# The game design
of a serious game about food waste
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Abstract

Food waste is a large environmental problem. Research has shown that throughout the whole food chain, most food is wasted in households. Current research to food waste in household uses surveys or digging through garbage bins. Since these methods each have their problems, alternative methods to collect data were researched. This research focusses on using a serious game to collect data for food waste research. A serious game is a game that has been created for another purpose than entertainment, it has the purpose to give the player some interesting content to think about. Particularly, this research report focusses on the design of a serious game with the goal of collecting data concerning food waste with the target audience consisting of people who are responsible for the entire food cycle within a household.

A serious game was created in which the player has to take care of a king, while the player is responsible for the entire food chain of the king. The player has to seek a balance between serving the king while not producing too much food waste. The serious game was play tested multiple times in order to research the potential of collecting realistic data from the game. It was found that the window in which realistic data can be collected is short, but that it is indeed possible to nudge players into realistic behavior using a serious game.

Acknowledgement

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Chapter 1 – introduction

The department Food and Biobased Research at the Wageningen University performs a lot of research about food waste. It was discovered that throughout the entire food chain, most food gets wasted in households. For further research, more precise information is needed on what foods are wasted the most and which factors people consider in wasting food. Current research methods include conducting surveys and digging through garbage bins. The results of surveys have been lacking in accuracy, since people tend to give more socially desired answers, rather than accurately describing their behavior. The downside to digging through garbage bins is that only the result can be observed. No information regarding the reasons for wasting and when the food has been wasted can be discovered using this method. To solve this issue, Wageningen University has contacted students of the University of Twente to develop a serious game that helps collecting data concerning consumer's behavior regarding food waste. Therefore, the main question becomes; how can a serious game collect data concerning food waste behavior? The process of making this game will be described in this paper.

The clients from the Wageningen University are Anke Janssen, Rene de Wijk and Hilke Bos-Brouwers. From now on they will be referred to as the client. In the first meeting with the client, it became clear that this game has two goals. The primary goal is to gather data about food waste behavior. The secondary goal is to change people's behavior such that they waste less food.

For the primary goal it is important that the gathered data closely resembles people's real-life behavior. Therefore, the game needs to be realistic, which means that the player should be able to perform the same actions as in real life.

It is important to keep in mind however, that at some point in the game, players are likely to realize how to play the game optimally. When this happens, there is a risk of newly collected data no longer being an accurate representation of the player's real-life behavior. It is hoped however, that the in-game behavior change is transferred to the real world, thereby achieving the secondary goal.

The target audience for this game are people who are responsible for the food in a household. This means that they do the groceries, store food, prepare food and throw away food. The client is looking to target people who go shopping only once or twice a week, because daily shopping requires somewhat less coordination and it makes it more difficult to balance the purchasing, storing and preparing, which usually causes to have more food waste. These actions are all aspects of the food cycle in which food can be wasted. Each of these steps will be included in the game, with the goal of measuring how much food is wasted in each step, what foods are wasted most, and for what reasons.

Making a game consists of several tasks; design, art, programming and sound. Design entails the broad view of the game, like what the gameplay should be like, and what the rules of the game are. This part will be done by both students. The game design will be done by Camille, while the game development will be done by Christiaan. For this reason, each student will answer different sub questions.

When a player plays the game, they have an experience. The experience in this game should provoke actions, that are desirable for collecting realistic data. For this, two aspects of game design should be taken into consideration. First, it is important to look at the implementation of real life situations of food waste. This will be used to invent the gameplay and rules of the game. The players' actions have to be realistic, thus the situations created have to be similar to situations in real life.

Second, the looks of a game define how a player feels about the game. The aesthetics influence the actions in the game. Since, the actions have to be realistic, it should be considered carefully how the game looks and feels like. It is important that the looks of the game enhance the goal. Looking from the perspective of game design, the research question

becomes: what should the game look and feel like to accomplish the goal of collecting realistic data?

However, the target audience eventually determines which look they like the most. Thus, it should be tested if the aesthetics of the game suit the target audience. It is also important to test if the general design and gameplay reinforce the player experience and the desired behavior. This will be done in collaboration with Christiaan Verloop since he is coding the game.

Chapter 2 – state of the art on serious games about food waste

Food waste in general

Before the project starts, it is important to have a good understanding of food waste and what the biggest issues are. Many sources state that about 30% of the produced food is wasted globally (Reutter, Lant, Reynolds & Lane, 2016; Mattsson, Williams & Berghel, 2017; Food and Agriculture Organization of the United States (FAO), 2011 and 2013; Gustavsson, Cederberg, Sonesson, van Otterdijk & Meybeck, 2011). Food production is one of the biggest source that causes environmental damage (Reutter et al., 2016). Notarnicola et al. (2012) and Roy et al. (2012) both state that 50% of environmental impacts is caused by food production. Not only does food production and waste lead to environmental problems, it also globally affects the economic costs and the social and moral implications (Mattsson, Williams & Berghel, 2017). The simplified food supply chain has four segments, which Bellemare, Çakir, Hanawa Peterson, Novak and Rudi (2017) define as growers, processors, retailers and consumers. Stenmarck, Jensen, Quested & Moates (2016) recognize the same segments, but have added one. In their research the segments of the food supply chain are called primary production, processing, wholesale and logistics combined with retail and markets, food service, and household. Their research shows that most food is wasted in the sectors household and processing. The client is interested in the production of food waste in households.

Food waste in households

Food waste appears at many different, but related, routines of life, like shopping, storing, cooking and eating (Hebrok & Boks, 2017). Additionally, people are not aware of all the factors behind food choice and the food they waste (Quested, Marsh, Stunell & Parry, 2013b). The size of a household and the life phases considerably influence the behavior around food and how much is wasted (Hebrok & Boks, 2017). Hebrok and Boks (2017) identify planning as an important factor in food waste. The client confirmed this in one of the meetings by stating that with a perfect planning there will be no waste. Quested et al. (2013b) observe that food waste generation should be viewed as the result of numerous behaviors rather than just one. These behaviors are connected to different phases of the food's cycle in and around the house: shopping, storage, preparation and consumption of food. The client has created a graph, which shows the cycle and is depicted in Figure 1.
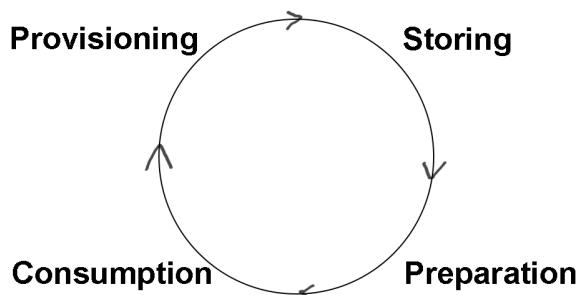
Figure 1: the food cycle in household, Rene de Wijk, WUR

Research has been performed on the food cycle and statistics have been gathered about how much food is bought and how much food is wasted. However, these are only the numbers and that does not tell anything about the reasons behind it. The existing knowledge on food waste excludes the question: why do people waste food? Sometimes it seems necessary, however, it is possible to not waste anything. Nevertheless, the answer is incomplete and more information on this subject is what the client tries to draw from the data that this project is going to collect.

Current ways of gathering data on food waste

There are many methods of collecting data about food waste. Food waste diaries, interviews and case studies are a few examples. However, many of these methods are either expensive, take a lot of time or they are privacy intrusive. There are some methods that are more accessible and two of them are discussed at the Food and Biobased Research Department. One of the methods is digging through garbage bins. This approach provides information on what foods are wasted and how much of it is wasted. Although this gives accurate numbers, it shows only the end result of the food waste chain. Using this method, does not give knowledge of the phase this food was wasted and why.

The other method used is conducting surveys to ask people what foods they throw away, how much and why. These surveys include which packages of food are bought in a supermarket and at what phase of the food cycle the food has been thrown away. This method provides broader information on food waste. However, there is a tendency to fill in a socially accepted answer, instead of the truth. Another downside to conducting a survey is that people are prone to forget things quickly, especially the small things. Therefore, the answers they give will be incomplete or not accurate enough.

In order to solve these problems, the client has asked for a serious game. To understand the possibilities and challenges of making a serious game for collecting data, it should be looked at what is currently out there in this field. First it is defined what a serious game is and then, current applications are described.

What is a serious game?

There are a couple of words that are similar, but do not mean the same and get mixed up a lot. These words are game, gamification and serious game. A game is made for entertainment and has a certain gameplay, where the player can interact with the game and have fun. Gamification is a way of making something fun. Rehabilitation games, for example, is a gamified way of rehabilitating. Something that used to be a chore is turned into something enjoyable. A serious game is created for another purpose than entertainment. It still has the feel of a game. However, it has a purpose of giving the player some interesting content to think about (Growth Engineering, 2018).

The project

The client asked for an application with three requirements. It has to be a game (1), it has to collect data (2), and it has to be about food waste (3). A search has been conducted to find applications that fulfill at least two of these requirements.

Games that collect data

There are several examples of games that collect user data for scientific research. However, these are not about food waste. Examples of these games are:

Hooked

Hooked is a game that studies music properties. It does so by letting players listen to a music fragment. If they know the song, the user indicates this in the game. The music will then play again and stop after a few seconds. The player is asked to continue the song in

their head. A few seconds later, the music starts playing again and the player is asked whether the music continued at the right time or not. If the player answered correctly, they get points. Multiple correct answers in a row grant bonus points. The collected data is used to learn and understand what makes a song catchy.

