different game ideas and application areas. Because none of our stakeholders had strict definitions of what the game's application area should be, we could choose both the topic and the gameplay, which made the ideation process easier.

Some ideation was however also done throughout the development process. This was mainly done to achieve a specific experience for the player regarding visual impairment or entertainment. One example of this was during the design and development of the smell system (5.11.7).

Gathering knowledge from other games was also an important aspect of the development of the game. This was for example done when designing the players footstep mechanic (5.11.2) and during the development of the world environment and layout (5.11.3).

Adapt the game to important stakeholders, including people with visual impairment and the target audience. For us, adapting the game to important stakeholders meant that we needed to have an open dialogue with the stakeholders of the project (2.3) throughout the development of the game and thesis so that we knew what we needed to adapt. It also informed us of any changes to the requirements or expectations from the stakeholders made during the development. This is something that also is advised when working with scrum (4.2.1).

Some of the stakeholders we had for the project were clearly defined entities; our sister thesis group, Psyon games, and Chalmers University. This made it simple to conduct regular meetings with the stakeholder groups or their representatives. The final two stakeholders, the target audience and people with visual impairment, were not defined entities, thus no single person can represent each stakeholder. For the target audience we addressed this issue by conducting several playtests throughout the development process (5.10.2). This allowed us to early on understand how the different mechanics used by the players worked in practice and if they achieved their entertainment or characterizing goal.

For keeping contact with people with visual impairment we reached out to different organizations and people with visual impairment, and we managed to get a few people we could interview (5.10.1). This allowed some contact with that stakeholder group, but conducting more interviews with more members would have been preferable.

Based on this, we cannot say that our contact with these two stakeholders is enough to ensure that we fully understand their expectations completely. That said, we can conclude that we at least understand the expectations of some members of the groups. It is also important to note that it is unlikely that all members of the groups have the same expectations at all and that instead only some similarities of expectations between the members of the groups can be found.

Use concepts that make normal games appealing and engaging to play. Making the game appealing and engaging to play was important to achieve the game's entertainment goal (5.5.2). We tried to achieve this in several parts of the game. One example of this is how exploration was implemented. One of the main goals for exploration was to make it fun and interesting for the player to do. Therefore, many concepts that were used in previous games to make exploration fun were implemented (5.11.3). This included adding points of interest that could be detected from a distance and making the game world diverse with different regions that have different aesthetics and mechanics. We also needed to adapt these concepts to fit our game, an example is that we could not use points of interests that were supposed to be seen from a distance, instead we used things such as sound to create them.

During the development of the footstep system (5.11.2) we also tried to use concepts from normal games, such as FOG OF WAR. FOG OF WAR can be described as hiding information that has currently not been explored by the player, but after the player has explored an area, they can still remember static information about it [4]. However, after testing the concept during paper prototyping and early playtests it was concluded that the systems did not fit the characterizing goal well. Therefore, the concepts were almost completely removed.

Narrative and audiovisual design was also vital to make the game appealing and engaging. This was mainly done by the members of our sister thesis [1], and therefore it will not be discussed in detail here. However, we think it is important to acknowledge its importance for reaching the entertainment goal of the game.

Allow the player to explore by themselves and make mistakes. Exploration was one of the main mechanics in our game. Both exploration through navigation of the in-game world and exploration in the game mechanics themselves was featured. For the exploration of the game world, it was important for us to let the player explore by themselves and risk making the mistake of getting lost. Getting lost was discussed during our interviews as a real risk for people with visual impairment, so we wanted the players to experience a similar risk.

To encourage exploration of the game world, as well as connecting the exploration to our application area we created four goals for the layout of our world (5.11.3). These four goals were that the layout needed to: Encourage exploration through points of interest, encourage exploration through areas that feel and functions

differently, include distinct features and landmarks that could help the players make a mental map of the area, and it should aim to be dense and crammed to help with navigation. These goals were developed through analyzing other games, researching our application area, and doing initial paper prototyping tests. By developing the game layout with these goals in consideration, we could achieve a game world that encouraged exploration and enabled it to spread awareness about visual impairment. This was also reflected in our final playtests (5.13).

To add another layer of exploration into the game we also ensured that the players could explore and investigate the different ingredients and how to mix them into potions (5.11.4). This mechanic lets the player investigate which ingredient was which and then explore their hypotheses by making potions using the ingredients. It also lets the player make mistakes by understanding an ingredient is wrong and failing to make the correct potion.

Allowing the player to make mistakes was also implemented in the game. In the gameplay design, we focused on creating risks for the player to make mistakes similar in nature to those common for visually impaired people. These mistakes could sometimes be frustrating for the players and could therefore be seen as a hindrance for the game to reach its entertainment goal. However, playtesting results showed that the players who made the mistakes often adapted and started to address the mistakes in similar ways as visually impaired people address the issues (5.13.2). Therefore, we kept the risks and consequences in the game. In some cases, the severity of the consequences was however limited to reduce frustration. One example of this can be found in the beginner area which was restricted in size at the start of the game to reduce the potential consequences of getting lost (5.11.3).

Provide some guidance to the player. Providing guidance to the player was done through many means such as sounds, smell, points of interest, dialogue and the brewing book (5.11.4). In some cases, guidance was done through UI such as the smell UI component (5.11.7), sometimes it was done through the game environment through using paths and roads (5.11.3), and sometimes it was done through player NPC interactions such as dialogue and quests.

Give the player regular feedback. Feedback was given to the players through a few different systems. The potion brewing system was the main system for giving the player feedback on if they had identified ingredients correctly (5.11.4). If the player put the wrong ingredients into the cauldron the player would get either a failed potion or a different potion than expected. This indicates to the player that at least one of the two ingredients that the player used were identified incorrectly. Correspondingly, if the expected potion was brewed then the player would know that they had identified the ingredients correctly.

The smell system also gave feedback to the player as it made the smell more visible when moving towards the smell source and made the smell less visible when moving away from it (5.11.7). Therefore, even if the player could not in an instant use the system to tell them in what direction the source of a smell was, they could still walk around and use the feedback from the smell system to try and get closer to the smell.

Add enough challenges to the game to fit target audience expectations. The main challenges the player faced in the game were to navigate using limited vision (5.11.3, 5.11.1), interpreting information from characters' senses (5.11.6, 5.11.7) and to identify the different ingredients in the game (5.11.4). Other parts of the game, like for example character movement or abilities were made easier for the player to learn.

Playtesting showed that the difficulty of exploring the map was decently balanced as some, but not all, players got lost at least once (5.13). The challenge of navigation also reflected upon similar challenges for visually impaired people, and it could be addressed with similar strategies. The balance of the difficulty in ingredient identification was also quite good as it was common for the players to identify some, but not all, of the ingredients correctly from the start. Sometimes ingredients were only identified correctly after they had been used incorrectly in the potion brewing process and through that realized they had made a mistake, allowing them to feel like they are learning and improving. The main area that required more balancing was how to find ingredients. For some ingredients it was unclear in which area they were located. This required the player to search through a large area to find them, something that often leads to unnecessary frustration.

Minimize unnecessary cognitive load in the game. As described in 3.2.2, cognitive load refers to how much information our working memory can process. For this reason, minimizing cognitive load essentially means that the information that the player thinks they need to keep track of needs to be minimized when playing the game. It is also important to present the information in a way that is easily processed by the player to reduce the extraneous cognitive load.

The application area alone made it hard to minimize the cognitive load in our game, especially the extraneous cognitive load. A lot of game world information needed to be presented through character senses other than vision, such as the smell system (5.11.7) or the characters hearing (5.11.6). This was something that the players during the playtesting were often unfamiliar with at first, which led to increased cognitive load. These issues were addressed by trying to make the sense systems easy to interpret and learn. The smell system did for example add an additional UI feature to make it easier to understand. The player also started in an area where they could still use some sight to see what they were walking on allowing them to learn the sounds from different materials when the character walked on them.

The game introduced most mechanics at once as the mechanics were mostly Fabians own senses. This increases the intrinsic cognitive load at the beginning of the game. However, there is also a point to this. One of the core goals of the game is to present the player with the journey from being uncomfortable with their visual impairment to being comfortable and confident with it (5.5.1). Introducing the player to that environment completely at the beginning, instead of gradually gives a higher contrast between the beginning of the game and the end. This is something that was also reflected by our playtesters, as many playtesters noted that they were confused and unsure at the start of the game but towards the end of the testing session they felt more confident with the game (5.13.2).

However, this game tries to minimize cognitive load in other parts of the game. The main way this was done was to limit the gameplay mechanics in the game to only mechanics that promoted the characterizing goal or promoted exploration. Things such as a combat system, enemies, advanced puzzles, or player construction were therefore not added to the game. This kept the game's core mechanics simple, meaning it would be simpler for the player to learn everything at once.

Adapt the environment and interactions to suit the characterizing goal of spreading awareness As described in 5.11.3 the initial goals for designing the environment and layout of the world were partly defined by how visually impaired people experience navigation. The most important goals for this were that the game world should include distinct features and landmarks as well as be crammed and dense to help with navigation.

Interactions were also adapted to suit the characterizing goal in places such as the ingredient investigation system (5.11.4). The ingredient investigation system lets the player analyze information given to them through the perspective of a person with visual impairment and to compare that to the information given by a seeing person. Other interactions that were adapted include spreading awareness trough player-NPC interactions (5.11.8). This was for example done through a quest that let the player experience a scenario where they got forcefully displaced because of the ignorance of another character, a situation our interviews told us could be common for people with visual impairment.

Incorporate an explicit debriefing phase into the game. Explicit debriefing was implemented in the game through the reflection system (5.11.10). The reflection system was designed to make the players reflect over visual impairment in the game by prompting the players with one question to reflect over each night in game. By adding the debriefing system throughout the game, it avoided the issues by only having debriefing at the end of each play session or at the end of the game. However, some players explicitly told us that they did not interact with the reflection system because when it appeared they were more invested in other parts of the game, so they skipped interacting with the reflection system to get to the parts that they were interested in faster.

5.14.2 Analysis of Initial Guidelines

This section describes how useful and effective each initial guideline seemed to be for the development and result of our project.

Research the application area of visual impairment. Generally, this guideline was an important guideline for us. Doing research both in the beginning of the development and throughout the process allowed us to prioritize what game mechanics would fit the application area of visual impairment well and what should be considered when implementing them. However, from our perspective, the guideline gave little information on how research should be conducted or what its aim should be. It also did not state when in the development process the research should be done or if the methods used for conducting research should change in any way during that time.

Ideate and gather knowledge about gameplay mechanics and aesthetics that might fit application area. This guideline was somewhat useful for us. Ideating and gathering knowledge about gameplay mechanics that would fit representing visual impairment was important, however the guideline itself did not give clear instructions on how that should be done. We found that following the process described in 5.6 of focusing on the experience first helped us come up with better ideas for gameplay that fit visual impairment representation better. This also helped us avoid developing mechanics that we would later discover to be problematic because they reduced the representation of visual impairment within the game, as for example with the footstep system (5.11.2).

Adapt the game to important stakeholders, including people with visual impairment and the target audience. This guideline was important for us, but it did not give a lot of information about how to adapt the game to different stakeholders and different kinds of stakeholders. Adapting to stakeholders was important for many different reasons, such as ensuring that the research question for the sister thesis also was answered and that the game represented visually impaired people correctly. However, the guideline is not relevant for answering the research question for this thesis, as it does not directly relate to how the gameplay should be adapted to promote visual impairment. During our project, the only two stakeholders important for this purpose were people with visual impairment and the target audience. Adapting the gameplay to represent people with visual impairment was important to ensure that the information presented in the game was correct, and the gameplay was adapted to the target audience to ensure that the information was presented in a way it could be easily understood.

Use concepts that make normal games appealing and engaging to play. This guideline was important to reach the game's entertainment goal (5.5.2), but the concepts and game mechanics often needed to be adapted to also suit our application area of visual impairment. Not adapting to visual impairment when using the concepts could risk that the concepts did not fit the goal of the game well, for example the initial footstep system (5.11.2). It could also mean that they would be hard to implement at all, such as the points of interest (5.11.3).

Allow the player to explore by themselves and make mistakes. The initial paper that proposed this guideline [29] mainly focused on the development of educational serious games. However, from our experience with using it in the development of an applied awareness game we also found it useful for spreading awareness about visual impairment. When using the guideline in our game we focused on spreading awareness through *how* the player explored rather than *what* the player explored. This fits our goal of allowing the player to experience how visually impaired people navigate and explore the world (5.5.1).

We also found it useful to spread awareness about visual impairment through what types of mistakes the players could make. This allowed us to represent common issues that visually impaired people might face. It was however important to balance the awareness value added by the mistake with the frustration felt by the player when making them. Our playtesting showed that allowing players to make mistakes often

resulted in the player learning from the experience and developing similar methods to addressing the issue as visually impaired people use (5.13.2). As for example keeping track of landmarks to not get lost again (5.11.3).

Provide some guidance to the player. Providing sufficient guidance so that the player could understand and use the game's core concepts and systems was important for enabling them to play the game. It was however important to not give too much guidance as that could reduce the player's autonomy to make decisions by themselves [93]. That could risk reducing the game's ability of achieving its entertainment goals of allowing the player to analyze and explore things on their own (5.5.2).

It could also reduce the player's risk of making mistakes we wanted the player to make. One example of giving the player too much guidance in our game would be to give the player a map of the world. This would reduce the players' chance of getting lost, a risk that we wanted the players to have to make them reliant on making mental maps of an area. Therefore, it is our opinion that providing guidance to the player is an important guideline for making a good game but ensuring that the guidance does not restrict the characterizing goal is important for making a good applied game.