Games for patients with Niemann-Pick Disease
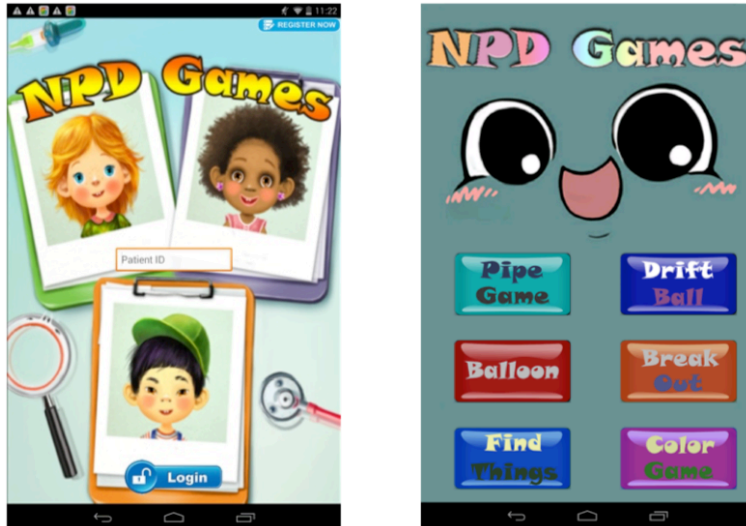
Figure 2: NPD games

NPD games is a platform which hosts 6 different games for NPD patients. The games are relatively trivial for healthy people but challenging for people with this disease. Doctors of these patients can use the collected data by these games to evaluate the patient's ability and any change thereof (Sinnot, Han, Hu, Ma, & Yu, 2015).

Alien rescue

(a) Alien Database (b) Solar System Database

(c) Probe Design Center (d) Comunication Center
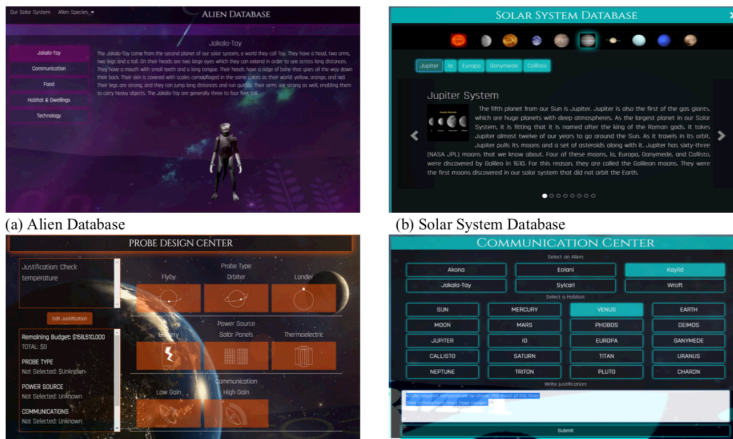
Figure 3: Alien Rescue

Alien rescue is a serious game that teaches people to think in a scientific way. Additional research expands on this game by collecting data about people's behavior in this game to see what people learn by playing this game (Kang, Liu, & Qu, 2017).

Games about food waste

There are a few games with the topic of food waste. These mostly test your knowledge, often to create awareness, but they are not known to collect data about user choices.

Food savers

Figure 4: Food savers

Food savers is a game developed by the project Food Waste Effect. The game is a board game for up to four players where you can roll the dice if you answer the questions correctly. The first player to reach the end wins the game. The type of questions asked in this game are about food products, processes, traditions, food poverty and food waste (Erasmus+, 2018).

Zero Waste

Figure 5: The Zero Waste Game

Zero waste is a single player game developed by a website called kids science challenge. This game takes place in a very dirty city. The city consists of 10 areas each with a question related to waste or recycling. Every correct answer makes that area of the city cleaner. The goal is to get as many questions correct as you can (Kidsciencechallenge.com, 2018).

Systems that collect data about food waste

There are also some systems that collect user data about food waste that are not in a game format.

Cogzum

Figure 6: CogZum

Cogzum is an iOS app developed in Bulgaria that helps you manage your shopping and cooking by making it easy for you to get an overview of the things you have and need as well as information on how long certain foods can be stored. This app is not a game, but it is relevant to the topic of food waste. The collected data is turned into an overview for the user and it will be processed for analytics (Dimitrov, 2018).

Food battle

Figure 7: Food battle

Food battle is a site that challenges people to waste less food. When you sign up for this challenge, you keep a diary about what food you wasted and how much. You can 'battle' with other people and compare your results. The challenge has a gamification aspect to it, but it cannot be called a game. The site collects data such that results can be compared, and an overview can be created on how much food waste has been prevented (Foodbattle.nl, 2018).

Food Fight

Figure 8: Food Fight

The Food Fight is a gamified system developed as part of a student's thesis. People can sign up to battle each other. Members can trade food waste for compost. The more food waste you collect, the more points you get. Data is collected about the amount of food you bring, how often you visit, and how much you volunteer. This is being combined into an overview for all players to see how well they are doing (Chun, 2015).

Novelty of this project

The goal in this chapter was to find applications that fulfilled the three requirements of the client; it has to be a game (1), it has to collect data (2), and it has to be about food waste (3). While the search yielded several results that met two of the three requirements there were none that met all three requirements. Therefore, this project can be called novel and is in interesting combination of elements in the research field of food waste.

Game design

In this case, the game design will focus on two things: (1) implementing real life situations to create realistic actions, and (2) designing the art and sound of the game to enhance the goal of the game and that it suits the target audience.

The realistic actions are important to collect the desired data. Above, some examples of games that collect data are described. These games were made to collect data for scientific goals. This will be done as well in this game. However, it can be argued to what extent these examples are fun to play and to what extent they can be called games.

Simulations

There are games that simulate real life actions, while still being fun to play. One of the most famous games in that category is The Sims.

The Sims

Figure 9: The Sims

In the game The Sims the player gets to create your own sims, which are people in the game, and they have to build a house for them. When that is done, the player can play the lives of the sims. The player needs to decide their careers, their friends, their relationships, and a lot more. This game is a simulation of life. However, now the player has the complete freedom to design your sims and your house. In this simulation game, being creative is the most fun and it is a place where the player has full power over the lives of the sims (Electronic Arts, 2018).

Rollercoaster Tycoon

Figure 10: Rollercoaster Tycoon

In the game Rollercoaster Tycoon, the player is the boss of a theme park. They have to decide which attractions they want to place, how many employees have to be in the park and how expensive rides will be. Basically, the player has to run the theme park. Although simplified, this is a simulation of a real-life situation. In this game, it is easy to see how well the player is doing and the more visitors are visiting, the more money is earned and the more possibilities there are to improve the theme park. The fun lies in the creation of your own theme park (RCTO Productions LLC, 2018).

Alter ego

Figure 11: Alter Ego

      The game alter ego is built in 1986 and the player gets to experience a whole life. It starts from birth, and by answering questions the player grows older and a personality is created. The vision for this game was to tell the story of an "ordinary" American. Therefore, it is a simulation of a real-life situation. However, the game is played by reading what is happening and answering questions on how to react on the situation. Because of this, the game lacks elements of fun and surprise (Favaro, 1986).

Aesthetics

      The aesthetics of games has a broad field of differences and in this case, it will be looked at from two views. For one, it is important in this game that the aesthetics provoke the desired actions of the player, which are go shopping, storing food, preparing food and serving food. Therefore, some games have been found that involve food.

NOUR - experimental food art game

Figure 12: NOUR

NOUR does not have a goal or an objective, but the player can play with the food on the screen. The food can be played with in a way that in real life parents would say 'don't play with your food'. The game can be played with a MIDI fighter 3D by DJTechTools, which makes the game more interactive. The aesthetics are in 3D and the images are clean and compelling. Some surrealistic things can happen, however, this is not greatly noticeable, because the aesthetics are satisfying to look at (Hughes, 2018).

Cooking Chef Food Game

Figure 13: Cooking Chef Food Game

In this game the player is the owner of a couple of restaurants. He has to prepare food for his clients and collect money in order to improve the restaurants and to upgrade the cooking tools. The overall look of the game does not look appealing and the gameplay is

fairly simple. The challenge in this game is to prepare and serve the food on time. In order to inform the player about the time, a timer for the food in the pan is shown. However, in general the game does not look compelling to play (YouTube, 2016).

Supermarket shopping

Figure 14: Supermarket Shopping

In this game the player has to gather the food that the girl wants. This happens in a couple of stores. The game itself is not challenging, because there is no limit on how many times the player gets to try to pick the right food. The looks of the game are quite simplistic, but effective, because it is easy to see what the products are. However, some parts of the aesthetics are not appealing and the game itself is quite boring to play (MaFa.Com, 2014).
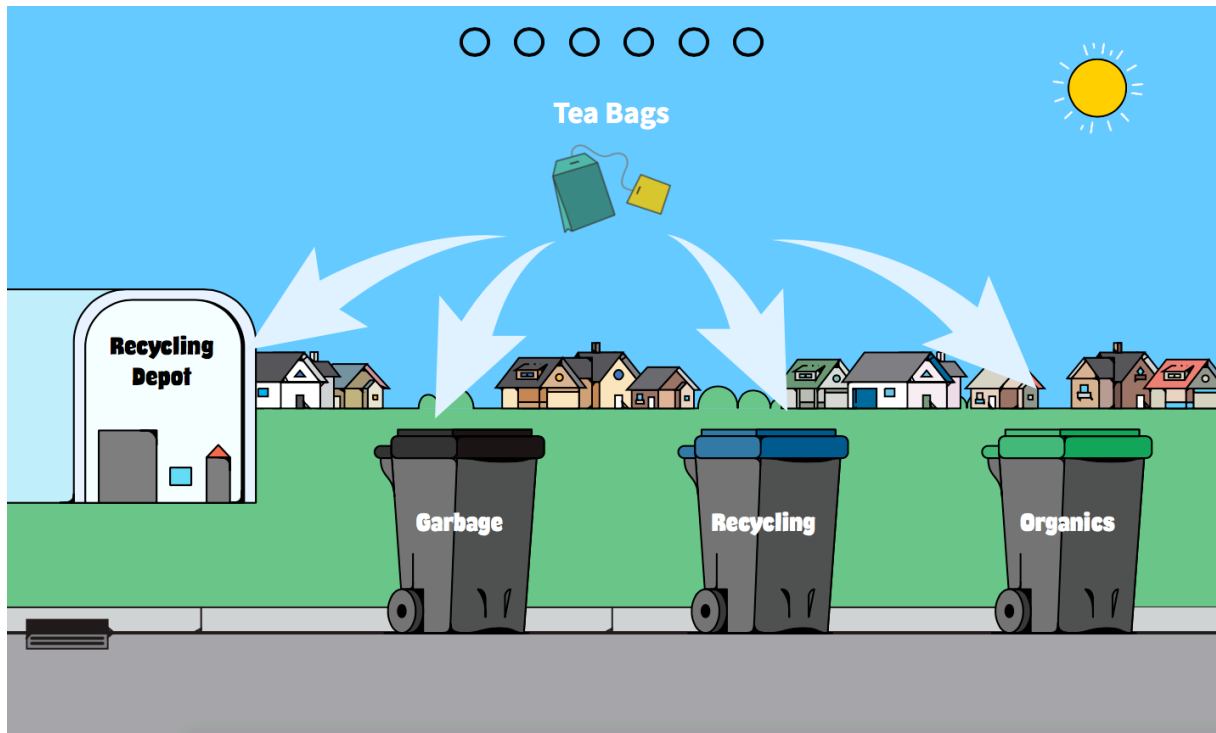
Figure 15: Rethink Waste

Rethink waste is a game about waste, including food waste, where you have to drag the waste into the right garbage bin. If all done right, the player can upgrade the park (visible behind the garbage bins) with objects, some quite weird, but all fun. The aesthetics is simple, but effective. It is immediately clear what to do and the simplicity gives the objects in the park more fun. However, the game is not difficult to play (Surrey.recycle.game, 2018).

Games for the target audience

Another view on aesthetics for the food waste game is that it has to fit the target audience, which are adults. Many games that have the title 'for adults' are called that way because of the amount of violence and the amount of nudity. But there are some examples, that do not involve a lot of violence or nudity.

Machinarium
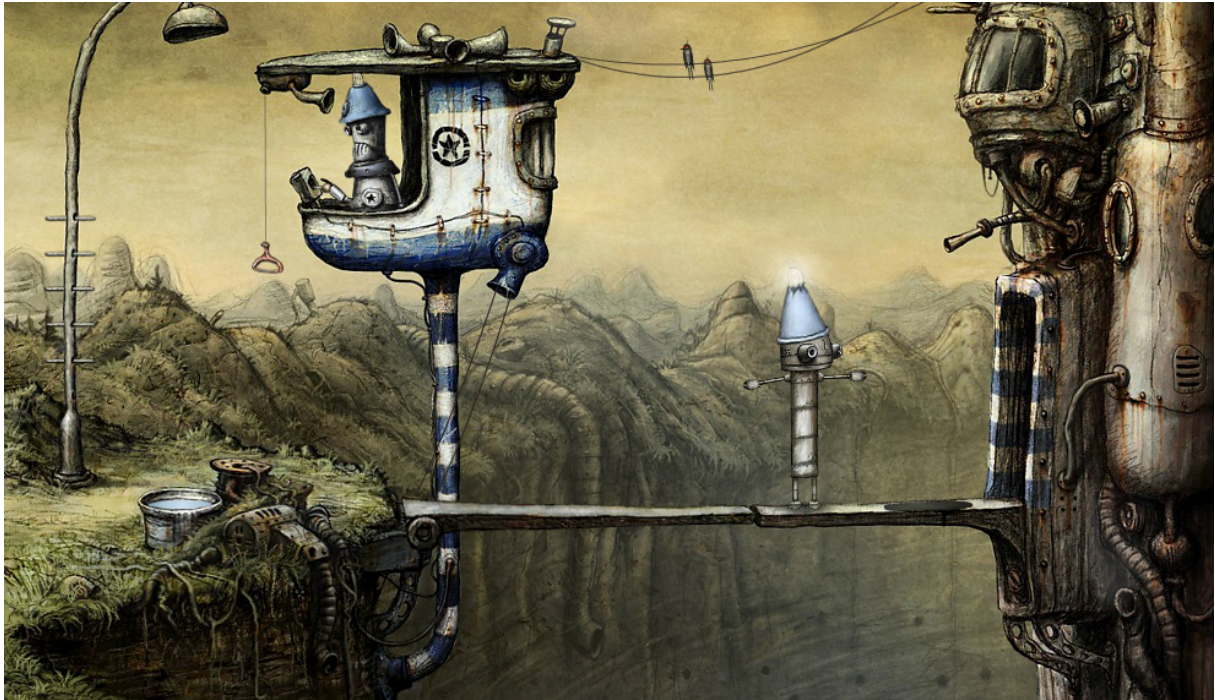
Figure 16: Machinarium

This is a puzzle-solving game for adults. You play a robot and you have to solve small puzzles in the game to reach a certain goal. The aesthetics are beautiful and fit the theme of robots. There are animations in this game that enhance the playful character of the main robot. Overall the game is very compelling, and it is a style that adults can appreciate (Amanita Design, 2009).

Mini Ninjas

Figure 17: Mini Ninjas

In this game the player is a ninja in training who has to find the missing ninjas. There is a story that unfolds in the game and the graphics have a lot of detail. The game is made in 3D and the player can move freely. The story takes place in a setting that many people have imagined and therefore, it is fun to experience it. In general, the game looks appealing to play and the story is the element that keeps the adults engaged (Eidos Interactive, 2009).

Ni no Kuni: Wrath of the White Witch

Figure 18: Ni no Kuni: Wrath of the White Witch

This game has a story about a boy who overcomes grief for the death of his mother, by entering a new world and saving it. The style is in anime and therefore the animations are somewhat simplistic, but the backgrounds are beautiful. They have a lot of detail and the color schemes are fitting the theme of the place. Only considering the backgrounds, the game looks appealing. However, anime is a style that one should like, in order to want to play the game (Sony Computer Entertainment Inc., 2011).

Conclusion

Thus, the simulation of real life events is possible to show in a game. However, the most fun in those games is the freedom of creativity. Therefore, it should be looked at the possibilities of giving the player creative freedom for this game. There are games existing for adults and the 3D platform is used a lot in those games, but in most of the games a great eye for detail is put into the aesthetics and they all look very appealing to play. Each game has its own element that speaks to the adults.

The found examples from above give two elements that will be adapted in the serious game of this project:
- There should be a colored timer to show the progress of the cooking food
- There should be enough detail in the art of the game

Chapter 3 – methods and techniques

The client wants to have a better understanding of the behavior of people who are responsible for the food in a household. Therefore, they decided on using a serious game as part of their research, where the in-game behavior is expected to be very similar to real-life behavior. An alternative would have been to use surveys. The problem with surveys in this research is that they are biased. When people fill in surveys they write down what they think they do, instead of what they actually do, which is what the client is interested in. Therefore, a game seemed the best solution, because people are less likely to fake their behavior. Additionally, a game is more fun for the participant and is more engaging to participate in.

The goals

The main research question of the client's research is: what is the most important motive of people relative to behavior related to food waste? They want to learn and see what happens in households. Because of that, the goals of the food waste game are:

1. Data collection to create insight in people's behavior
2. Changing the behavior, both in the game and in real-life

The requirements

This gives the following requirements for the product:

- The product has to be a serious game
- The product has to collect data
- The product has to be about food waste
- The product has to incorporate the food cycle in a household (fig. XX, *> provisioning > storing > preparing > consuming >*)

However, a serious game like this one does not exist yet and it has not been proven that it is possible to create such a game that achieves the discussed goals. Therefore, there is a general research question for the game: how can a serious game collect data concerning food waste behavior? Because of the research question and the fact that the client wants to use the game for Dutch household, there are some additional requirements:

- The game has to be in Dutch
- This first version has to be limited, small and simple

A question that should be asked with the second requirement is: how will it stay interesting? The players should feel that they are playing a game, while getting them to perform realistic actions. In order to try to achieve that, the book by Jesse Schell[1] has been used. He created lenses that can help make a game better and to have the designer think about different aspects of their game. The big difference with a game and a serious game, is that in the latter there is a secondary goal of raising awareness of an important issue in the world

This game is made as a research tool for the client to collect data about the behavior. To create what they want with the game, it was asked what exactly they want to know when it comes to the data. This created a second additional set of requirements:

- They want to figure out if a person is driven by money, health or the shelf life of products
- They want to be able to check the amount of nutrients, whether the prepared food is relatively healthy
- They want to incorporate the shelf life of products
- They want to keep track of the budget and not have unlimited money
- They would like to be able to see the relation between choices in the supermarket and at the storage to the amount of produced food waste

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[1] Can be found in the references

- They would like to see all the player's choices
- They would like to see if there is a balance between money and food waste

With these sets of requirements and with help from the client a target audience has been formulated. The people that will play this game are people who are responsible for the food in a household. Since the game has to involve the whole food cycle in a household, these people are the most likely to be responsible for all of the phases. Another important aspect of the target audience is that they preferably go shopping only once or twice a week, because daily shopping requires somewhat less coordination and it makes it more difficult to balance the phases of the food cycle, which usually causes to have more food waste.

Conclusion

As mentioned in the introduction this game is created by two students and in this report the focus will be on the game design, where the research question is: what should the game look and feel like to accomplish the goal of collecting realistic data? In order to answer these questions, a set of gameplay art and sounds will be created. Design decisions of this set will be documented to understand how this set was established. Then the research question is answered by performing three tests divided in two parts.

The evaluation and results of these tests are described in chapter 8, evaluation. The last test was conducted using the final version of the game, of which the ideation, the specification and the realization are described in the following chapters.

Chapter 4 – ideation and brainstorming

As shown in the previous chapters, there does not exist yet a serious game that meets the requirements given by the client. Therefore, an idea for the concept game needed to be defined. In order to accommodate for this, a couple of brainstorm sessions have been held. Some of these brainstorm sessions were organized with my fellow student who programs the game. The other meetings in between were with the client, to verify what they like and if it matches with what they want. At first, multiple different ideas were formed such that these could be discussed with the clients. Afterwards, two ideas were chosen to look into. Based on new material for these two ideas, a new meeting with the client was organized to choose the final idea and elements that needed to be considered in creating the final game. In this chapter, at first the seven initial ideas will be presented. Afterwards, the chosen ideas and the final idea are discussed in more detail.

Idea 1 – similar to a Tamagotchi

Figure 19: An example of a Tamagotchi. it is a handheld digital pet, which the player has to take care of

The player has to take care of a little creature, for which you have to buy food, store it and serve it. The waste created will be collected on screen and the more waste, the less view the player has and the more difficult it will be to play the game. Once in a while, a small hand of waste will be taken away. If the creature drowns in the food waste, the game will be over. This idea raises the question how representative the data will be. In this idea, many actions from real life are missing: going to the supermarket, storing the food and preparing the meals are missing from this idea.