Give the player regular feedback. Feedback is important for the player not to feel lost or confused by something happening or the lack of something expected. It also helps in reducing cognitive load for the player because feedback makes it easier to keep track of what is happening in the game because of the player's actions. It was useful for making the game more entertaining, as it reduced frustration and confusion. However, from our experiences in this project, giving the player regular feedback did not seem very useful for directly spreading awareness about visual impairment. This does not mean that giving the player regular feedback is necessarily unimportant for all applied games. But from our observation during playtests of our specific game feedback seemed to never by itself be the direct source for a player learning about visual impairment.

Add enough challenges to the game to fit target audience expectations. Designing the learning curve to provide the right amount of difficulty in the game was important to reduce cognitive load (3.2.2) and to achieve entertainment goal (3.3.1). Similar to using player mistakes for promoting awareness, adapting the challenges to fit challenges within visual impairment was also important for achieving the game's characterizing goal.

Minimize unnecessary cognitive load in the game. The important aspect of this guideline is to define what cognitive load is unnecessary and what cognitive load is not. We handled the cognitive load as a budget, each element that added cognitive load for the player was considered a cost, and the maximum cost could not exceed the expectations of our target audience. By addressing the cognitive load this way, we could add things that increased the cognitive load in the game, if we balanced it out in other parts of the game. It is important to note that the target audience should also be considered when balancing cognitive load, some target audiences might prefer more complex games that require a higher cognitive load, while others prefer simpler games. This should also be considered when designing

the learning curve of the game, as it is closely linked to cognitive load [30].

When designing an applied game about awareness we found it important to also consider that promoting awareness to the player makes use of the cognitive load budget. Because representing our application area of visual impairment required the player's cognitive load it was important to prioritize this in the budget. This is also supported by the statement that spreading awareness is similar to letting the player learn about a subject (3.2.1), and as discussed in 3.2.2 learning requires cognitive load.

Adapt the environment and interactions to suit the characterizing goal of spreading awareness The core concepts of this guideline were applicable to our game, but the guideline itself is a bit redundant. As the environment and interactions are part of the gameplay, the guidelines essentially says that the gameplay should be adapted to suit the characterizing goal of spreading awareness. This is correct, but it merely mirrors the research question without really answering it.

What was important regarding this guideline was that several parts of the gameplay should be adapted to promote awareness about visual impairment, such as the environment and interactions. Feedback from both playtesting and interviews showed that adding representation of visual impairment into several parts of the game, and not just one interaction or game mechanic, were important for giving a clearer and more correct view of the application area. One person who was interviewed answered that one of the best things about the project was that visual impairment was shown through several different parts of the game and from different perspectives (5.12).

Incorporate an explicit debriefing phase into the game. Even though only some players interacted with the reflection system we found it to be a good addition to the game because it further connected the game to its application area. Some players that skipped interacting with the system still mentioned that the system made them reflect a bit more about the game in their mind. The players that skipped the system completely also mentioned that they did not mind the addition of the system as they could skip it if they wanted. Overall, adding debriefing into an applied game showed to be somewhat useful for reaching the game's characterizing goal, but more work and research needs to be done to achieve the full potential of such a system.

6

Results

This section contains the results of this master thesis. This includes how the applied game project turned out and the resulting guidelines developed through it.

6.1 Fabian and Fables

The final project resulted in an awareness game about visual impairment named *Fabian and Fables*. In the game the player plays as Fabian the witch, a character that is visually impaired. As Fabian they need to explore the world around them to find and identify different ingredients. These ingredients are then brewed into potions that can be given to NPCs to help them complete their quests.

As Fabian, the player's view of the game is heavily restricted, and they can only see things close to Fabian. To compensate for this, they have access to several systems that reflect their other senses; for example, smell, hearing, and muscle memory. When navigating the world, the player needs to keep track of landmarks such as characters and roads to not get lost as well as use all their senses to detect points of interest. This is especially important for the areas in the game with fog, where Fabian's vision is even more limited. Nighttime also changes how much Fabian can rely on his vision.

After finding ingredients the player also needs to identify what type of ingredient it is. This is done by analyzing and comparing a description Fabian makes about the ingredient to an external description that can be read in the brewing book UI. While Fabian only reflects on things that he can easily detect using touch, smell, taste, and hearing, the book's description focuses more on a seeing person's perspective. The player can also, if they want to, use Fabian's description when choosing their visual representation of the ingredient. It is here completely up to the player to decide how they imagine what each plant would look like. The game never makes any judgement on that.

The game has several quests. Some of them work primarily to motivate the player to interact with different mechanics and systems in the game while others focus more on simulating experiences that visually impaired people face in real life. The game also contains a reflection system. Each night, the player is asked a question tied to visual impairment. It is up to the player if they want to answer that question, if they just want to reflect on it by themselves, or if they want to ignore it completely.

6.1.1 Visual Field System

The visual mask was made so that the player had a limited field of vision in the shape of a circle centered around their feet. Most of the game world was put under the mask which meant the player had to get close to see anything. Exceptions to this existed with objects that were not a part of the ground or wall, as when close enough to the player the objects would appear above the mask and instead have its opacity changed based on player distance. When an object appeared, it was dependent on the object's ground position point in the world, and not its center position. This was more notable in larger objects that were seen slightly further away. This system also handled whether the player should be in front or behind an object, using the ground point to compare it against the player. If the player's point was below the object, the player would be in front and if above the player would be behind.

Figure 6.1: Image showing how the visual field works when the player is standing behind parts of a tree with other trees fading depending on distance.

6.1.2 Footstep System

The footstep system was implemented to emulate parts of muscle memory. The footsteps were displayed behind the player as they were walking, displaying where the player had recently been. These footsteps were handled differently to other elements as they were not affected by the vision range of the player through the mask and were always on top of the mask. Only a limited number of footsteps were shown behind the player, which meant they could only backtrack a short distance before they disappeared.

Figure 6.2: Image showing the limited footsteps behind the player from the footstep system.

6.1.3 Game World

The game world layout was mainly designed with player driven exploration in mind and a list of requirements were used when creating the game world layout:

- The layout needs to encourage exploration by using points of interests that can be detected from afar.
- The layout needs to encourage exploration by adding different areas that feel and function differently.
- The game world needs to include distinct features and landmarks that can help the player to make a mental map of the area.
- The game world should aim to be dense and crammed to help with navigation, and in areas where that is not the case it should be considered a challenge for the player.

Three different areas were implemented, *Forest meadows*, *Critterton* and *Bear River*. Forest Meadows were further divided into three subareas which include the first subarea around *Fabians House*, the *Forest Road* subarea, and the *Dark Forest* subarea.

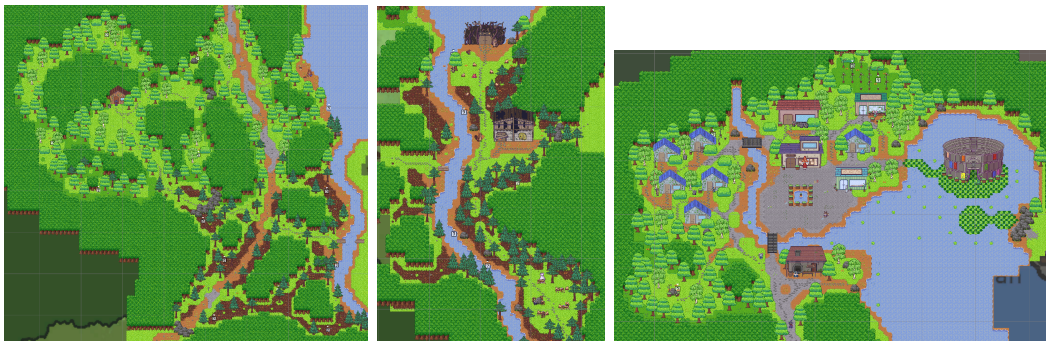

Figure 6.3: To the left, an overview of Forest Meadows. In the middle, an overview of Bear River. On the right, an overview of Critterton.

Throughout all areas various sets of points of interest were added. These points of interest were added to encourage the player to explore different areas and served as landmarks that could be used by them to create a mental map. Multiple systems were used to create points of interests which include:

- Audio in ways such as the player could hear streams of water or an NPC playing music from a distance.
- The smell system in ways such as *Fabians house* was detectable by smell in the beginning of the game or plants that gave off different smells.
- Dialogue where characters would sometimes give the player a direction of where to locate a specific landmark.

Other landmarks that were not detectable from a distance were also added, as for example NPCs, houses and structures where the most important thing about these was that they were memorable and could be noticed when close to them.

To make the regions and sub-regions feel more unique they were designed slightly differently from each other. Examples of this include using different trees, tile-sets, density of trees, buildings, and using different sounds and music. In the Dark Forest fog was also added as a game mechanic. This fog heavily restricted the player's remaining vision.

Figure 6.4: Image showing how the fog could at times almost entirely block the player's vision, forcing them to rely on other senses.

6.1.4 Ingredient Identification Process

Ingredient identification was a way for us to clarify the differences in perspective when describing an object as it could vastly differ between sighted people and people with visual impairment. The ingredient identification process was set up so that the player

would find unknown ingredients as they explore. By investigating the ingredients, the player could gain information on how Fabian interpreted the plant. This information was given through Fabian describing what he could sense. A brewing book also existed that contained how a seeing person describes each ingredient and the player could then compare these descriptions to try to identify which ingredient is which. If the player wanted, they could then use the re-imagination system to set their own visual representation of the ingredient. To verify if the ingredients they had were correct they needed to use them in brewing.

6.1.5 Re-imagination System

A system that lets the player pick their own visual representation of any ingredient they found from a set of images the player had access to which contained different sprites of ingredients. It allowed the player to choose which one they wanted and allowed the player to change them afterwards as they found more plants but never gave any confirmation on if it was the right image or not. This was accessed through a menu that popped up when the player pressed the *Re-imagine* option from the plant interaction dialogue or from the inventory. When interacting with a plant type that the player already had found previously it would update its sprite to the one picked for that ingredient type, if one was picked.

Figure 6.5: Image in the upper left shows an ingredient before it is investigated. Image in the upper right shows an ingredient that has been investigated and re-imagined. Image at the bottom shows the re-imagine menu where players can pick a visual representation.

6.1.6 Brewing System

The brewing system also existed to help clarify the differences in perspective and acted as a way for the player to confirm if their ingredient identification was correct. The system let the player put any ingredients into a cauldron and then click brew once they were happy with what was in it. If the ingredients in the cauldron matched a recipe it gave them the respective potion back and if an incorrect combination was put in the player would instead receive a failed potion. The ingredients used were always consumed regardless of if the potion created was correct or failed and the menu for viewing brewing book descriptions also included known potion recipes. To brew the player had to travel back to Fabian's house where the cauldron could be found.

Figure 6.6: Image showing the brewing menu. On the left is the players inventory. On the right is the inventory of the cauldron. An ingredient has already been put into the cauldron.

6.1.7 Sound System

Sounds existed to provide the player with information based on sound instead of vision. Three different types of sounds existed: footstep sounds, environmental sounds and music. Footstep sounds were the sounds made when the player walked on any given surface and changed depending on what was walked on. Different sounds were heard if, for example, the player walked on a stone path compared to grass, and the sounds were different.

Environmental sounds' main trait was that they could be directional, and distance based. This meant that the player was able to hear the direction a sound was coming from, as well as the volume changing based on distance where being closer increased the volume. An example of this is the river where the player heard sounds of water to the right in Forest Meadows before being able to see the river itself. It is important to note that the directional sounds only worked when the game is played with headphones or similar as they relied on stereo sound.

Music was always heard by the player and at the same volume, but each area had a different music track. It allowed the player to associate different music to different areas which created a connection to where they were located. Music also helped in setting the mood as a part of the audiovisual aesthetics of the area and assisted in making each area stand out more. Even if the background music was non-diegetic, they did reflect how sound images could be used by visually impaired people when navigating.

6.1.8 Smell System

The smell system was created to provide another source of information and the system used particles that could float around the player whenever a source of smell was nearby. The number of particles changed depending on the strength of the source of the smell and the distance to the source of the smell which gave the players an indication of when they were moving towards or away from the source. It does, however, not indicate in what direction the source of the smell was. The sprite used for the smell particles could also change depending on the type of smell, for example a fresh smell used a different image to a flowery smell.

A UI component in the top right corner of the screen also existed that showed the images that were used for the particles and the word *"smell"* underneath. The alpha value of the image was also matched to the strength of the smell, meaning that the image would fade in more when the smell got closer and fade out when walking away from the smell source, similar to how the number of particles in the air also depended on the strength of the smell.

Figure 6.7: Image showing smell being detected by the player. The particles floating in front of the visual mask are the smell particles and the UI component can be found in the upper right.

6.1.9 Dialogue System

Dialogue was how a lot of information was given to the player and acted as the main way to interact with things like ingredients or NPCs. It allowed for choices to be made and for a way to let other systems know which choice was made and when a dialogue has ended. It supported monologues from Fabian and two-way dialogue with NPCs where it displayed each participant on the sides of the text field. Text was displayed gradually to emulate it being typed out and by using the interact button the player could progress the dialogue or if used when text was typed out skip the typing process, showing all text of the current section at once.

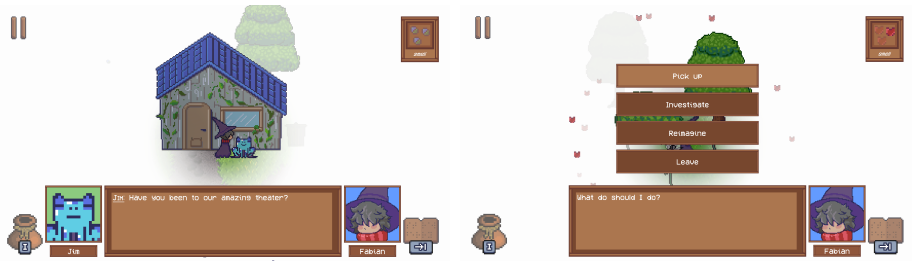

Figure 6.8: Left image shows the player having a conversation with an NPC. Right image shows the player using the dialogue system to interact with an ingredient.