Feedback from the client

When discussing the idea with the client, feedback was asked for. The client warned that in real life, it is possible to create a lot of waste without really noticing. Although your garbage bin might start to smell, it is not always directly visible. The client wanted an idea in which it is clearer that the money of people is converted to food waste, because of buying too much food. That would make more impact than only seeing the waste.

Idea 2 – Mother Earth minigames

This game takes place in a town, where Mother Earth exists and is the fuel behind everything. If she does not exist, the town does not exist either. The player has to take care of their family and the town, where in every building a small game can be played. For example, in the supermarket, the player will have to catch groceries in a basket if they want to buy it. The food waste the player creates will be collected in one of three places; in the town, around Mother Earth or around the player. If it surrounds Mother Earth, the same thing as in idea 1 will apply; if she drowns in waste, the game is over. For the latter, where the food

waste surrounds the player, it will become more and more difficult for the player to move. Eventually, if the food waste is as high as the shoulders, or even higher, the game will be over.

Feedback from the client

When discussing this idea with the client, they thought that both variations of this idea would be fun to play, but not very realistic. They suggested to include the balance between your wallet and the dump of food waste.

Idea 3 – process game

In this game the player or players will experience the whole food process, starting at the farm and ending at the dump. There will be a continuous story, where at each place a game will be played. This game can be played with one or multiple players, where the multiple players can choose if they want to play against each other, or with each other. However, this game seems to be more fun oriented with a message than being able to collect data, because it has not just a consumer's focus.

Feedback from the client

When discussing the feedback for this idea, the client made clear that the idea has some good aspects but is mostly too large for now. For consumers, the food cycle starts in the store and ends in the garbage bin. They could imagine that when the concept game is realized more features like these could be added to this, because it is true that consumers start looking more for local products and thus the farmer starts to play a bigger role. Therefore, a factor of biological or animal health could be implemented. However, it seems too much to start with for now.

Idea 4 – AR game

In this game, the player would have to take a picture of some moments involving food, which would open a game for them. For example, the player can take a picture of their fridge and in the app, they would be able to play a game where they have to fit all kinds of food in the fridge. Playing such a game would create points for a competition with other players. In some ways, the data collected this way, is more representative, because it can be seen what is actually bought or stored. However, it could be that some products are hidden by other products and thus they would not be noticed by the app. Another issue with the AR game is that it is privacy intrusive.

Feedback from the client

When discussing the AR game with the client, they warned that there has already been done a lot of research and thinking into keeping track of your household and what you have in your storage. An idea for tracking the food storage in an app has been discussed. However, the biggest bottleneck is how to get the right information without having the people keeping busy with filling everything in. For example, there has been the idea to scan a receipt from a supermarket, but it has been very difficult because most retailers do not want that. The idea of having an AR application providing the same information seems like a whole other project. In addition to this, it would be difficult to check the expiration date of the products on the picture. And thus, to see how long a product in one of the storage places still has. The client's project has a focus on the expiration dates of products, so that should be in the game. It would be great to be able to create this, but it seems very difficult.

Idea 5 – Family game

This idea was created by considering creating the game for a family, where it is assumed that a family consists of 2 parents and 2 children. That means that the game needs to be for multiple players, but also a fun, easy and social game. In this idea, at the beginning of the game, every player gets a role, either by choosing it or picking a card. This can be for example a farmer, a food truck driver, a supermarket owner, a cook or a garbage man. This

game will go through the process of food and at every new place, a game will be played. The person with the role that is most important for that particular game, will play that role. Everyone else will be side characters at that moment. This way everyone has some way of being dependent on each other, but it should also be possible for each player to want to win. For example, the game that will be played when food is being wasted: the player who has the role of garbage man has the main focus and his goal is to clean up the waste as fast as possible and put it in the right garbage can. The other players can be people who make the food waste and put their bins outside.

This idea could be developed into a board game, or a PlayStation/Wii game.

Feedback from the client

Although the client thought this could be a nice idea, the same problems as with the third idea apply. It is too large for now, but it might work in the future work of the food waste game.

Idea 6 – Serving a king

The player is the servant of the king and has to plan a meal (or multiple, maybe a feast). In order to do this, the player has to go grocery shopping in the king's village. In the village, the player can find a supermarket, bakery, greengrocer and a butcher. Thereafter, the player has to store the food in the kitchen and prepare the meal. After the meal, the player has to take back the plates and throw away the left-overs. However, all the wasted food gathers in the village, where it makes small dumps of food waste. But the king does not want that, because it causes the villagers to be unhappy and pay fewer taxes.

The goal of the game is to keep the king happy by serving good, healthy and varied meals, not spending too much money and not producing a lot of food waste in the village. In this game world the stores are only open one day a week and at the beginning of the game, it is not told the player that it is about food waste. This is to see what the player will do, only after a will they will figure out what is happening. However, there can be asked a question with this idea: would adults like to play such a game?

Feedback from the client

When discussing the idea with the client, they saw a lot of potential. The village can be seen as a supermarket and the king as your family and/or wallet. This is closer to what the client had in mind, because in this idea there is a balance between waste, storage, buying products and money. The king seems to be the screaming family and the servant is the one who is responsible for the grocery shopping and the food. The environment is the village and the king can become angry if he is not satisfied. The village has to stay clean because if the player creates too much waste, the villagers will not pay enough taxes for the player to do grocery shopping. The client thought that this idea had the most potential.

Idea 7 – chef

This idea is similar to idea 6, except the player is now a chef in a restaurant. The player has to go grocery shopping, storing the food, preparing the food and throwing away any leftovers. This time the food waste gathers itself in front of the restaurant. So, the customers have to pass that first, before entering the restaurant. The goal of the game is thus keeping the customers happy by serving good food and keeping it clean. To make sure the player only goes grocery shopping once a week, customers can reserve places only one day in the week. This way there will never be more customers than the reserved places, but it can be less if they don't want to enter the restaurant because of the food waste in front of the building. So, at the beginning of the week, the player has to decide what they are going to cook that week. However, this game seems almost very stressful, instead of fun.

Feedback from the client

Although the client thinks that this idea, just like idea 6 had some potential, they agreed on the stressful aspect. The chef is really responsible for everything in this idea. It

seems good to think about other environments for this concept, but this one might not work that well.

Further research

After all ideas were discussed with the client, it was decided to think further about ideas 4 and 6. For idea 4 it is going to be looked at the possibilities of AR with pictures from the phone. For idea 6 different kinds of the concept are going to be thought of, to see if there is another way of presenting this idea.

Idea 4

In the case of idea 4, small research has been done to the possibilities of using AR for the food waste game. It seems to be very difficult to use it and to create useful games and data with it. In addition to this, it was quickly realized that the pictures might not get everything. It could be that a product lies beneath or sits behind other products and thus it would not be seen and be put in the collected data. A picture taken by a phone cannot give information about the expiration date, since that is a detail that is difficult to collect from a picture. A product might be faced differently, so that detail and others would be challenging to collect.

Idea 6

In the case of idea 6, there is an advantage that levels can be created by unlocking new products or recipes. It will also be more difficult to produce little food waste and it will go away less quick. Although this would also apply to idea 7, this idea was not chosen because of the stressful factor.

The concept

In short, the concept of the king has the following aspects:
- The player has to take care of someone by taking care of the food
- The player has to prepare meals, which includes
    - grocery shopping
    - storing the food
    - cooking
    - serving
- clearing the table or, in other words, throwing away the food.
- The more waste the player produces, the less money the player gets.

Two versions of this concept are already discussed, namely the king (idea 6) and the chef (idea 7). Another version is an adaption of idea 2 with Mother Earth. In this version, she is an actual human being that is part of your family. By keeping the village healthy and happy (by not wasting much food), Mother Earth gets donations from the villagers. A similar idea is to have a sacred animal, with which the village cannot live without.

Another version is by changing the king into the mayor of a village, so the player will have to take care of the mayor. However, it does not seem realistic to have the relationship servant – mayor. To solve that, the player could be the wife of the mayor, which creates a realistic relationship, but it would make it harder to keep it a fun game.

Another version that was thought of is with an army and their captain. The player has to take care of the food of the captain and all the food waste gathers in the camp, where the soldiers stay. The soldiers have to be happy, because if not they will not listen to the captain, which causes the captain to not perform is job well and therefore, not earn enough money for food.

The second last version is with musicians. The player will have to take care of the musicians and all the food waste that is produced will gather in the concert hall, where the fans come at the concert. However, if there is too much food waste there will not be many or any fans, which causes to not have many or any income for food.

The last version that was thought of is a very realistic one, mainly that the player has to take care of a family. This would be very realistic. However, it would not be realistic to

have the stores open only one day a week. Another aspect taken into consideration is the feedback loop for the money because there is no connection to the work of the player. Additionally, a game being too realistic might be boring to play. So, it should be thought of on how to make it more fun and interesting.

Conclusion

After passing these variations of idea 6 on to the client, it was decided to go for the idea with the king. It had also been decided that the game is going to be 2D and made in Unity.

Although the initial idea had been established, a lot of aspects were still unclear and incomplete. Of some of these aspects was already clear that they had to change. For example, the client wants the target audience to be people who only go shopping once a week, it is important to implement this in the game as well. One way to do that is to have the stores open only once a week. However, that does not seem to be realistic. There has to be something else that makes the player go grocery shopping just once a week.

A concept that was not already been though through was the scoring system. While developing the game, the scoring mechanism should carefully be planned. It has to be comparable to the real world.

Since it is tried to nudge the player to realistic behavior in the game, all the factors that play a role in choice behavior related to food are written down. These factors can be found in appendix 1 and are used to decide on some gameplay rules. The final gameplay rules and idea are discussed in the next chapter.

Chapter 5 – specification and final idea

After the idea of the king was chosen, this idea needed to be developed further. With the requirements in mind, some additions have been made to the original idea. One of these additions is about the in-game budget. Every week there will be a budget for the player. If the villagers give more taxes, it does not mean that the budget will be bigger. Instead, the king will keep track of it and by playing the game in an optimized manner the player gets to pick a reward, which could be all kinds of things related to food like, extra storage space, an extension of the supermarket or a new cookbook.

In the remaining parts of this chapter, the different scenes and actions in the game will be discussed in detail.