6.1.10 Quest System

The quest system was designed to be flexible to handle a lot of different types of quests through quest steps. These steps include but are not limited to giving the player an item, requesting a potion from the player, asking for an item from the player, moving the player or an NPC, waiting a specific amount of time, having dialogue with an NPC, and more. A quest would not proceed to the next step until after the current step was completed. Combined these created a modular system that allowed for flexible creation of quests and were also easily extended if a new type of quest step was needed.

Figure 6.9: Image showing an NPC that has a quest for the player.

6.1.11 Day and Night System

The day and night system existed for multiple reasons such as for story elements, changing the environment and showing how light can have a significant impact on how things are perceived for people who are visually impaired. A day was approximately ten minutes long and after that it started becoming night gradually until it became completely dark. This affected the players mask in the way that it changed the mask color depending on the time and it also affected visibility in the world as most light sources became darker and got a blue tone. Some structures like buildings had lamps that lit up as it got dark, but not all structures had this. Fireflies also existed that would light up small areas when it was dark, and they would also follow the player for a bit if they got close enough. It would not become a new day until the player slept and would stay dark until the player did so.

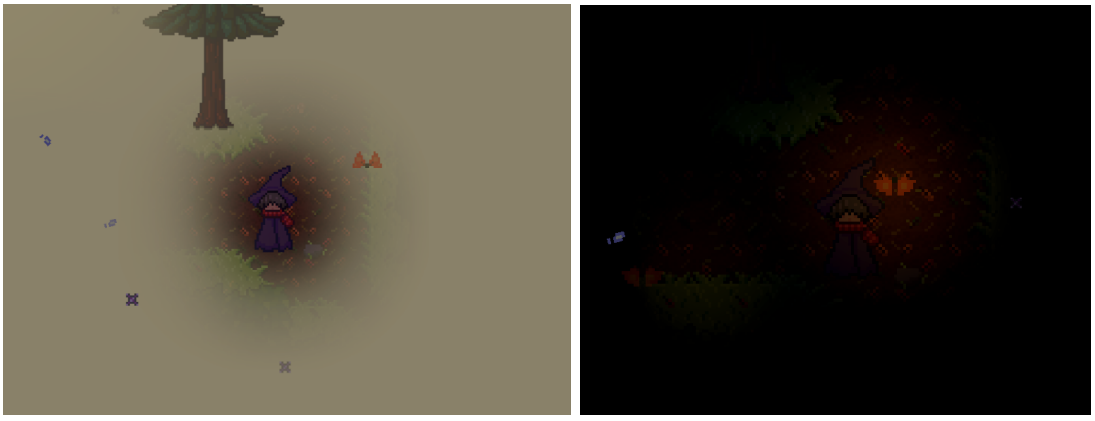

Figure 6.10: Left image shows the view as it is becoming night time. Right image shows the view when its fully dark outside and how moths help light up if they are around.

6.1.12 Reflection System

The reflection system existed to strengthen the game's connection to its characterizing goal. Each night when the player used the in-game bed to sleep to a new day the player was prompted with one question to reflect over. Examples of questions that were used where: *"What do you think being blind means?"*, *"Have you ever received help that you did not want to have?"*, and *"Do you use glasses or any other visual aid? If so, would your everyday life be different without them?"*. The players could then choose to write an answer for the question before continuing to the next day. The answers that the player wrote down would then be saved so they could go back to look at their old answers if they wanted to. Only one question was asked each night to reduce players cognitive load and make it feel less exhaustive to answer questions each night. The questions asked were also determined in a preset order to allow us as designers to control in which order each question where asked.

Figure 6.11: Image showing a question being asked to the player trough the reflection system as they slept for the night.

6.2 Resulting Guidelines

These are the resulting guidelines that we propose after analyzing the initial guidelines' usability in the game project (5.14) and the results from the final playtesting (5.13) and final interviews (5.12). These resulting guidelines include the changes and adaptations that we found useful for the design and development of an awareness game about visual impairment. The guidelines were also adapted or removed if they did not specifically answer the research question of: *What should be considered when designing gameplay to promote awareness about visual impairment through an applied game?* Meaning that these guidelines specifically regard how gameplay can be used to promote awareness about visual impairment. The result includes guidelines for directly promoting awareness, but also guidelines for avoiding accidentally promoting disinformation or adding things that reduce the game's ability of spreading awareness. These guidelines are included because even though they do not promote awareness directly they are important components of promoting awareness.

As an applied game (3.1.4), is also considered a game (3.1.1), it is important to note that guidelines for traditional game development should also be used for designing gameplay for applied games. Linehan et al. defines common game design concepts recommend using [94], we also recommend general design advice found in the book *Rules of Play* by K. Salen and E. Zimmerman [95]. The guidelines proposed in this section should be considered as an addition to these guidelines and practices for game design. It is important to note that the titles of our resulting guidelines are not the complete guidelines themselves, instead they are labeled in italics underneath.

6.2.1 Research visual impairment

> *Research visual impairment throughout the development process with the goal of ensuring the correctness of the information and representation done through the gameplay.*

This means that research should be made with the goal of ensuring information given to the player about visual impairment is correct and represents the real world. The research should preferably be started early in the development process to ensure that the core game mechanics are designed on a factually correct base. However, it is also recommended to continue doing studies and research during the development of the game to ensure that the iterative design stays factually correct. We for example conducted research through interviews (5.10.1) and research into specific areas regarding visual impairment, such as how smell is used by people with visual impairment (5.11.7), during the development process.

It is strongly advised to follow this guideline as otherwise the game risks accidentally spreading misinformation about visual impairment. This would mean that the game would achieve the opposite to spreading awareness about the topic. An example of research that was done in our project was the research about how visually impaired people navigate (3.2.3).

6.2.2 Ideate and gather knowledge

> *Ideate and gather knowledge about gameplay mechanics that might represent visual impairment while looking at the game from an aesthetics first perspective.*

This guideline means that the ideation should focus on the player's experience first. Then try to explore different dynamics in the game that provide these experiences. Finally, game mechanics can be constructed to support these dynamics. During ideation it is recommended to use already established methods for ideation processes such as the methods discussed in 4.3.

It is recommended to use this lens for all stages in the development process where ideation about gameplay mechanics is needed. This lens should also be used when gathering knowledge about gameplay mechanics from other games. Naturally, it will be useful at the start of the process, but in an iterative development cycle, new ideas would be required later. An example of this was how we used this method when designing the quests in the game (5.11.8).

It is important to consider following this guideline because developing ideas for mechanics and dynamics in the game while having a clear goal of the aesthetics can make it easier to achieve the game's goal of spreading awareness about visual impairment, as discussed in 5.6. Focusing too much on the mechanics first, instead of the preferred experience, could risk the resulting mechanic being unrepresentative of the real-world experience of being visually impaired. This was partly one of the issues that we faced during the development of the footstep system (5.11.2).

Figure 6.12: Image shows parts of a quest that allows the player to experienced being moved without consent. This is an experience that was described as common during our interviews. The quest was ideated and developed using an experience first approach.

6.2.3 Consider visually impaired as stakeholders

> *Consider the people who are visually impaired as being your stakeholders and adapt the gameplay to them by keeping contact with them throughout the development process.*

People who are visually impaired are not a single defined entity, such as an organization or company. Instead, they are more similar to the target audience, having some similar traits, in this case being visually impaired, but otherwise they can have different opinions and expectations. Therefore, no single person exists who could represent them. Thus, it is recommended to reach out to several organizations that might represent visually impaired people, as well as to reach out to experts within the field. It is recommended to reach out to several people and organizations early in the development process. An interviewing process, as used by us (5.10.1), is recommended to be used to discuss their experiences of being visually impaired and the game idea. In this case we recommend using a predefined method for doing the interviews such as the one that can be found in 4.6. It could also be beneficial to define the game about spreading awareness towards a specific type of visual impairment to make this guideline easier to follow, because the stakeholder would be more defined.

This guideline is important because the game development project would fail as an awareness game if none of the people who are visually impaired considers the game as representing them properly. By regularly communicating with the stakeholders, showcasing the gameplay and asking for their opinion, gameplay can be adapted to their expectations early in the development process. This often limits the size of the changes that need to be made. Having continuous communication with stakeholders fits the scrum process well (4.2.1).

6.2.4 Adapt gameplay through playtests

Adapt the gameplay to the target audience through iterative design that is informed by continuous playtests throughout the development process.

The development process should be conducted by incrementally developing the gameplay and testing it often to ensure that the design fits the target audience and achieves the goals for the design. It is recommended to conduct different types of playtests throughout the development process. At an early stage we recommend paper prototyping (4.4) the core concepts of the game before the actual development of the game is started. Then after the core MVP product is completed, we recommend conducting regular playtests for each iteration. Towards the end of the development process, it is recommended to do more evaluative playtests to ensure that both the characterizing and entertainment goal is reached by the game. This structure of changing the objective of the testing is similar to how Cooper et al. [61] recommends that interviews should be changed as described in 4.6. It is recommended to use qualitative testing during the formative playtests as they are faster to set up and conduct regularly, while a few larger quantitative playtests can be used if more concrete proof of design is needed in for example the evaluative playtests (4.5). During the development of our game, we only conducted qualitative playtests because of limited amount time and resources (5.10.2). This worked well for the development of the actual game, but it proved problematic when evaluating the design of the game.

Conducting formative playtests often and early in the development process allows for an informed design process of the gameplay. It is important to use playtests to test if the player understands the representation of visual impairment within the game and if the specific gameplay mechanics achieve their characterizing goals. Not doing regular playtests risks that the message of visual impairment is not understood or noticed by the player, even if the information in the game might be factually correct. The playtests also provide insight into how the player reacts to different parts of the gameplay, and what the player wants and expects from the game. The playtests also provide information of what the player thinks is most important to fix within the game.

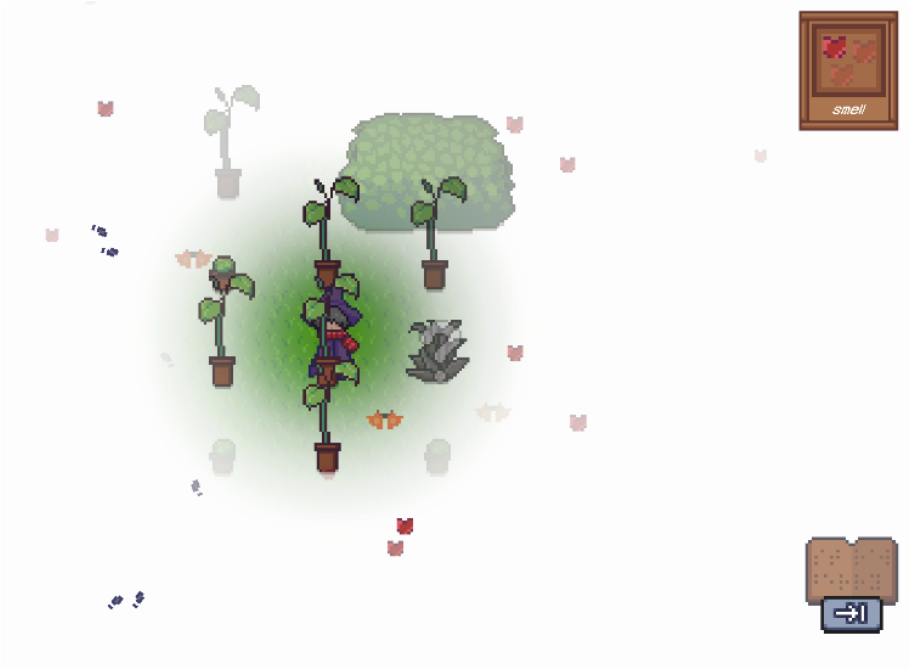

Figure 6.13: Image shows part of the screen in-game after the smell UI component was added because of playtest feedback. It can be seen in the upper right section of the image.

6.2.5 Adapt normal game concepts

> *Use concepts and methods that make normal games appealing, but adapt them to fit visual impairment.*

This states that other non-applied games should be examined to find concepts that might be useful for achieving the entertaining goal of the developed game. However, when using the concepts from other games it is important to consider the application area of visual impairment to see if the concept would fit or could be altered to fit it. The primary use-case for this guideline is when trying to ideate and find gameplay mechanics and dynamics that promote the game's entertainment goal.

Examining and analyzing other games is a good source to get inspiration for mechanics and systems. A benefit of using concepts already used in games is that these concepts have already been tested by someone else. By adapting concepts to visual impairment, it can be assured that the implementation does not risk reducing the game's ability of reaching its characterizing goal. In some circumstances an adapted concept from a non-applied game might even be beneficial for reaching the characterizing goal, as well as the entertainment goal. One example of this is how the concept of points of interest were adapted to fit the application area of visual impairment (5.11.3). If this guideline is not followed it risks that concepts used from other games misrepresent visual impairment, this was an issue that we faced during the early development of the footstep system (5.11.2).

Figure 6.14: Left image shows how the game Elden Ring uses a large tree in the distance as a point of interest to encourage exploration [88]. Right image shows how our game uses smell as a point of interest to encourage the player to explore their vicinity.

6.2.6 Promote awareness through exploration

> *Allow the player to explore the game, and promote awareness in not only what the player explores but also how the player explores.*

This means the way the player explores the game should reflect the experiences of visually impaired people. This guideline is recommended to be used when the player explores the in-game world, but it should also be considered when exploring different gameplay systems and mechanics within the game. Consider how the player learns about something when trying to find and figure things out within the game.