Dining room and feeding the king

The king can always be found at his table in the dining room, where he talks to the player to inform the player how he feels, what he thinks of the food and if he is willing to give rewards. In this room the food will be served to the king and possibly his visitors, which could be the queen, the prince, the princess, an old friend or a cousin. The reactions of the king will be animated, to make him feel alive. Every week the king decides on a budget for the player and informs the player on how many people are eating that week and on which day. This information can also be found in the monetary overview. Every week there will be around the same number of people eating. The player himself doesn't have to eat.

The king will judge the meals on a couple of requirements. There has to be enough variation between the meals and within a meal. This way the king will get different nutrients. However, ingredients are allowed to partially overlap. For example, the player could make lasagna one day and the day after he could create a pasta. While in both recipes pasta is involved, the other ingredients are different. Therefore, that would be accepted. The king will also judge the meals on the quantity. He should eat enough to not be hungry. The final requirement of the king is that the food needs to be healthy. There may be some unhealthy food from time to time, but the king has to stay alive and healthy. Therefore, he should be given enough healthy food. The king can become really fat and really thin, if the food does not meet the requirements for a longer time. He can even die from obesity or malnutrition and then the game will be over. If the king is fat, he will refuse to eat unhealthy food at some point. He will demand vegetables first. When he is thin, he will be yelling for more food. If he was given too much food, he will just leave it on his plate, which will thus create food waste.

Kitchen and cooking the food

When arriving in the kitchen, the player sees both the cooking area and the storage area. It will be needed to click on one of the areas to zoom in and perform actions. Those areas will be discussed in more detail separately.

Cooking area

The actions of cooking are simplified. The player just chooses a pan that he wants to use, and it appears on one of the stoves. Immediately, the fire is on and there is butter, oil or water in the pan. When the player puts ingredients on the cutting board or in a pan, a slider will appear to fill in how much of the food the player wants to prepare. To cut vegetables and meat, the player has to place it on the cutting board together with a knife and then the player gets to choose how to cut it. There are always two ways of cutting a vegetable or meat. One gives more food waste than the other. After that, the vegetable or meat that has been cut into pieces can be brought to a pan. Each pan on the stove has the option for a timer. It has to be possible to see if the food is ready, but the player can also choose to click a button to have a timer appear. This option is available for each pan. If there are left-overs after preparing the meal it will go into the garbage bin. After the king has eaten his food and there are some left-

over, the player gets to choose to either throw it away or save it in Tupperware. If the latter is chosen, the food will be good for one day in the fridge and for three days in the freezer.

Storage area

At the very beginning of the game, the fridge, the freezer and the cupboard will be empty. To fill the storage with products, the player first has to go grocery shopping. When that has been done and the player is back in the kitchen, there will be an icon of a grocery bag on the screen. To open it, the player has to click on it and the screen will split in two, where on one side the storage space will be and on the other side the products in the grocery bag. The player can now drag the products to the storage space that he wants it in. In the cupboard the player has to fit everything on the shelves, which can be a puzzle if he has a lot of products. In order to achieve the feeling of it being a puzzle, the front of the products is used as filler space, since the game will be in 2D. Products can pass their expiration date. If that happens, the product is not good and should be thrown away. As long as the product has not passed its expiration date, it is still good and can be used in meals.

Grocery bag

If a product stays in the grocery bag, and is thus not put in the storage space, the product will rot much faster than in the cupboards. This has been decided on, to prevent players keeping products in the grocery bag if the cupboards are full.

Cookbook

In the kitchen there is a button to get to the cookbook. In the book there are some recipes that can be made in the game. The player cannot improvise. However, within a recipe there exists possible variations.

The garbage bin catapult

The garbage bin is actually a catapult. If it is full, the player can launch the catapult to empty the garbage bin. However, it costs money to launch the catapult. Although, it is visible that the food is thrown outside, it is not visible that the food ends in the village. This has been decided, to prevent the player from changing its behavior towards the game. The game is created to gather realistic data and if the player is aware that the food waste gathers in the village, which causes to have less money, the player will change his behavior earlier on in the game. Since the game is about food waste, it has been decided to have no packages enter the garbage bin. If a package is emptied during cooking, it will just disappear. If there is a rotten bit of food in a package and both are thrown in the garbage bin, only the food will fill the garbage bin and the package will disappear.

Note block

Before going grocery shopping, the player has the option to create a shopping list or notes. Therefore, a note block is created to have the player being able to write normal notes or bullet lists, where things can be crossed away. The player has to be able to create a new list and to delete existing lists.

Village square

When going to the village, the player starts at the village square. This is the center of the village and the supermarket is right next to it, such that it is clearly visible. There are villagers walking around, either happy or angry, depending on how much food waste is laying around. If there is no waste, they will look happy. Although it might go slow, there is something that has to get rid of the food waste. This can either be a sacred pig or a garbage

man. The first thing, the sacred pig, was an idea to add some humor, but also because a pig eats the food waste and it is a used method of getting rid of food waste. The latter can also be created and then it will be an old man with his little cart, slowly picking up the food waste. The client decided to have the garbage man walking around in the game.

Supermarket

The supermarket is next to the village square, which makes it easy accessible. At the supermarket, the products are slightly cheaper than other stores in the game. However, the food is less fresh and therefore, slightly less tasty. To choose products, the player can click on a group of products in the aisle and it will go to the shelf with the products. There it will be visible which products are on the shelf and how much each product costs. To have more information on the product, the player can click it. A pop-up will appear with the product and its information, like the quantity in grams and how much days the product is still good. From the shelf, the player can press 'buy' and the product will be added to the grocery basket. At all times in the stores, the basket can be clicked on to view which products are in it. From there, the player can also place a product back. In order to leave the supermarket, the player first has to buy the products in the grocery basket. However, if the basket is empty, the player can also leave the supermarket. This also applies to the other stores.

The village streets

The village has three streets that are visible for the player. In each street there is a store where the food is fresher and tastier. However, it is slightly more expensive than in the supermarket.

Bakery

At the bakery bread, pastries, cakes and pies can be bought. Per category there are a couple of different products to choose from. In the bakery there is a general poster with the expiration date of all the products in the store. In this store it is also possible to click on a category to view the products that can be bought and the same system as in the supermarket applies here.

Butcher

At the butcher chicken, pork, beef and fish are presented. Per animal there are a couple of different pieces to choose from. In the butcher there is also a general poster with the expiration date of all the meat. In the butcher it is possible to click on an animal category to view the products and the same system as in the supermarket applies here.

Greengrocer

At the greengrocer different kinds of vegetables and fruit can be bought fresh. There is one option per vegetable or fruit. Also, at the greengrocer there is a general poster with the expiration date and the same system as in the supermarket applies here for viewing the product options.

In-between screen to the castle

To go back to the castle, the player can click on the castle that can be viewed from a distance at the village square. At the gate of the castle, the player can choose to which room he wants to go to first. The options are the dining room, the kitchen and the catapult.

Monetary overview

Money is an important aspect in the game since that is used to buy food and can give the player some rewards. In the overview different elements can be seen. A player can earn rewards if all three requirements are met: the village is happy, the king is happy, and the king has received more money than a certain amount. Therefore, in the overview the happiness of the villagers and the king can be seen, but also the amount of money the king has. If that passes a certain limit, the king can choose to give that surpassed bit to the player to buy a reward, but the villagers need to be happy then as well. This might not be clear from the start of the game, but that is done deliberately for the same reasoning as with the catapult. If the player knows how to earn rewards, he will optimize his behavior in the game, which is different than real behavior and therefore, not useful for the data. During the game the king will slowly give some information on this subject and thus making the player aware that it is his food waste in the village.

The king receives the money from the villagers as taxes. The villagers will pay more taxes if they are happy with the cleanliness of the village. The more food waste there is, the less taxes they will pay, which will cause the player to have less of a chance to get rewards. The rewards that the player can get are about food, both in the castle and in the village. For example, a bonus can be an extra recipe, or a new variation in a recipe.

In the money overview, it can also be found how much money the player still can use that week and what his budget is. The budget is always the same for each week. The last element in the money overview is the amount of people who are eating with the king that week and on which day. So, the player can always go back to this screen, to see how much food he should prepare.

If, at the end of the week, the player still has some money left, he will get a choice. He can either put the money with the budget for the next week, which will only change the budget once, or he can put it in a piggy bank to use it for rewards later. If the latter is chosen, the money cannot be taken out later to buy products.

Overview

Before creating the art for this game, an overview of scenes has been made to display how the player can move through the game.

Figure 20: An overview of the screens of the initial idea

Once the final idea and all its scenes were discussed, the art for the game had to be created. This will be discussed in the next chapter.

Chapter 6 – realization and creating process

In this chapter it will be described how the game play and game art was created. The main idea of the game play had already been decided on, but whilst creating the game many details had to be thought of. This had been done in corporation with Christiaan because he is responsible for programming the whole game. This way it was made sure that the decisions were also possible to program.

For the art of the game, concept art had been created with pen and paper. Some of the final decisions have been made together with the client to confirm that it was going to be what the client had in mind. After the confirmation, the art has been hand drawn into Photoshop by using a Wacom tablet. To achieve the right effect of buttons, Photoshop's systems of layers has been used. Each button got its own layer, so that the code of the game could be made much easier.

The king

The most important character in the game is the king. Therefore, a good amount of time was put into his design. The character traits of the king are righteous, kind, happy and strict. These character traits were chosen, because the king is mostly a king. Thus, he has authority and can demand many things. However, the game should still be fun to play and therefore, an additional trait of happiness is added. This makes the king likeable, but still someone with authority.

Early in the design phase, when it was not yet decided which game would be created, a fun drawing was made for the king. This can be found in Figure 21.

Figure 21: A first concept design for the king

Although, the king looks fun and well fed in this design, it was decided not to go with this design. The king needed some straight lines to get the feeling that he is a righteous and strict king. At first different design concepts for the king's face were created. These can be found in Figure 22.