Spreading awareness through how the player explores adds another layer that can help achieve the game's characterizing goal. This guideline is especially important when designing awareness games about visual impairment, as for example learning to explore and navigate is highly affected by being visually impaired (3.2.3). In our case we used this guideline for both designing gameplay mechanics regarding navigation and designing the ingredient identification process (5.11.3, 5.11.4).

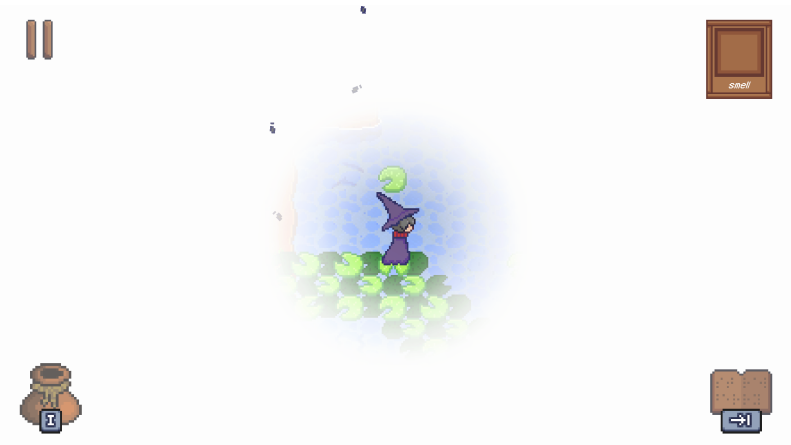

Figure 6.15: Image shows the player tracing the edge of the water during exploration.

6.2.7 Implement meaningful mistakes

Let the player make meaningful mistakes that represents visual impairment.

Meaningful mistakes are mistakes that inform the player about similar issues and difficulties within the application area of visual impairment. The guideline itself implies that the gameplay should provide space for the player to make these meaningful mistakes that they can learn from. The guideline is recommended to be used when designing the consequences of player actions. In our game we allowed the player to make meaningful mistakes when exploring the world (5.11.3) and when brewing potions (5.11.4).

Letting the player make meaningful mistakes can be an important tool to make them aware of the difficulties common for people with visual impairment. It is however important to balance the risk of the player making a mistake and the consequence of making the mistake to minimize unnecessary frustration for the player. That said, in some circumstances, allowing the player to be frustrated can prove useful in making them aware of the issue. This can for example be the case when frustration is one of the core experiences of a similar situation within the real world. One example of this in our game was that we wanted the player to feel some frustration when getting lost in the game (5.14.1), as that was representative of the experiences described in the interviews (5.10.1). As discussed in 4.7.2 letting the player make mistakes is also important for the player's learning process about the subject.

6.2.8 Budget cognitive load for visual impairment

When designing gameplay, budget the player's cognitive load in accordance to the target audience and allow space for learning about visual impairment.

This means that the game should try to match the cognitive load (3.2.2) required in the game with the expectation and mental dedication of the target audience. This sets an approximate limit for how much cognitive load the game can use without risking it being problematic for the appeal of the game. This guideline also implies that achieving the characterizing goal itself, being to make the player aware about visual impairment, also adds cognitive load for the player. Therefore, it is important to give space for this when designing gameplay around cognitive load.

This guideline should be followed both when deciding the number and complexity of the systems in the game and when designing the learning curve of the game. In our case we decided to limit the number of mechanics that did not fit the application area to leave more room for systems that represented visual impairment at the beginning of the game (5.14.1). We also reduced the size of the area the player could explore at the start to reduce the information the player needed to learn in the beginning (5.11.3). Budgeting the cognitive load wrong risks overloading the player. Overloading the player's cognitive load could make it unnecessarily difficult to learn and understand what is happening within the game. It also risks a harder time making the player aware about the application area, because when someone is

cognitively overloaded it can become harder to interpret and learn from information provided to them (3.2.2). The player might also have a reduced ability to interpret and reflect over situations and systems within the game.

Figure 6.16: Shows an image of the start of the game, right after the player leaves Fabians house. The player is presented with a quest, smell, sounds and the limited vision right at the start.

6.2.9 Make challenges fit visual impairment

> *Add enough gameplay challenges to the game to fit the target audience's expectations and when possible make them fit similar challenges that can be experienced by visually impaired people.*

The meaning of this guideline is that the game's difficulty should fit the difficulty that the target audience expects and that it is good if the challenges found in the game reflect on challenges that visually impaired people face. In our game this for example meant that that the challenges of navigating as someone who is visually impaired (3.2.3) was reflected within the game (5.11.3).

This guideline is recommended when designing the core challenges of the game and balancing it. That the challenges and learning curve fits the target audience is important for limiting the cognitive load (3.2.2) and achieving the game's entertainment goal (3.3.1). Connecting the challenges to real world challenges is an important tool for making the player aware about issues faced by people with visual impairment.

6.2.10 Provide some guidance

> *Provide enough guidance to the player so that they understand the core mechanics of the game but limit the guidance so it does not accidentally interfere with spreading awareness.*

Providing guidance to the player refers to elements in the game that directs and informs the player about other elements in the game. This can for example be a tutorial, tooltips in UI, or an NPC that describes a game element. It might also be more diegetic things that are in the game world, as for example a light that shines on

an important object. In our case we for example added guidance to the smell system (6.1.8) because during development we had initial problems that the player did not understand the system (5.11.7). This guideline is recommended to be followed when adding guiding elements into the game, such as the game tutorial or in game hints, or when finding that players during playtests do not understand a game mechanic.

Providing enough guidance for the player is important to give the player a starting point for interacting with the game. Even if the player might not know much about the mechanics in the game at the start, guidance gives the player enough knowledge to start exploring and learning about them on their own. It is however important to evaluate the guidance given to the player and limit it if it would interfere with the game's ability to promote awareness about visual impairment through, for example, challenges or meaningful mistakes. In our case this meant that when the player explores, it was important to not give the player too much guidance because that would reduce the risk of the player getting lost, which was part of the experience that we wanted to give the player. This is the reason we needed to redesign the footstep system during the development (5.11.2).

Figure 6.17: Image shows the small UI element that helps the player understand the smell system. The smell system itself does also guide the player to nearby ingredients.

6.2.11 Awareness throughout the design

> *Implement the characterizing goal of spreading awareness about visual impairment into several gameplay systems, not only a few.*

This statement implies that several parts of the game should be shaped to fulfill its goal of spreading awareness about visual impairment, such as gameplay mechanics, the game environment and in game interactions.

It is recommended that this is done throughout the game and development process. Not all gameplay systems need to follow this guideline as there is value in doing things that only focus on the entertainment goal as well. It might be unnecessarily challenging if all parts of the game need to fulfill both the entertainment and characterizing goal without allowing for some flexibility. With that said, adapting the gameplay to suit the characterizing goal is important when possible. The goal should be that the game at large can promote visual impairment throughout several parts of the game. In our game we implemented the characterizing goal of spreading awareness into almost all major gameplay systems in some way, as seen in the result of the game (6.1).

This allows the game to represent several parts of visual impairment and opens opportunities to show it from different perspectives. Our final interviews gave a good response to the adaptation of the game to the application area through several gameplay mechanics, systems, and interactions (5.12).

6.2.12 Incorporate explicit debriefing phase

> *Incorporate an explicit debriefing phase into the game, motivate the players to interact with it but be careful of making it mandatory.*

A debriefing phase means that the player is allowed space to reflect on in game situations, the game at large, or the application area of visual impairment. Incorporating it into the game means that the debriefing phase should not be a standalone part of the experience such as an external website or questionnaire. Instead, it should be part of the game itself. This guideline can be considered when you want the player to get a clearer image of what the game is about, or when you want the player to make a deeper reflection over the game. In our case we implemented a debriefing system where the player could reflect on questions regarding the game and visual impairment throughout the game (6.1.12).

A debriefing phase is not necessary when designing a game about visual impairment, but it can make the connection between the game and visual impairment stronger. This is something that was shown in the results of our playtesting (5.13). A debriefing phase could also make specific gameplay mechanics clearer for the player, especially if the systems require some extra thought to be understood. The result from our playtesting also showed that it is important to add motivation for the player to interact with the system. However, making it mandatory should be avoided as that has a risk of severely negatively impacting the entertainment value of the game for some players. It is recommended to add either intrinsic or extrinsic rewards for interacting with the debriefing system, depending on what fits the game and the system best.

7

Discussion

This chapter presents our opinions of the resulting game and guidelines as well as our thoughts regarding the methods used during the project. The chapter also included an analysis of whether the guidelines can be used in a more generalized context and the validity of the result. Finally, the chapter goes through what future work that can be done to the game and the guidelines as well as the ethical implications of the result of this report.

7.1 Result Discussion

The resulting game itself is in our opinion a decent demo game. It showcases the core concepts of the game mechanics and the player experience. Importantly, it is complete enough for us to be able to use it for testing and analyzing the guidelines. However, the game itself would need further work for us to be able to call it a complete game. Many of the concepts developed in the game could be used more to achieve their full potential, and the narrative of the game only includes the introduction. This this was never part of the scope for this thesis, so therefore, we are happy with the result of the game itself.

The fact that the playtesters thought that the game was cozy was important for two main reasons; first it was beneficial for achieving the game's entertainment goal, and second it counteracted that the game would be considered a scary game, which was part of our entertainment goal (5.5.2). The audiovisual aesthetic of the game and the NPC dialogues were of vital importance for achieving this general aesthetic, however people also reflected that the gameplay helped with supporting it. The gameplay was for example not hectic, the players did not feel stressed over completing tasks because of time constraints, and things such as quiet slow movement speed helped with establishing the feeling of the game. To achieve the game's coziness the audiovisual and narrative design was most important, while the gameplay design supported it. This shows that even if this report focuses on the design of the gameplay, other parts of the game are still important. Sometimes gameplay is mostly important as support to these other aspects of the game instead of being the focus itself.

One mistake made in the game's development was that we did not define what type of visual impairment Fabian, the main character, had. This is a problem because different mechanics and systems suggest that Fabian has a different amount of vision. For example, the exploration systems suggest that Fabian has limited vision, but

that he still can see some things at close distances. At the same time, the ingredient identification process suggests Fabian has no vision, because it only uses other senses than vision when Fabian describes the plants. This is a problem, because even if it can be seen as the game trying to reflect many different perspectives of visual impairment, the game cannot reflect visual impairment as a whole. Therefore, it might have made the purpose of the game clearer and more correct if a specific type of visual impairment was chosen and all aspects of the game were designed to promote awareness about that specifically. This would limit the issue that visual impairments are very individual, so it is hard to determine what specific things to inform about which represents the whole subject.

During the initial development of the MVP (5.8) we discussed that porting the game to mobile was postponed until a later stage of development and that we would at first focus on making PC builds which allowed for us to be more flexible with conducting playtesting. This was a decision that we believe was suitable for this project, as all playtesting we could conduct was important for the game and guidelines development. However, because of time limitations we did not have time to fully port the game to mobile. Some parts of the game were adopted to suit mobile, such as for example making menus and interfaces available as buttons on the screen instead of purely keyboard shortcuts, but the game lacked some critical elements. The main thing that the game would require for a mobile port is touchscreen mobile controls and a button for interacting with in-game objects. That the mobile port was not prioritized during the master thesis project was not a problem for answering the research question itself, in fact it allowed for more time to be spent on the design of the game and the final guidelines. This was discussed with our contact from Psyon Games (2.3.2) and he was fine with us delaying the port to mobile until after the master thesis itself was completed, as they did not have a strict deadline for the project.

Regarding the resulting guidelines we think that it is important to note that they should not be considered a complete list of guidelines. Instead, it should be considered as list of some guidelines, and that list could be expanded upon in the future. We do also want to make it clear that the guidelines are not ranked by importance, because it is assumed that the importance of the different guidelines will differ between different games. In some cases, it is also expected that a guideline can be completely ignored. This is because these guidelines are developed to answer the research question of: *What should be considered when designing gameplay to promote awareness about visual impairment through an applied game?* Therefore, we present these guidelines as things that the developer should *consider* following, but it is up to the developer to determine if each guideline is applicable for their circumstances.

7.1.1 Audiovisual, Narrative and Gameplay

When designing awareness games for visual impairment audiovisual and narrative design is also of vital importance, which is something that our sister thesis has investigated further [1]. Their result is an analysis of the strength, weaknesses, opportunities, and threats (SWOT analysis) of seven different aspects:

- Inclusion of Sounds
- Using No Visual Elements
- Using Visual Representation of Senses
- Inclusion of Dialogue
- Directly Addressing the Topic of the Game
- Inclusion of Different Visual Aids
- Using Player Assigned markers

Their findings and the guidelines for gameplay design suggested in this thesis complement each-other in various ways. Their analysis of using visual representations of senses in the game does for example mention a threat that overdoing it could overload the visual stimuli for the player. This is something that should be considered when addressing the guideline about budgeting the players cognitive load which is proposed in this thesis. Another example of how the two results complement each other is in their analysis of the inclusion of sound in the game mentions an opportunity for using sound for environmental storytelling. This is a useful tool when using exploration for promoting awareness through how the player explores. Even though the two reports have two different focuses and results, this shows that when designing an applied game for spreading awareness about visual impairment both results are important to consider.

7.1.2 Discarded Initial Guidelines

These guidelines were the initial guidelines (5.7) that were discarded during the development process. The reason for why they were discarded varies, but common reasons were; we did not find the guideline useful for answering the research question or that the guideline did not fit the scope of our project. However, these guidelines might still be useful in some circumstances. This could for example be to achieve the games entertainment goal or achieve other types of characterizing goals. The guidelines might also be useful for answering the research question during very different game design projects. However, we cannot confirm their usefulness or viability, so they are not part of our result.