Figure 22: Different kinds of heads for the king

All kinds of crowns, beards, heads are tried out to find the perfect fit for the king. The client thought that the two heads in Figure 23 were the best.
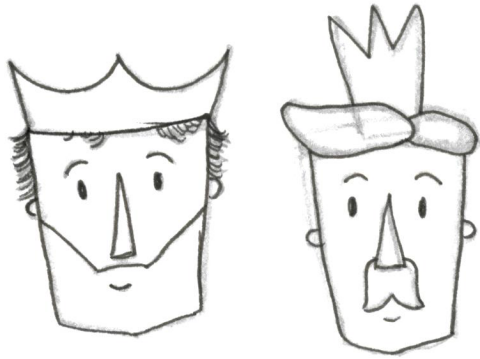
Figure 23: The two heads that were preferred by the client

With these two heads, silhouettes have been created to find a good body for the king. Different stances and width of the hips and shoulders have been tried out as can be seen in Figure 24.
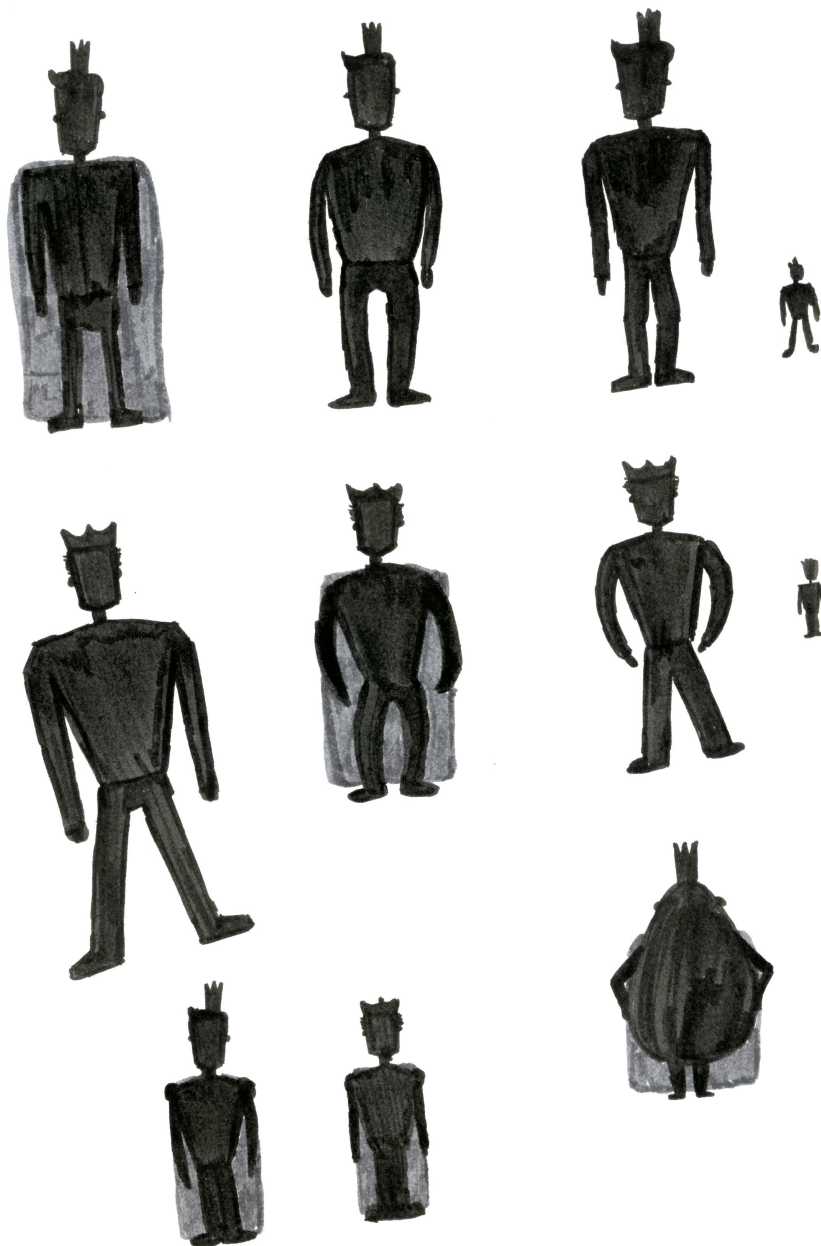
Figure 24: Different silhouettes of the king

Eventually a very straight design with some round shapes was chosen and the king now looks like the king in Figure 25.

Figure 25: The final design of the king

As can be seen in Figure 25 the king does not have a mouth. The face is design such that the moustache is very expressive and will help with the emotions, as shown in Figure 26.
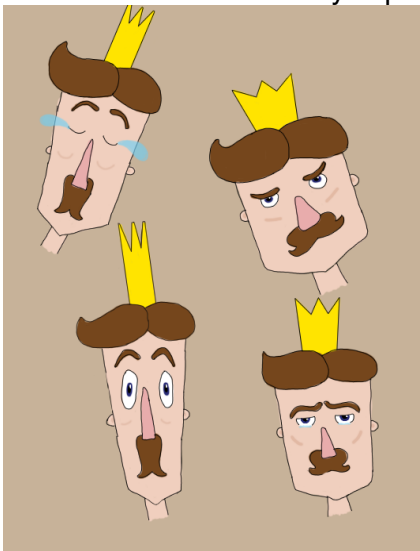
Figure 26: Different expressions of the king

Note that in Figure 26the style of drawing is different. This is because these were some earlier sketches, right before settling with a final design. Besides that, together with the

client it has been decided that the king is called Karel and that the village is named Schoondorp (Cleanvillage in English).

Voice recording sessions

The king also needs a voice, because he has to guide the players through certain actions in the game, as well as inform the player about the state of the village, the villagers and the food. The voice could be represented in two ways; with text in a text balloon or an actual voice speaking. It was decided to not do the text balloons, because that makes it difficult to present the king as a strict and kind man. With an actual voice, another element is added, which gives more impact on the importance of the king, since other characters do not have that. At least not in this first version of the game.

Three men were asked to come by to record their voices. A good microphone was set up and the voices were recorded in Garageband. Fifty-three sentences were written for the men to say and these sentences can be found in appendix 2. The sentences were about different aspects of the game. For example, if the king had the same meal for a couple of days, he would say that he wants something different. Another example is when a guest is coming over and the king notifies the player that he has to cook for one more person. Each voice actor would act out these sentences, sometimes a couple of times. They were given some instructions on how to express the sentences in order to have it the best way suitable for the king and the game.

After the recording session, for each actor the best expressed sentence for each sentence has been chosen. This way it was clear which sound to use. To choose which voice suited the king best, the actors' voices were put under the animation of the talking king. Eventually it was decided to go with one of them, since that voice had both the righteous, strict king and the more kind and happy king.

Later in the creating process, it turned out that more sentences were needed. Therefore, the man, whose voice got picked for the king, was asked to come by once more and record the extra sentences. These sentences had more guidance towards the player in the beginning of the game and they were more precise on how much the king liked the food. These additional set of voice lines can be found in appendix 3.

King's symbol

The symbol of the king is a deer. This animal has been chosen, because it is an elegant, yet imposing animal. It is seen as the king of the forest and therefore, it matches the king in the game. He is strict, yet a kind king, which is reflected in his symbol, the deer. This symbol can be found on the shields in the dining room and it is a fountain in the village.

The other characters

The queen

The king has a beloved wife, who encourages the sweet side of the king. Therefore, the character traits of the queen had to be sweet, kind and gentle. Because of that, the design of the queen included round and feminine shapes, to give her a soft look. In Figure 27 different sketches are shown, where different kind of hairstyles and dresses are used.
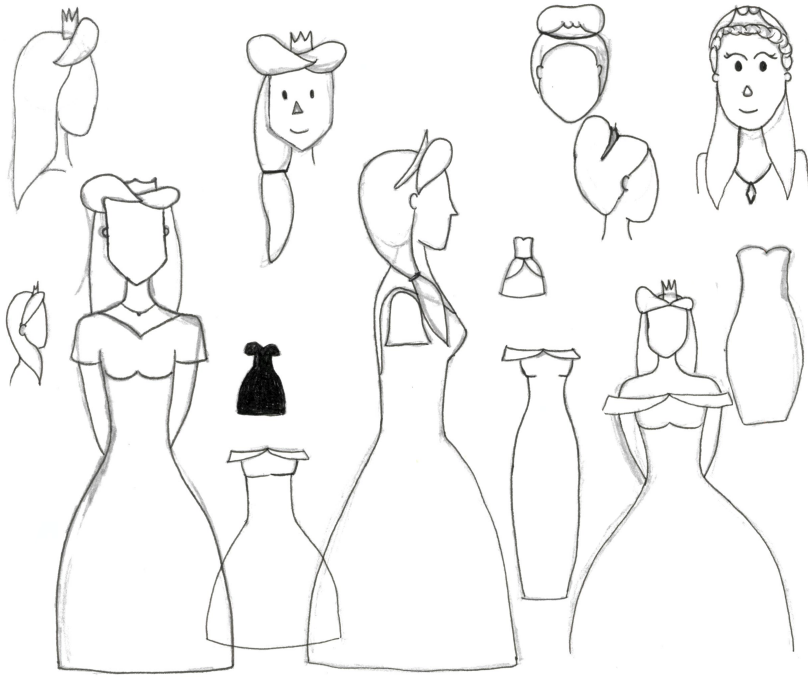
Figure 27: Concept sketches of the queen

Eventually, together with the client a final design has been chosen, that is depicted in Figure 28.