Adapt the game to important stakeholders. This guideline was changed twice, once in the initial guidelines (5.7) and then parts of it were added to the resulting guidelines (6.2). However, the guideline at whole did not really answer the research question (5.14.2).

Give the player regular feedback. As discussed in 5.14.2 we found this guideline useful for achieving the games entertainment goal, however for us it was not that important for achieving the characterizing goal of spreading awareness about visual impairment.

Adapt the environment and interactions to suit the characterizing goal of spreading awareness. This guideline was not wrong, but it was not really helpful in answering the research question. Therefore, it was significantly changed to *Implement the characterizing goal into several gameplay systems, not only a few.* This is discussed more in 5.14.2.

7.1.3 Potential Guidelines

In this section we propose potential future guidelines. These are speculative guidelines based on the insights learnt from the game development project. However, because these guidelines are not part of the initial guidelines that we set out to test, we cannot speak for the validity of these guidelines. Therefore, we do not consider these guidelines to be part of the result of this thesis. Instead, we propose that it might potentially be interesting to test the usability and validity of these guidelines in future research.

- Instead of spreading awareness about visual impairment at large, focus on a specific type of visual impairment. This might solve the issue that it is hard to represent everyone in such a diverse group of people.
- Gameplay might not be the most important aspect of spreading awareness. Even though this report focuses on gameplay specifically it is important to note that the audiovisual and narrative design of the game also was extremely important for the design of the game.
- Be very clear with the message of the game. That can allow the player to understand the less obvious aspects of the gameplay and its connection to the application area. It is not wrong to explicitly state the purpose of the game at the start.

7.2 Methods Discussion

We believe that the decision to develop the guidelines through using them in the development of an actual game was a good decision. This let us not only evaluate how well the methods worked in practice, but it also allowed us to test the result of using those guidelines. Furthermore, it gave us more experience in working on applied games, which presumably allowed us to make a better analysis of the guidelines. That said, it is also important to note that the game project's development used a lot of time that could be spent doing more research. A lot of the development time was spent on developing and testing aspects for the guidelines themselves. However, we also needed to spend time implementing things, such as player movement, that were not important for testing the guidelines but were important to make the game

playable. We believe that this tradeoff was beneficial for the result of this report, but it needs to be noted that it was a tradeoff.

Working on the game development project together with another master thesis project also worked well. This required that the final game project also provided a platform for them to answer their research question, which required extra work. However, having two teams of people with different expertise working on the project allowed each person to focus on doing what they were best at. This increased the development speed of the project in general. It was also very beneficial that the members of the two groups had previously worked together on another similar project, something that sped up the initial process of defining and adapting to a common work process significantly.

Using an agile scrum workflow worked well for the development of the game. This allowed us to evaluate the game continuously through playtests and made it easy to adapt the design and development of the game to the result of the playtests and interviews continuously throughout development. This is from our experience a good workflow when developing normal games as well [81], however, it is in our opinion extra useful for the development of applied games because applied games have more stakeholders to adapt to. Using an altered scrum workflow also suited our small development team well, because it allowed us to easily change and adapt while still providing some structure to the process.

Using the Gameplay design patterns [4] during the development process was a bit tricky to do in practice. The main issue was that because of the agile development process many of the gameplay systems were continuously changing. This meant we needed to redesign the Gameplay design pattern graph continuously. This was a problem, because redesigning the gameplay design graph required abstractions and searching through long lists of patterns, things that took a long time to do. The abstract patterns were also hard to find a good use for during the development process itself. Instead, we relied more on using concrete scrum tasks and stopped updating the Gameplay design pattern graph after a while. That said, we still think the Gameplay design patterns can be used during some parts of developing applied games, for example when analyzing other applied games. Using smaller graphs that are more focused on specific mechanics and systems instead of the whole game could potentially also be easier to update and use during the development process. Experimenting with combining concrete scrum tasks with a gameplay design graph might also be interesting, but this is highly speculative.

During the development process we also wrote a design document. This document's purpose was to describe the game to external actors, not for the development of the game itself. Instead, we used a scrum board to keep track of tasks internally. As previously mentioned, the systems continuously changed to adapt to new circumstances and feedback. Because of this we avoided defining the details of the mechanics and systems within the game. Instead, the game design document puts more focus on concrete things such as the goal of the game. The design document did, however, need to be updated at some points during the development process. It was a decent tool for discussing the game with external actors, such as stakeholders to the project.

However, the game design document was at times not concrete enough to explain the game by itself, and often relied on additional media such as a game showcase, images, or gameplay footage of the game. A final version of the game design document can be found in Appendix D.

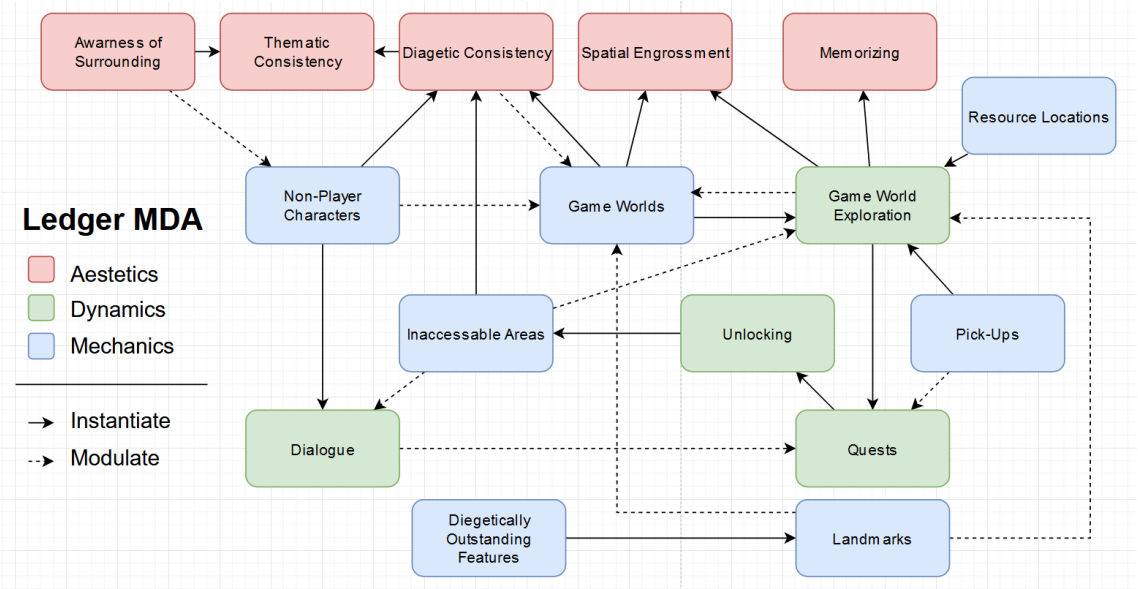

Figure 7.1: The image shows one iteration of the Gameplay design pattern graph during the development process.

7.3 Generalization

Even though the research question was specified during the development of this thesis to focus specifically on visual impairment, we believe that the guidelines have a good probability to also be adapted to suit other types of application areas. In many cases the guidelines could theoretically be adapted by changing the specific wording to visual impairment to another application area, and the guideline would probably still be at least partially viable. However, this is not something that has been tested in this study, and therefore we cannot confirm this.

It is also possible that the guidelines could be suitable for some other types of characterizing goals instead of spreading awareness. This is because as previously mentioned (3.2.1, 3.3.2) awareness games are similar to for example educational games. Even the design of rather different types of applied games, such as exergames (applied games that focuses on physical exercise), could potentially benefit from using some of the more general guidelines such as adapting the game to the target audience through continuous playtesting. That said, the guidelines are not developed for these scenarios, so it is recommended to consider which guidelines to follow and why.

7.4 Validation

This report focuses on design research. Design research relies on subjective statements and can therefore not be validated through traditional engineering means such as logical induction or deduction. Instead validating design research is a process of building confidence in its usefulness with respect to a purpose [96].

In our case, this master thesis's purpose was to research and develop guidelines for designing gameplay to promote awareness about visual impairment through an applied game. In this thesis we aimed to build confidence in their usefulness by investigating previously developed guidelines for similar purposes and adapting them to our specific research question by using them in the development of an applied game. By evaluating the game regarding its ability to promote awareness about visual impairment and being an effective applied game, we could learn how useful the guidelines were in practice and use that feedback to develop new guidelines.

The validation process of our master thesis has some possible flaws. The first flaw is with the evaluation of the game itself. Because of limited resources and time this project could only conduct qualitative testing, and not any quantitative testing. As discussed in 4.5 qualitative testing is useful for getting insights into the design of the game, but it cannot be used to prove anything about the game. This means that the evaluation of the game risks being biased towards the opinion of the specific playtesters that participated in testing the game. This is also an issue with the interviews that were used as a basis for evaluating the correctness of information and representation in the game as only a few interviews were done with a couple of people. Increasing the number of interviews and playtests conducted, and doing proper quantitative tests would be beneficial for validating the game. This would also provide better validation for the resulting guidelines that answered the research question. However, this would in practice require more time, especially in regards of reaching out and booking meetings with people with visual impairment and finding a large quantity of playtesters.

Another issue with the validation of the result of the research question is that the guidelines were only evaluated through the development of a single game. Developing several awareness games about visual impairment using these guidelines could give a more generalized result as different games could provide different perspectives on the guidelines. This could reveal issues with the guidelines not recognized in the development of our game, and it might be found that some of the initial guidelines we discarded would be useful in another setting.

We suggest that this report should be seen as a step towards developing guidelines for using gameplay design to promote awareness through an applied game. However, to achieve guidelines that with full confidence can be said to be accurate and useful when designing gameplay for awareness games more steps need to be taken.

7.5 Future Work

This section describes the future work that could be done on the game and the guidelines. For the game, we expect future work would be done by us and our sister thesis group, but for the guidelines, the future work could be done by anyone.

7.5.1 Game Future Work

As mentioned, we see the final resulting game as a demo game. This means that more work could be done to the game to make it a fully releasable game. In this section, we will go through parts of the game that were left out but could be added or expanded on in the future.

The game world itself could be increased with more unique regions. This could allow us to explore more different environments that could impact the experience of being visually impaired. Examples of this are the *Bon-Bon fields* who could be harder to navigate because they would be more open, or the *Mushroom forest* which could overload the player's sense of smell. Some areas which already existed in the game could also be improved and made more unique, for example by adding more sounds to *Critterton* to fully overload the player's hearing in that area. A full list of regions and region mechanics planned for the game can be found in the game design document, Appendix D.

We would also like to add more quests to the game. This would allow us to complete the narrative story throughout the game. A type of quest that would be especially important to add more of is the type of quest that informs the player about situations that can commonly occur for people with visual impairment. This is because the main quest that does this in the current game received great feedback from both playtesters and people interviewed.

Another system that we would like to develop further is the reflection system. As written in 5.11.10 and 5.14.2 the reflection system implemented into the game showed potential for being a good system for conveying the game's characterizing goal, however it needed more development for making more players interact with it, getting the most out of that interaction. An interesting proposal for a change to that system that one of the people that were interviewed provided was that when the player had answered one of the reflection questions, they should be provided with an answer to the same question written by someone who is visually impaired. This might make this system not only useful for debriefing purposes, but it could also give the player new information about visual impairment. Another change that could be made to the system is to connect it with the quest system so that some questions only appeared after specific quests were completed. This could ensure that the player had experienced a specific scenario before being asked to reflect upon it.

Even though it was not part of the scope of this project, we think that it is a shame that the game is lacking in accessibility options. Therefore, adding more accessibility to the game in general is something that we would want to look more into in the future. Accessibility tools that could be added to the game is that all the text in

the game could be read out loud, adding options in the settings to change the UI scaling, and allowing rebinding of controls. We would also want to add additional tools that could visually indicate sounds and direction to the sounds for people with hearing impairment.

As discussed previously (7.1), one thing that we did not have time to do during this thesis was porting the game to mobile. Therefore, this is something that we plan to do in the near future. Porting the game to mobile would be an essential step for a potential continued collaboration with Psyon games, and it could potentially allow the game to reach a broader audience if the game would be released. Creating a mobile build would not require redoing anything in the project, as most things were developed with a potential mobile port in mind, but it would require some additional support for mobile controls.

7.5.2 Guidelines Future Work

As mentioned in 7.4 we see the result of this master thesis merely as a step towards the development of guidelines for design of gameplay of awareness games. Thus, we propose that for future work more steps need to be taken to develop resulting guidelines that with high confidence can be assured of their usefulness.

These steps can be refined through more testing on the resulting guidelines of this thesis, more testing and evaluation of the game developed in this thesis and with the development and testing of other games using the same guidelines. We also propose that other competing guidelines be developed from scratch and compared the thesis's guidelines. Finally, we propose that other already existing awareness games are analyzed further to explore what principles make them work. This would provide an alternate way of defining guidelines that is not dependent on the development and testing of the guidelines through a game development process.

7.6 Ethics

This report aims to make guidelines for awareness games about visual impairment so that more can be developed in the future to increase people's awareness and solidarity with people with visual impairment. However, it is important to note that some potential ethical issues do exist with both the resulting game and the resulting guidelines. In this section we will address these risks.

One issue is that not all applied games are made with an ethical characterizing goal. Examples of games that are immoral are propaganda and fake-news games. Even though some people might classify these applied games as separate from awareness games it is important to note that propaganda and fake-news at their core also refers to spreading information, even though that information is false [97]. Therefore, even though it was not the intention of this thesis, the guidelines created in this report could hypothetically be adapted and used in the creation of these unethical games because the underlying goal of spreading information is the same.

An ethical issue with the game itself is that as previously mentioned it cannot be stated that the game represents all types of visual impairment. Therefore, the game might for some people with visual impairment feel wrong or miss-representing. If the game would at a larger scale change the assumptions or stereotypes sighted people have about visual impairment this might risk sidelining these people. This is something we have tried to avoid, but more work is needed to minimize this risk.