Figure 28: The final design of the queen

The prince and the princess

The king has two children, who are both around the age of fourteen to sixteen. The princess got a dress and hairstyle that had been tried out for the queen. She got this design, because it was the look of a younger person, who is both sweet and royal. This design can be found in Figure 29.
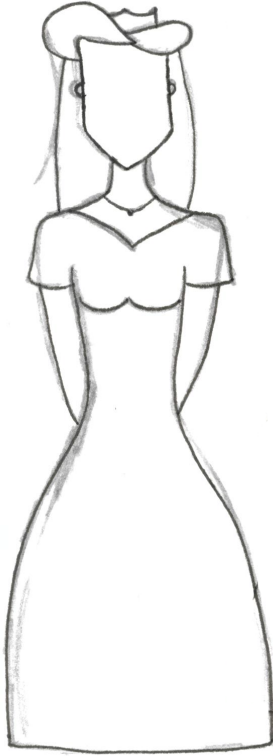
Figure 29: The design of the princess

The prince is slightly older than the princess, but he is also somewhat more nonchalant. His design shows the straightness of royalty, but the messy style of a teenager as well. Figure 30 shows the concept drawings, with the final design on the bottom right.
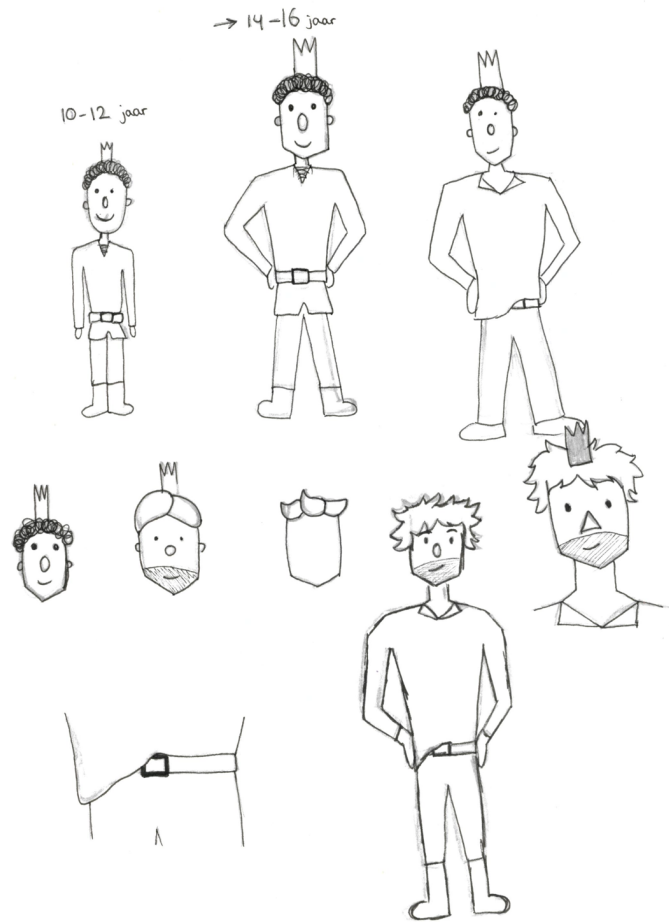
Figure 30: Sketches of the prince

The garbage man

In the village there is a garbage man walking around slowly cleaning up. The garbage man had to be old, to explain why he is slow. Because of his age, his design also was grumpy and bored since this job is his last way of earning some money at this age. His design is depicted in Figure 31.
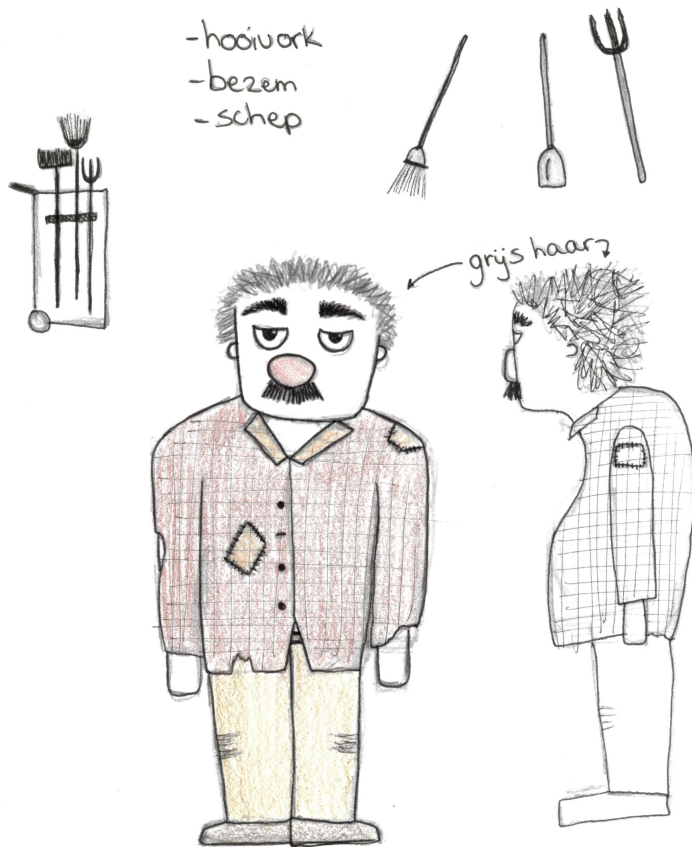
Figure 31: The design of the garbage man. On the top middle it names the three items he carries around on his cart, which are pitchfork, broom and shovel. The note about his hair mentions that it is grey

Other scenes

For all the other scenes in the game a quick drawing has been made, that were used as placeholders by the programmer. However, while creating these sketches it was an idea to create an opening screen, where the player can give their name, see the king and read a small description of what should happen in the game.

Opening screen
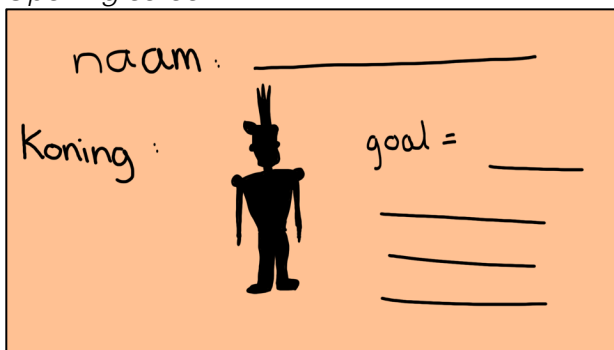
Figure 32: Sketch of the pening screen

This looks simple and the sketch shows only the silhouette of the king. For the one in the game, the actual king will be shown. It had also been decided to not have the player write their name, since it will not be used in the game. Therefore, it would not be necessary. The opening screen in the end game will only show the king and give a short description of the game.
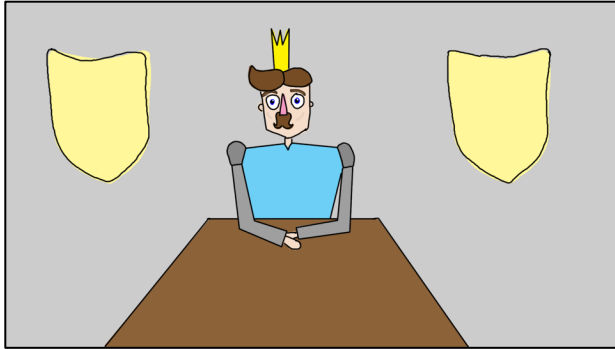
Figure 33: Sketch of the dining room king

When the game is started, the player starts at the dining room, where the king is seated. There is enough space at the table for guests. In this room the king will talk to the player and notify him if he is content or not. There will be arrows on each side of the screen to navigate through the castle. To the right will go to the kitchen and to the left will go to the catapult.

Kitchen
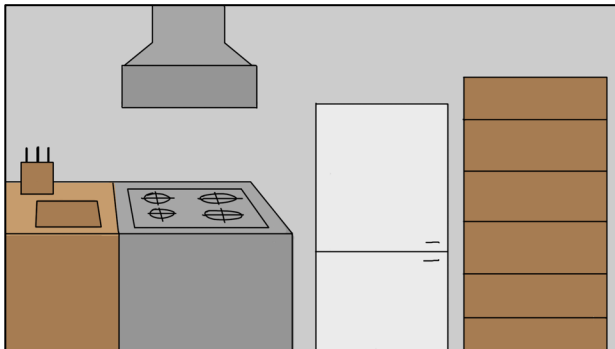
Figure 34: Sketch of the kitchen

In the kitchen both the cooking area and the storage area are visible. To get closer to either one, the player has to click on the side he wants to go to. In this full kitchen scene, it is not possible to perform cooking and storing actions.

In the kitchen there are also two arrows on each side of the screen. This time, the arrow to the right will go to the catapult and the arrow to the left will go back to the king.

Cooking area
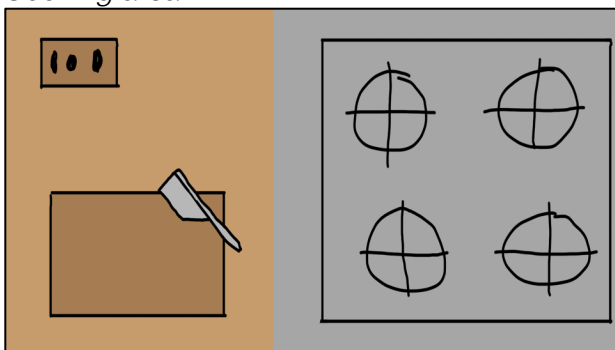
Figure 35: Sketch of the cooking area

The sketch shows the cooking area from above. However, this way it would be difficult for the player to choose a pan that he wants to use, and the player cannot use the oven for some dishes. Therefore, the final design has been changed to more of a front view. Nonetheless, the cutting board, the block with knifes and four stoves stayed to have enough cooking space.

Storage area
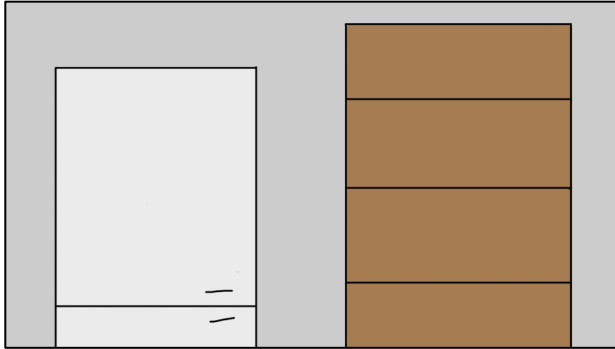
Figure 36: Sketch of the storage area

There are three ways to store food. In a dry cupboard, in a fridge and in a freezer. All three are sketched for in the game. The freezer is beneath the fridge. There will be an icon of the grocery bag in the right bottom corner.

Grocery bag
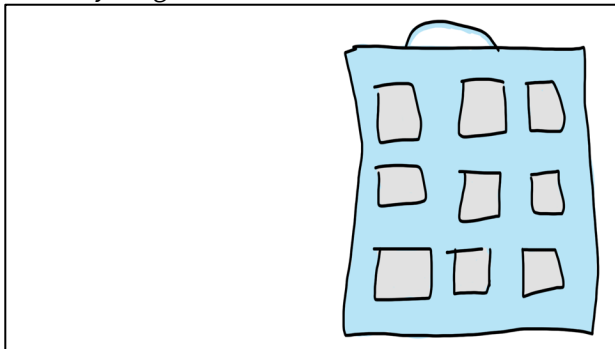
Figure 37: Sketch of the grocery bag

In order to empty the grocery bag, the player has to click on the icon. It will open a split screen, where the storage spaces are on the left side and the grocery bag on the right, as shown in Figure 37. From here, the products can be dragged into the cupboard of the player's choice. To close the split screen, the player has to click on the icon again, that is still visible in the right bottom corner.