Another issue with the game is that the game has accessibility issues. Something that is ironic when considering its characterizing goal. Two large accessibility issues in the game are that because the game relies a lot on hearing, it might be hard to play for people with impaired hearing. The game is also inaccessible for visually impaired people. This is because some systems that represent other senses still display those senses to the player using the screen, as for example the smell system. The game does also have a lot of text, without implementing a screen reader or an option to resize UI and text on the screen. Given more time these are issues we would want to address.

One final potential issue with the guidelines themselves is that if the guidelines are followed too strictly by many people there might be a small risk that the awareness games would feel too similar in nature. Therefore, we only propose the result in this report as guidelines that developers can follow, not rules they need to follow.

8

Conclusion

This thesis set out to answer the research question: *What should be considered when designing gameplay to promote awareness through an applied game?* However, during the development of the thesis it decided that the research question should be narrowed down to *What should be considered when designing gameplay to promote awareness about visual impairment through an applied game?* This decision was made to make the result more direct and useful. It did also make it easier to answer the research question with less speculation and generalization.

To answer this research question, the concept of an applied game was first defined. This report defines an applied game as: needing to follow the definition of a game, it is created with the goal of entertainment, it is created with a characterizing goal within an application area, its characterizing and entertainment goal are not ranked by importance, and it is not limited to a specific medium.

Previous guidelines for similar topics, for example other applied games, were researched and summarized. These guidelines were then paired with the characterizing goal of spreading awareness, creating initial guidelines for the research question. These initial guidelines were then used in the development process and design of an applied awareness game about visual impairment to analyze how well they worked in practice.

The game project resulted in a game *Fabian and Fables* where the player plays the visually impaired character *Fabian the Witch*. In the game the player needs to explore the world and investigate different ingredients to brew potions and help NPCs. Because of the character's, and player's, limited vision the player also needs to rely on other senses such as smell and hearing which are represented in the game as different gameplay mechanics and systems. The player may also experience scenarios that reflect similar experiences that visually impaired people have in real life, and a reflection system was added to allow the player to debrief over their experiences in the game.

The game was developed and evaluated using both qualitative playtesting and interviews with visually impaired people. The interviews showed that from the participants' perspective the game did a decent job at representing visual impairment but mentioned that visual impairment is very individual and therefore it cannot be concluded that the game represents visual impairment for everyone. The playtest showed that the game did a decent job at informing and making the players aware

about the topic and that the target audience of players seemed to enjoy the game.

By analyzing how well the initial guidelines worked when used in the development of a game combined with the result of the game a set of new guidelines were developed:

- Research visual impairment throughout the development process with the goal of ensuring the correctness of the information and representation done through the gameplay.
- Ideate and gather knowledge about gameplay mechanics that might represent visual impairment while looking at the game from an aesthetics first perspective.
- Consider the people who are visually impaired as being your stakeholders and adapt the gameplay to them by keeping contact with them throughout the development process.
- Adapt the gameplay to the target audience through iterative design that is informed by continuous playtests throughout the development process.
- Use concepts and methods that make normal games appealing, but adapt them to fit visual impairment.
- Allow the player to explore the game, and promote awareness in not only what the player explores but also how the player explores.
- Let the player make meaningful mistakes that represents visual impairment.
- When designing gameplay, budget the player's cognitive load in accordance to the target audience's expectations and allow space for learning about visual impairment.
- Add enough gameplay challenges to the game to fit the target audience's expectations and when possible make them fit similar challenges that can be experienced by visually impaired people.
- Provide enough guidance to the player so that they understand the core mechanics of the game but limit the guidance so it does not accidentally interfere with spreading awareness.
- Implement the characterizing goal of spreading awareness about visual impairment into several gameplay systems, not only a few.
- Incorporate an explicit debriefing phase into the game, motivate the players to interact with it but be careful of making it mandatory.

Because of issues with the evaluation process, mainly that only some evaluative playtests and interviews were conducted, the result of this thesis should only be considered as a step towards a final answer to the question. More research and practical implementation of the guidelines are needed to create a high confidence answer.

Bibliography

[1] M. Grahn and H. Pettersson, "Aesthetic design of applied games - designing games for promoting awareness about visual impairment", [Master Thesis], 2024.

[2] R. Hunicke, M. LeBlanc and R. Zubek, "Mda: A formal approach to game design and game research", 2004. [Online]. Available: https://users.cs.northwestern.edu/~hunicke/MDA.pdf.

[3] Cambridge Dictionary, *Awareness*. [Online]. Available: https://dictionary.cambridge.org/dictionary/english/awareness (visited on 11/02/2024).

[4] S. Björk and J. Holopainen, *Gameplay design patterns wiki*. [Online]. Available: http://virt10.itu.chalmers.se/index.php/Category:Patterns (visited on 08/02/2024).

[5] PwC, *Pwc global entertainment & media outlook 2022–2026*, 2022. [Online]. Available: www.pwc.com/outlook (visited on 06/02/2024).

[6] World Health Organization, *World report on vision*, Licence: CC BY-NC-SA 3.0 IGO., Geneva: World Health Organization, 2019.

[7] American Optometric Association, *Low vision and vision rehabilitation*, American Optometric Association. [Online]. Available: https://www.aoa.org/healthy-eyes/caring-for-your-eyes/low-vision-and-vision-rehab (visited on 11/02/2024).

[8] Maddy Makes Games Inc., Extremely OK Games Ltd., *Celeste*, [Game], Maddy Makes Games Inc., 2018. [Online]. Available: https://www.celestegame.com/.

[9] Psyon games, *Antidote-covid-19*, [Game], Psyon Games, 2021. [Online]. Available: https://iamtheshield.com.

[10] GainPlay Studio., Gray Lake Studios., Hence Games, *Mindlight*, [Game], Play Nice LLC, 2017. [Online]. Available: https://playmindlight.com/.

[11] E. A. Schoneveld, A. Lichtwarck-Aschoff and I. Granic, "Preventing childhood anxiety disorders: Is an applied game as effective as a cognitive behavioral therapy-based program?", *Prevention Science*, vol. 19, pp. 220–232, 2018. DOI: https://doi.org/10.1007/s11121-017-0843-8.

[12] Daisy Ale Soundworks, *Lost and hound*, [Game], Daisy Ale Soundworks, 2022. [Online]. Available: https://store.steampowered.com/app/1054350/Lost_and_Hound/.

[13] Mojang AB, *Minecraft education*, [Game], Microsoft Corporation, 2016. [Online]. Available: https://education.minecraft.net.

[14] Psyon Games, [Company]. [Online]. Available: https://psyongames.com.

[15] Psyon games, *Antidote*, [Game], Psyon Games, 2019. [Online]. Available: https://psyongames.com/antidote/.

[16] Psyon games, *Full adhd*, [Game], Psyon Games. [Online]. Available: https://psyongames.com/full-adhd/.

[17] E. M. Avedon and B. Sutton-Smith, "The study of games", *(No Title)*, 1971.

[18] B. Suits, *Games, Life and Utopia*. Toronto: University of Toronto Press, 1978, ISBN: 9781487574338. DOI: doi:10.3138/9781487574338. [Online]. Available: https://doi.org/10.3138/9781487574338.

[19] R. Caillois, *Man, play, and games*. University of Illinois press, 2001.

[20] J. Stenros, "The game definition game: A review", *Games and culture*, vol. 12, no. 6, pp. 499–520, 2017.

[21] I. Stahl, "Chapter iii:a - what is operational gaming?", in *Operational Gaming*, I. STÅHL, Ed., Pergamon, 1983, pp. 33–34, ISBN: 978-0-08-030870-8. DOI: https://doi.org/10.1016/B978-0-08-030870-8.50009-6. [Online]. Available: https://www.sciencedirect.com/science/article/pii/B9780080308708500096.

[22] S. Deterding, D. Dixon, R. Khaled and L. E. Nacke, "From game design elements to gamefulness: Defining "gamification"" *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments*, pp. 9–15, 2011. [Online]. Available: https://uwaterloo.ca/scholar/lnacke/publications/game-design-elements-gamefulness-defining-gamification.

[23] R. N. Landers, "Developing a theory of gamified learning: Linking serious games and gamification of learning", *Simulation & gaming*, vol. 45, no. 6, pp. 752–768, 2014. [Online]. Available: https://journals.sagepub.com/doi/full/10.1177/1046878114563660.

[24] R. Dörner, S. Göbel, W. Effelsberg and J. Wiemeyer, *Serious games*. Springer, 2016. [Online]. Available: https://link.springer.com/content/pdf/10.1007/978-3-319-40612-1.pdf.

[25] W. L. Bedwell, D. Pavlas, K. Heyne, E. H. Lazzara and E. Salas, "Toward a taxonomy linking game attributes to learning: An empirical study", *Simulation & Gaming*, vol. 43, no. 6, pp. 729–760, 2012. [Online]. Available: https://journals.sagepub.com/doi/full/10.1177/1046878112439444.

[26] D. Ašeriškis and R. Damaševičius, "Gamification patterns for gamification applications", *Procedia Computer Science*, vol. 39, pp. 83–90, 2014. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S1877050914014318.

[27] R. Dörner, S. Göbel and M. Kickmeier-Rust, "Introduction to the gi-dagstuhl book on entertainment computing and serious games", in *Entertainment Computing and Serious Games: International GI-Dagstuhl Seminar 15283, Dagstuhl Castle, Germany, July 5-10, 2015, Revised Selected Papers*, R. Dörner, S. Göbel, M. Kickmeier-Rust, M. Masuch and K. Zweig, Eds. Cham: Springer International Publishing, 2016, pp. 1–16. DOI: 10.1007/978-3-319-46152-6_1. [Online]. Available: https://doi.org/10.1007/978-3-319-46152-6_1.

[28] F. Laamarti, M. Eid and A. E. Saddik, "An overview of serious games", *International Journal of Computer Games Technology*, vol. 2014, pp. 11–11,

2014. [Online]. Available: https://dl.acm.org/doi/pdf/10.1155/2014/358152.

[29] K. Becker, "Video game pedagogy: Good games= good pedagogy", *Games: Purpose and potential in education*, pp. 73–125, 2009. [Online]. Available: https://www.researchgate.net/publication/260105281_Video_Game_Pedagogy_Good_Games_Good_Pedagogy.

[30] C. E. Catalano, A. M. Luccini and M. Mortara, "Guidelines for an effective design of serious games", *International Journal of Serious Games*, vol. 1, no. 1, 2014. [Online]. Available: https://journal.seriousgamessociety.org/index.php/IJSG/article/view/8.

[31] N. Pyrhönen, *Beyond entertainment: Game design for impact*, Northen Game Summit, 2023.

[32] R. Schmidt, K. Emmerich and B. Schmidt, "Applied games – in search of a new definition", Sep. 2015, ISBN: 978-3-319-24588-1. DOI: 10.1007/978-3-319-24589-8_8. [Online]. Available: https://www.researchgate.net/publication/284169462_Applied_Games_-_In_Search_of_a_New_Definition.

[33] Office of educational Improvement, *Cognitive load theory, a guide to applying cognitive load theory to your teaching*, Medical College of Wisconsin, 2022. [Online]. Available: https://www.mcw.edu/-/media/MCW/Education/Academic-Affairs/OEI/Faculty-Quick-Guides/Cognitive-Load-Theory.pdf (visited on 29/04/2024).

[34] P. A. Kirschner, *Cognitive load theory: Implications of cognitive load theory on the design of learning*, 2002.

[35] X. Aidi, "Cognitive overload and its countermeasures from the angle of information processing", in *2009 Third International Symposium on Intelligent Information Technology Application*, IEEE, vol. 1, 2009, pp. 391–394.

[36] N. Banovic, R. L. Franz, K. N. Truong, J. Mankoff and A. K. Dey, "Uncovering information needs for independent spatial learning for users who are visually impaired", in *Proceedings of the 15th International ACM SIGACCESS Conference on Computers and Accessibility*, ser. ASSETS '13, Bellevue, Washington: Association for Computing Machinery, 2013, ISBN: 9781450324052. DOI: 10.1145/2513383.2513445. [Online]. Available: https://doi.org/10.1145/2513383.2513445.

[37] S. R. A. W. Alwi and M. N. Ahmad, "Survey on outdoor navigation system needs for blind people", in *2013 IEEE Student Conference on Research and Developement*, 2013, pp. 144–148. DOI: 10.1109/SCOReD.2013.7002560.

[38] M. A. Williams, C. Galbraith, S. K. Kane and A. Hurst, ""just let the cane hit it": How the blind and sighted see navigation differently", in *Proceedings of the 16th International ACM SIGACCESS Conference on Computers & Accessibility*, ser. ASSETS '14, Rochester, New York, USA: Association for Computing Machinery, 2014, pp. 217–224, ISBN: 9781450327206. DOI: 10.1145/2661334.2661380. [Online]. Available: https://doi.org/10.1145/2661334.2661380.

[39] Z. Cattaneo, T. Vecchi, C. Cornoldi *et al.*, "Imagery and spatial processes in blindness and visual impairment", *Neuroscience & Biobehavioral Reviews*, vol. 32, no. 8, pp. 1346–1360, 2008, Special section: The European Work-

shop in Imagery and Cognition: Neurocognition and Visual Imagery, ISSN: 0149-7634. DOI: https://doi.org/10.1016/j.neubiorev.2008.05.002. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0149763408000638.

[40] M. Cziksentmihalyi, "Flow - the psychology of optimal experience", 1990. [Online]. Available: https://www.researchgate.net/publication/224927532_Flow_The_Psychology_of_Optimal_Experience.

[41] P. Vorderer, C. Klimmt and U. Ritterfeld, "Enjoyment: At the heart of media entertainment", *Communication theory*, vol. 14, no. 4, pp. 388–408, 2004. [Online]. Available: https://academic.oup.com/ct/article/14/4/388/4110468.

[42] F. Mäyrä and L. Ermi, "Fundamental components of the gameplay experience", *Digarec Series*, no. 6, pp. 88–115, 2011. [Online]. Available: https://publishup.uni-potsdam.de/frontdoor/index/index/docId/5046.

[43] B. Bostan and S. Öğüt, "Game challenges and difficulty levels: Lessons learned from rpgs", in *International simulation and gaming association conference*, 2009, pp. 1–11.

[44] J. Huizinga, *Homo Ludens, a study of the play element in culture*. The Beacon Press, 1955.

[45] D. Brown, "Games and the magic circle", in *Encyclopedia of Computer Graphics and Games*, N. Lee, Ed. Cham: Springer International Publishing, 2015, pp. 1–4, ISBN: 978-3-319-08234-9. DOI: 10.1007/978-3-319-08234-9_32-1. [Online]. Available: https://doi.org/10.1007/978-3-319-08234-9_32-1.

[46] A. I. Abdul Jabbar and P. Felicia, "Gameplay engagement and learning in game-based learning: A systematic review", *Review of educational research*, vol. 85, no. 4, pp. 740–779, 2015. [Online]. Available: https://journals.sagepub.com/doi/full/10.3102/0034654315577210.

[47] Interaction Design Foundation - IxDF, "What are wicked problems?", [Online]. Available: https://www.interaction-design.org/literature/topics/wicked-problems (visited on 10/02/2024).

[48] H. W. J. Rittel and M. M. Webber, "Dilemmas in a general theory of planning", *Policy Sciences*, vol. 4, no. 2, pp. 155–169, Jun. 1973, ISSN: 1573-0891. DOI: 10.1007/BF01405730. [Online]. Available: https://doi.org/10.1007/BF01405730.

[49] Interaction Design Foundation - IxDF, "What are wicked problems and how might we solve them?", [Online]. Available: https://www.interaction-design.org/literature/article/wicked-problems-5-steps-to-help-you-tackle-wicked-problems-by-combining-systems-thinking-with-agile-methodology (visited on 14/02/2024).

[50] opentext, *What is agile development?* [Online]. Available: https://www.opentext.com/what-is/agile-development (visited on 14/02/2024).

[51] ProAgile, *Vad är scrum?* [Online]. Available: https://proagile.se/larmer/vad-ar-scrum (visited on 14/02/2024).

[52] J. C. Jones, *Design methods*. John Wiley & Sons, 1992.

[53] iMindQ, *What is brainstorming and how is it helpful?* [Online]. Available: https://www.imindq.com/brainstorming/ (visited on 24/05/2024).

[54] Google, *Crazy 8's*, [Method], n.d. [Online]. Available: https://designsprintkit.withgoogle.com/methodology/phase3-sketch/crazy-8s (visited on 14/02/2024).
[55] GroupMap, *Six thinking hats*, [Method], n.d. [Online]. Available: https://www.groupmap.com/portfolio/six-thinking-hats (visited on 14/02/2024).
[56] GroupMap, *Swot analysis*, [Method], n.d. [Online]. Available: https://www.groupmap.com/portfolio/swot-analysis (visited on 14/02/2024).
[57] LucidSpark, *Dot voting*, [Method], n.d. [Online]. Available: https://www.groupmap.com/portfolio/swot-analysis (visited on 14/02/2024).
[58] Funretrospectives, *Plus minus voting*, [Method], n.d. [Online]. Available: https://www.funretrospectives.com/plus-minus-voting/ (visited on 14/02/2024).
[59] Interaction Design Foundation - IxDF, "What is paper prototyping?", [Online]. Available: https://www.interaction-design.org/literature/topics/paper-prototyping (visited on 11/02/2024).
[60] E. Stull, "User testing", in *UX Fundamentals for Non-UX Professionals: User Experience Principles for Managers, Writers, Designers, and Developers*. Berkeley, CA: Apress, 2018, pp. 311–317, ISBN: 978-1-4842-3811-0. DOI: 10.1007/978-1-4842-3811-0_43. [Online]. Available: https://doi.org/10.1007/978-1-4842-3811-0_43.
[61] A. Cooper, R. Reimann, D. Cronin and C. Noessel, *About Face: The Essentials of Interaction Design, Fourth Edition*. John Wiley & Sons, 2014.
[62] A. Drachen and A. Canossa, "Towards gameplay analysis via gameplay metrics", in *Proceedings of the 13th international MindTrek conference: Everyday life in the ubiquitous era*, 2009, pp. 202–209. [Online]. Available: https://dl.acm.org/doi/abs/10.1145/1621841.1621878.
[63] P. Lankoski and S. Björk, "Formal analysis of gameplay", in *Game research methods*, 2015, pp. 23–35. [Online]. Available: https://dl.acm.org/doi/abs/10.5555/2812774.2812779.
[64] O. De Troyer, "Towards effective serious games", in *2017 9th International Conference on Virtual Worlds and Games for Serious Applications (VS-Games)*, IEEE, 2017, pp. 284–289. [Online]. Available: https://ieeexplore.ieee.org/abstract/document/8056615.
[65] N. Pyrhönen, *Producing successful applied games*, Psyon Games, 2023.
[66] R. Swartz, "Mistakes as an important part of the learning process", *The High School Journal*, vol. 59, no. 6, pp. 246–257, 1976. [Online]. Available: https://www.jstor.org/stable/40365921.
[67] *Discord*, [Software], Discord. [Online]. Available: https://discord.com/.
[68] *Zoom*, [Software], Zoom Video Communications. [Online]. Available: https://zoom.us.
[69] *Google meet*, [Software], Google. [Online]. Available: https://meet.google.com/.
[70] *Slack*, [Software], Slack. [Online]. Available: https://slack.com/.
[71] *Google drive*, [Software], Google. [Online]. Available: https://www.google.com/drive/.
[72] *Dropbox*, [Software], Dropbox. [Online]. Available: https://www.dropbox.com/.

[73] *Github*, [Software], GitHub. [Online]. Available: https://github.com/.
[74] *Git*, [Software], Software Freedom Conservancy. [Online]. Available: https://git-scm.com/.
[75] *Google documents*, [Software], Google. [Online]. Available: https://www.google.com/docs/about/.
[76] *Microsoft word*, [Software], Microsoft. [Online]. Available: https://www.microsoft.com/sv-se/microsoft-365/word.
[77] *Overleaf*, [Software], Overleaf. [Online]. Available: https://www.overleaf.com/.
[78] *Unity*, [Software], Unity Technologies. [Online]. Available: https://unity.com/.
[79] *Unreal engine*, [Software], Epic Games. [Online]. Available: https://www.unrealengine.com/.
[80] *Godot*, [Software], Godot Fundation. [Online]. Available: https://godotengine.org/.
[81] S. Dahlborg, E. Ekroth, M. Grahn, G. Muñoz, H. Pettersson and P. Wei, "Painted peril: A roguelike game about unleashing the power of color magic", Chalmers University of Technology and University of Gothenburg, 2023.
[82] Paper Will, *A (blind-accessible) history of blind gaming*, [Online Video], 2021. [Online]. Available: https://www.youtube.com/watch?v=oKgN4va-gas.
[83] Inklestudios, *Ink*, [Plugin], Inklestudios, 2024. [Online]. Available: https://www.inklestudios.com/ink/.
[84] Masahiro Sakurai on Creating Games, *The majority shouldn't always rule [work ethic]*, [Online Video], 2023. [Online]. Available: https://youtu.be/dP94K69NSVc?si=5r4gXAI5iMo1jDn9.
[85] *Low vision and legal blindness terms and descriptions*, American Foundation for the Blind. [Online]. Available: https://www.afb.org/blindness-and-low-vision/eye-conditions/low-vision-and-legal-blindness-terms-and-descriptions (visited on 09/05/2024).
[86] Firaxis Games, *Sid meier's civilization vi*, [Game], 2K, 2016. [Online]. Available: https://civilization.2k.com/.
[87] Tiger and Squid, Team17 Digital Ltd, *Beyond eyes*, [Game], Team17 Digital Ltd, 2015. [Online]. Available: https://store.steampowered.com/app/356050/Beyond_Eyes/.
[88] FromSoftware Inc., *Elden ring*, [Game], FromSoftware Inc., Bandai Namco Entertainment, 2022. [Online]. Available: https://en.bandainamcoent.eu/elden-ring/elden-ring.
[89] Nintendo, *The legend of zelda: Breath of the wild*, [Game], Nintendo, 2017. [Online]. Available: https://zelda.nintendo.com/breath-of-the-wild/.
[90] Mobius Digital, *Outer wilds*, [Game], Annapurna Interactive, 2020. [Online]. Available: https://www.mobiusdigitalgames.com/outer-wilds.html.
[91] Ovani Sound, *Humble bundle: Audio odyssey – tier 3 – (32 packs)*, [Music Package], Ovani Sound, 2023. [Online]. Available: https://ovanisound.com/products/humble-bundle-tier-3.

[92] O. Troyer, A. Helalouch and C. Debruyne, "Towards computer-supported self-debriefing of a serious game against cyber bullying", Dec. 2016, pp. 374–384, ISBN: 978-3-319-50181-9. DOI: 10.1007/978-3-319-50182-6_34.

[93] M. R. M. Norman and A. Canossa, "Let the players go!", in *HCI International 2023 – Late Breaking Papers*, J. Y. C. Chen, G. Fragomeni and X. Fang, Eds., Cham: Springer Nature Switzerland, 2023, pp. 341–369, ISBN: 978-3-031-48050-8. [Online]. Available: https://link.springer.com/chapter/10.1007/978-3-031-48050-8_24.

[94] C. Linehan, B. Kirman, S. Lawson and G. Chan, "Practical, appropriate, empirically-validated guidelines for designing educational games", in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ser. CHI '11, , Vancouver, BC, Canada, Association for Computing Machinery, 2011, pp. 1979–1988, ISBN: 9781450302289. DOI: 10.1145/1978942.1979229. [Online]. Available: https://doi.org/10.1145/1978942.1979229.

[95] K. S. Tekinbas and E. Zimmerman, *Rules of play: Game design fundamentals*. MIT press, 2003.

[96] C. C. Seepersad, K. Pedersen, J. Emblemsvåg, R. Bailey, J. K. Allen and F. Mistree, "The validation square: How does one verify and validate a design method", *Decision making in engineering design*, pp. 303–314, 2006. [Online]. Available: https://web.archive.org/web/20110401131755id_/http://www.me.utexas.edu/~ppmdlab/files/ccs.valid.square.Jan05.pdf.

[97] J. Posetti and A. Matthews, "A short guide to the history of 'fake news' and disinformation", *International Center for Journalists*, vol. 7, no. 2018, pp. 2018–07, 2018. [Online]. Available: https://www.icfj.org/sites/default/files/2018-07/A%20Short%20Guide%20to%20History%20of%20Fake%20News%20and%20Disinformation_ICFJ%20Final.pdf.

A

Appendix 1

Figure A.1: Definition of games and applied games by Psyon games. Image was provided to us through direct communication. Image was created by Niko Pyrhönen from Psyon games [31]

.

B

Appendix 2

Figure B.1: A short summary of guidelines for creating a successful applied game by Psyon Games. Image was provided to us through direct communication. Image was created by Niko Pyrhönen from Psyon games. [65]

.

C

Appendix 3

This appendix includes a summary of the final two evaluative interviews. Note that the summary is not a 1:1 transcription of the interviews, some answers are compressed. Names and personal information have been removed and both the questions and the answers have been translated from English to Swedish.

Evaluation Interview Summary

This document contains the summary of the two evaluative interviews conducted. The documents only contain the notes taken about the answers in the interviews, and it should not be considered a 1:1 transcription of the interviews themselves. Some answers are also compressed. Names and personal information have been removed. Both the questions and answers have also been translated from Swedish to English. The two interviews were conducted separately on two different occasions.

The facilitator started the interviews by showing the final game to the participants. A screenshare was shown and the gameplay was also described during the showcase, as the participants were visually impaired.

Question 1: What do you think about the player's view in the game? Is it reasonable to represent someone that is visually impaired?

Answer:
The distance that the player can see seems reasonable. It looks pretty good, it is good that the game also has smell and not only sound. It is good that things disappear relatively fast when moving away from them, that seems reasonable. It is good that the player doesn't have many footsteps.

Answer from later in the same interview, but it is regarding visual mask:
One thing that could be improved is that even if the player has a limited view distance. The things within the player's view are very clear. This is usually not the case, however it might be true for some people. Generally visually impaired people have bad vision of things they can see.

Answer:
I think it seems reasonable, it does however depend on what type of visual impairment you have. It is reasonable that you can see larger buildings from a distance. When I am walking outside I can miss small objects that are really close to me, but I can detect trees and buildings because of their size.

Question 2: *Is it representative to need to compare your own experience of an unknown object with the external description to try and determine what the object can be?*

Answer:
Yes that can be the case. It is something that occurs in reality. The descriptions you had in the game were also pretty good. However, some details felt as they were missing in the descriptions from Fabian (the main character).

Answer:
Yes, you need to have something to compare with when you investigate something. It is good to have that feeling. From what I can hear it seems logical and fits what I think and what I would have done.

Question 3: *Are these descriptions representative of what you would detect if you found an unknown object?*

Example 1:
Hmm, this feels… a little rubbery. Or maybe spongey?
There are multiple of them, and they are all small and thin.
At the end there is a hat? It seems to be some kind of mushroom.
And it smells.. more than edible. It smells delicious!

Answer:
I think that you could describe the shape a bit more. You are describing the consistency but not the shape. You can also describe if it has different textures and for example if the play grows from the ground could be interesting.

It is also important to note that for some people, if they feel something unpleasant they don't want to investigate and touch it more. That can affect how much information they can get from feeling the object.

Answer:
I guess it is a mushroom? Yes you can describe it like that.

Exempel 2:
Hmm, this feels… wet!
It seems to be shaped like a spiral.
But it is not hard like a shell. It's soft and flexible, and I can stretch it out.
A few of them have been tangled together.
And I can hear… the rushing waters.

Answer:
The description does not say that much. You could for example describe where it is growing, if I remember correctly it grows in the water. You can feel not only that the plant is wet, but you can also feel that it is growing in the water. The description could be more detailed.

Answer:
Good description because I could start to identify myself with it. It feels as this is how you would describe it and how I would describe it in day to day life.

Follow up question was asked regarding if the word spiral is commonly used:
I have my own perception of what a spiral is, and I think it fits this description.

Question 4: *Is it reasonable that external descriptions of objects describe things such as what the object looks like for you?*

Answer:
Yes, that is reasonable. Generally things are described with the perspective of someone that can see. That the description includes the look is a part of the experience.

Answer:

Yes.

Question 5: *What do you think about the sound of the players footsteps? Is it representative to use the sound of footsteps for navigation?*

Answer:
Yes, it is very representative and reasonable. There definitely exists people who use that. Feeling the ground is important, but people do absolutely use the sound as well.

Answer:
Yes, I hear the sounds of my footsteps and feel the material under my feet. Because this is a videogame it might be reasonable to use the sound primarily. You can use the material to know where you are.

Question 6: *Is navigation through the other sound effects representative? Right now you can detect what region you are in depending on the background music, is this something that would make the game less representative?*

Answer:
Yes, these are absolutely things that can be used for navigation. One thing that you could add is the sound of different quest givers. The different NPCs should be detectable by sound.

The use of the background music is not a problem. You do not have background music in real life but depending on where you are in a city you can have different sound images. The background sound would for example be different in a shopping mall and an industrial zone. The music could be a representation of that.

Answer:
Yes, that is similar to when you are outside. There are a lot of sounds, and they can help you know where you are. If you are walking in the forest you can hear the sounds that you and animals are making. You can also hear the forest rustling.

Question 7: *Is it representative to explore unknown areas by yourself? What is your opinion about this game presenting visually impaired people that explore areas by themselves?*

Answer:
Hard question… Of course it happens but it differs between individuals, differs in their confidence and the like. Maybe you would want to be able to ask which way to go, perhaps ask the quest givers about the way as it occurs in a limited area. Perhaps people have different strategies.

We described that playtesting showed that people often follow paths, roads. People also follow edges; for example the forest and water.
It sounds like the experience matches pretty well, interesting.

Answer:
Yeah, that would be how I would do it if I was in the forest and exploring, you feel yourself forward and such. In real life you choose yourself when you want to explore and are the one doing it.

Question 8: *Is the smell system representative of people with visual impairment? Is it representative to note things that are close by through smell?*

Answer:
That's tricky, it depends on where you are and if it's windy it's harder. But you can localize it if you get closer. Smell is indeed something you actually use.
Is that black particles for trash and blue for plants?

Answer:
Yeah that is something you use, almost so that you are over sensitive to some smells. Wonder where it's coming from, but it is not that often it is used to navigate. If you recognise the smell you could perhaps use it, but it is not that common.

Can you suspect the direction from a strong smell?
Yes, you can follow it, if it becomes stronger it means you're on the right track and if it becomes weaker you're walking in the wrong direction. Depending on what it is you might suspect if it's flowers, trees or a chanterelle forest. I think i'm pretty good at telling if chanterelle is close by or not.

Question 9: *We received feedback that the main character was too stereotypical as a bat and so we changed it to a human, was this a reasonable change in your opinion?*

Answer:
That sounds wise and I think it sounds good. Bats and moles are absolutely the stereotype of being blind. It is better and resonates better with reality to change it to a human.

Answer:
The character itself shouldn't matter, either way a human or an animal can be visually impaired and the main point is to get the experience of being visually impaired. But for some that might be sensitive.

Question 10: *We have discussed representations for NPCs. When you are supposed to meet someone, say in the city how do you identify that person?*

Answer:
Most often identifies people through phone calls, or large gestures. It also depends on how many people are there. If it is in a big crowd it can be very hard to identify someone through sight. If there are specific markers, such as an orange reflective vest it can become easier to identify people.

Answer:
It is usually through voice. If you are in school and not supposed to meet someone special you can usually say something to get a reaction and know if someone is there. It is common

that people forget that you don't see and then you might need to shout out yourself. Sometimes it is enough with their sounds though like breathing or something else.

Question 11: *What is your opinion on this quest?*

Fabian being pulled away: A child grabs hold of Fabian and walks away somewhere. The idea is that you end up somewhere you might not recognise straight away

Answer:
I thought it was really good. It was spot on and a bit humorous at the same time, which also mirrors reality. The quest also marks that it is not okay. What I'm reflecting on is that it would have been nice to use the reflection system to reflect the quests themselves.

Potentially we would want Fabian to be pulled away multiple times and that Fabian becomes increasingly irritated about it.

I'm a bit unsure if that might be a bit too much, at least if it's the same NPC every time. Perhaps it could be different NPCs each time?. Maybe you don't need to ramp it up all the time, I think it's nicely done as it is currently.

Perhaps you could bring up other things as well, such as people pulling you on the subway. You get help you don't want, Forced help.
Perhaps you could also portray the opposite and have situations where Fabian needs to ask for help as well. It could create more balance and also mirror situations in reality.

Answer:
What is described is precisely something that could happen in everyday life and is not uncommon. It is often that you might feel yourself forward and it is common that someone then just pulls you away with them. And if you are put in a new environment it can be scary especially if there are no people around. There is also the risk of stumbling while you are being pulled away which creates a lot of stress.

Question 12: *Overall, what things in this game do you think make up the best and worst representation of visually impaired people and how you rate the game as a whole?*
.
Answer:
The best thing is the game as a whole in how it includes several parts and perspectives. You have for example managed to get in smell, sounds and restriction of things. It is great how things disappear as you move away from them.

A challenge is that inside the radius of the mask your vision is incredible. This is not fully representative, it can be correct for some but generally even inside this radius your vision is bad.

Answer from another part of the same interview, but regarding the game as a whole and future potential improvements:

This thing when the players themselves reflected and wrote, it would have been cool if we already could show answers from people with visual impairment who answered the same question.

Another reflection is that it feels like the game would be a pretty interesting game you could use in education for younger people. Perhaps you could show the The National Agency for Special Needs Education and Schools, SPSM [1].

Overall great game, it looks good.

Answer:
From what you have told me it sounds like it's on a good path.
You could add that if you stumble and fall and get hurt if you're not careful. Maybe you stumble into a hole. What you have presented is the most relevant and what I have taken part of seems good. There are always things you could do better but it mirrors how I feel when I am thinking from my own perspective. For example all the sounds in the forest you need to have to understand how to orient yourself. In reality it's perhaps not music bit there are a lot of other sounds in the forest. I do however not know how a seeing person would experience the game, as I can't see myself. Are you more cautious or adventurous? I am personally very adventurous of myself when I'm out but there are people who are more careful. It would be fun to have a personality on the main character.

What I have taken part of today is reasonable and I think it works for representing people with visual impairment, But it is also very individual how you experience your own visual impairment.

I get a feelgood feeling in my stomach of the world you have painted up.

[1] SPSM: Our task is to ensure that children, young people and adults – regardless of functional ability – have adequate conditions to fulfil their educational goals. This is done through special needs support, education in special needs schools, accessible teaching materials and government funding.

D

Appendix 4

This appendix includes the final version of the game design document. This documents primary purpose was to be able to give some insight into the design of the game for external actors. The game design document focused more on the goals and purposes of the game than the details of the gameplay mechanics, the primary reason for this was that the gameplay mechanics changed a lot and quickly during the development process.

Game Design Document

In this game you play as Fabian the witch. He is a visually impaired witch who has just moved to his new home in Moonlight springs. As a witch a lot of the inhabitants of Moonlight springs come to him in hopes that he can provide them with magical potions that help them with their issues. To be able to craft these potions Fabian needs to explore the world to find the required ingredients, a task that can be challenging even for people with perfect vision. The core mechanics of the game are exploration and discovery while having limited vision.

Characterizing Goal

The characterizing goal of the game is to promote awareness about how it feels to live as someone who is visually impaired. The game focuses specifically on the representation of how it is to live as someone who is visually impaired, which includes normal day to day situations. This means that the game does not focus on giving an accurate visual simulation, but rather to focus on the experiences. That being said, some level of simulation of how it feels to be visually impaired is important.

The core message of the game is that visually impaired people might interpret the world around them differently to fully seeing people, but that they often handle themself better than what many sighted people think.

Inspiration and Previous Work

Inspiration for the gameplay design includes:

- *Lost and Hound*
- *Outer Wilds*
- *Beyond Eyes*
- *Stardew Valley*
- *Chants of Sennaar*

Inspiration for graphic design includes:

- *Stardew Valley*
- *Pokémon*
- *Minecraft*
- *Animal crossing*
- *Painted Peril*

Target Audience

The target audience for this game are people who are not visually impaired and usually play games. The game aims to be a game that the audience picks up for entertainment purposes, but then uses that space for also achieving its characterizing goal. Therefore, entertainment is also one of the game's goals. The game is aimed towards pre-teens and older.

Our target audience is defined by people who enjoy slower paced exploration games where dialogue and narrative are important factors. We also define our target audience as players who enjoy investigating and analyzing game elements such as reading item descriptions. We also define our target audience as players who enjoy cozy games and value the audiovisual aesthetics of the game.

General Mechanics

The game's core mechanics are based around exploration with a heavily restricted field of view.

Game World Mechanics:

- The world is divided into different regions, each having their own game mechanics.
- The game has a day cycle that progresses by itself. This day cycle can influence events in different regions. At night it will be dark, making it harder for Fabian to use his already limited sight. Fabian needs to go home to end the day.
- The game has quests that can be completed over several days. These quests can for example unlock new regions or areas. The quests' purposes are to give the player an incentive of interacting and using the other mechanics of the game, as well as letting the player experience common situations that visually impaired people might face.

Character Mechanics

- The player has a heavily restricted field of view, only allowing them to see things that are really close to Fabian.
- The player can hear what material that they are walking on, this is especially useful when moving in areas where the player has an even more limited sight.
- The player can hear different sounds in the world around them as for example running water or sounds from non-player characters.
- The player has a sense of smell that shows particles around the player when specific objects or ingredients are close by. The sense of smell does not tell the player in what direction the object is, but it can notify the player that it is nearby from some distance.
- When finding ingredients or objects in the world the player can’t see exactly what it is but they will get an instruction of what Fabian can for example feel or taste. The player can then choose their visual representation of the object themselves.

Game Regions:

The world is divided into several different regions. Each area has different quests, aesthetical style, layouts and game mechanics. The main goal with the design of the world is to encourage the player to explore through curiosity, therefore the world needs to feel diverse and interesting. As this project is currently specifically a master thesis project with limited time for development it is unlikely that all regions will be implemented, and of the implemented regions they might only be partially implemented.

Forest Meadow
This is the starting region of the game. The main focus of this region is to introduce the core concepts and mechanics of the game to the player. Therefore this region is divided into a few different areas that will be unlocked by completing simple quests that also teaches the player the core game loop. One of the unlockable areas will have fog that makes it even more difficult to rely on sight, allowing the player to further train on using their other senses for exploration.

Critterton
This is an urban region that changes throughout the in-game day. This introduces a time based property of the game that the player needs to manage. This area will also overload the player with sound effects, impacting how the player can use hearing when exploring the game. Critterton also includes the Amphibian Theatre

Bear River
This region is more narrative focused, requiring the player to solve the feud between the bear and beaver tavern.

Forest Ruins
This is a final region of the game which will be unlocked late in the game. The area will have a part where the player's vision is heavily obscured by fog, requiring the player to navigate almost completely using their other senses.

Bon-Bon Fields
This region will have strong wind spirits that move throughout parts of the region. This requires the player to pay attention to incoming sounds of winds so they are not relocated by the winds. This region might also be more open and have less points of references, making it harder for someone who is visually impaired to navigate.

Mushroom Forest
This area will overload the player's sense of smell.

Core Game Loop

1. The player finds a NPC that gives them a quest. This quest is made up of several quest steps, each quest step requires the player to do a specific task. A common task is to deliver a potion to someone.
2. The player can find a recipe of the potion and descriptions of the ingredients that are required and a rough explanation of where they can be found in their brewing book menu..
3. The player explores and traverses the world to find the specified ingredients.
4. The player finds ingredients and can try to guess what they are by comparing the description of what Fabian senses with the description in the brewing book menu.
5. The player then needs to navigate back to Fabians house to brew the potion by guessing what ingredients are correct and adding them to a cauldron.
6. The player might need to finish other quest steps such as finding items or talking to NPCs to be able to finish the whole quest.
7. When a quest is finished other quests might become available, NPC dialogue might change, and areas in the world can be unlocked.

Theme and Player Experience

As previously stated the core experience of the game is to make the player understand how it feels to live as someone who is visually impaired. This is achieved through challenging the player to rely on more senses than just sight as well as having a narrative theme, through character dialogues and quests, that focuses on common experiences that visually impaired people have.

This core theme is also supported by the focus on exploration. Exploring a new area is something that can be especially challenging and daunting for people with visual impairments, however after learning the layout of an area they can often navigate it with ease. This is one of the core experiences that we want to provide to the player.

The game does not focus on combat and it has a style that is friendly and almost a bit childish. This choice of style is chosen to reduce the risk of the game feeling like a horror game. Turning a game about visual impairment into a horror game is not uncommon and is something visually impaired people take issue with, and thus something to avoid.