Cookbook
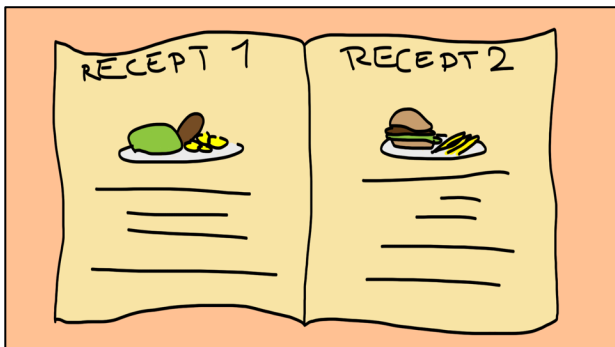
Figure 38: Sketch of the cookbook

In the kitchen there is an icon to get to the cookbook, where different recipes are shown. The player has to choose which meal he wants to prepare. However, there are some ingredient variations within a recipe, to keep some options open for the player. The reason that it was chosen to create certain recipes, is because if the player has total freedom, a lot of sprites had to be created, which makes the game really complex.

Catapult
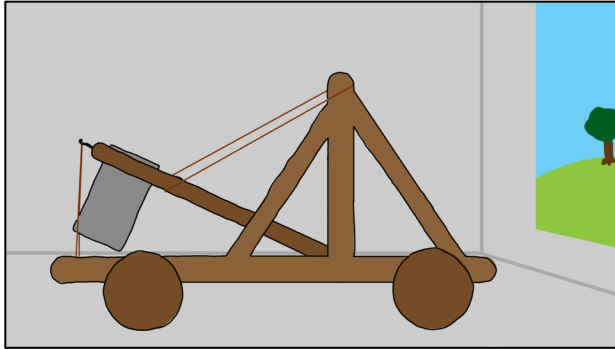
Figure 39: Sketch of the catapult

The garbage bin is part of a catapult. If the garbage bin is full, it can be emptied by launching the catapult. There is a window on the right of the scene, where the food waste is launched through. The food waste will be thrown outside, but it cannot be seen where to exactly.

Note block
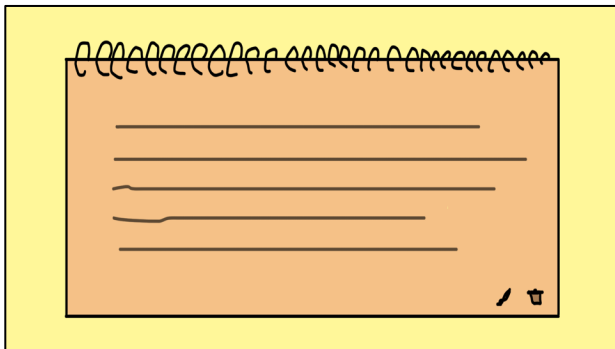
Figure 40: Sketch of the note block

The note block is like any other note block, but for the game with a create new and a delete button.

Village square
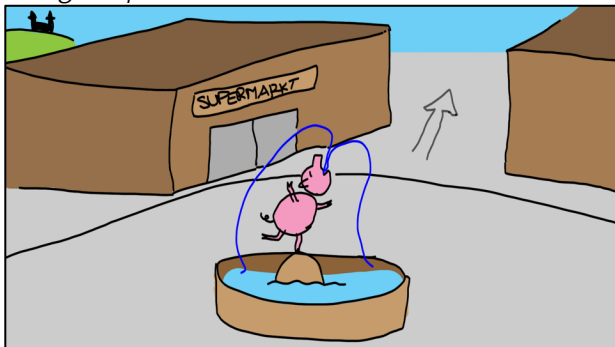
Figure 41: Sketch of the village square

The supermarket is right next to the village square and the castle is visible from a distance. In the sketch the fountain is a pig, but this is going to be a deer. From the square the player can enter the supermarket or go to other streets to find the other stores in the game. For the latter there is an arrow on the right of the screen, which brings the player to the first street.
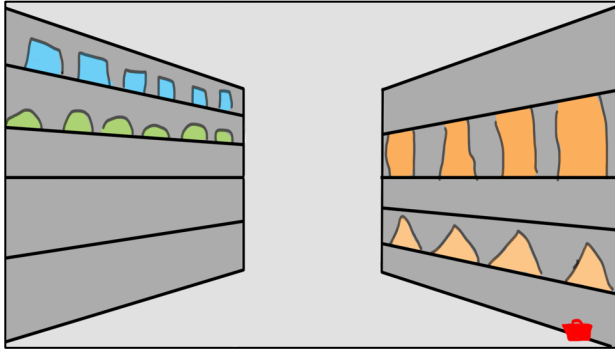
Figure 42: Sketch of a supermarket aisle

As soon as the player has entered the supermarket, he will be in one aisle. In total there are two aisles. In the bottom right, there is a button to get to the grocery basket. In order to show how many products are in the basket, a number is going to be displayed on the basket. To see which products are in there, the player can click on the basket. The products in the cupboards are separated in four groups per cupboard. For example, the upper left corner of the left cupboard has the pastas and the bottom right corner of the right cupboard has meat. This is done to keep it organized and to not have more than 6 or 8 products per group. If there are more products than 8 it would not fit on a shelf for the next scene. To get back to the village, the player either has to pay for the products, or if the basket is empty, a 'village' button will be available.

Products on shelf
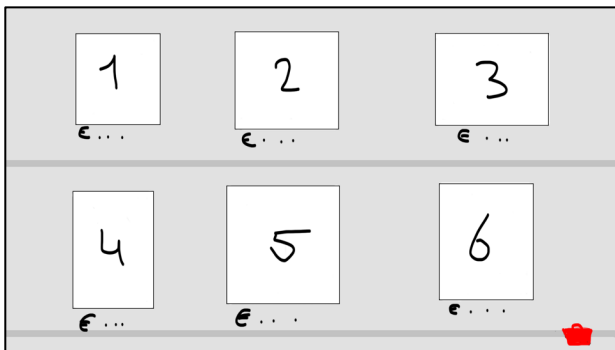
Figure 43: Sketch of products on a shelf

This scene shows 6 or 8 products of a group standing on a shelf. Here it is also displayed how much it costs. For each product there is a 'buy' button which will put one product in the basket. In this scene there is also the basket icon in the right bottom corner.

Product information screen
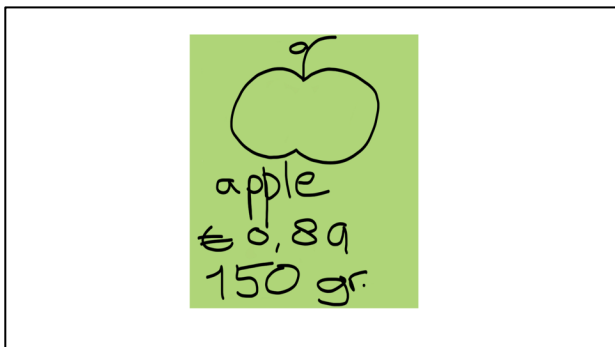
Figure 44: Sketch of the product information screen

To see more information on a product, the player can click on it and a pop up as shown in the sketch will appear over the scene. In this pop-up some detail information is given, like how much it is and what the expiration date is.

Cash desk supermarket

Figure 45: Sketch of the cash desk of the supermarket

To buy the products in the supermarket, there is a button in the aisle and in the basket with 'to the cash desk'. Here the total price is shown, and the player can choose to buy the products or to go back to the supermarket if there is not enough money.

Shopping basket
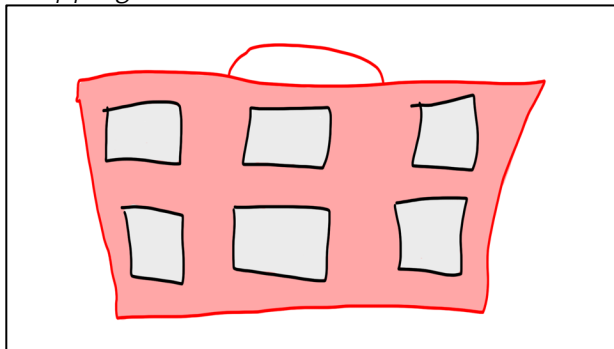
Figure 46: Sketch of the grocery basket

In the shopping basket, the products can be seen. Here it is possible to place the products back or to go to the cash desk.

Street one with bakery
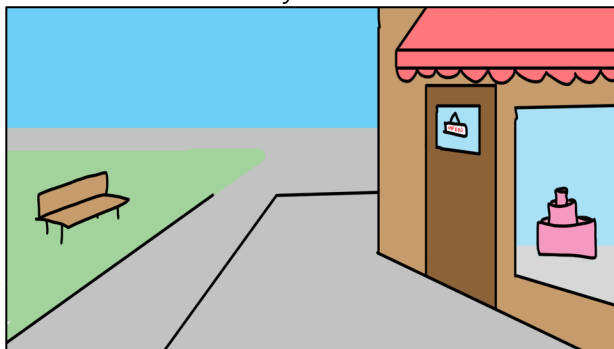
Figure 47: Sketch of street one with the bakery

The player can walk through the village and in the first streets he enters, there is a bakery. There will be two arrows on the sides of the screen. The arrow to the left goes to the village square. The one to the right brings the player to the second street.

Figure 48: Sketch of street two with the butcher

The player can walk through the village and in the second street, there is a butchery. On the sides of the screens there are arrows. The arrow on the left gets the player back to the first street. The arrow to the right goes to the third street.

Street three with grocery store

Figure 49: Sketch of street three with the grocery store

The player can walk through the village and in the third street he encounters a grocery store. Two arrows are displayed on each side of the screen. The arrow pointing to the left goes back to the second street. The arrow on the right gets the player to the village square.

Bakery
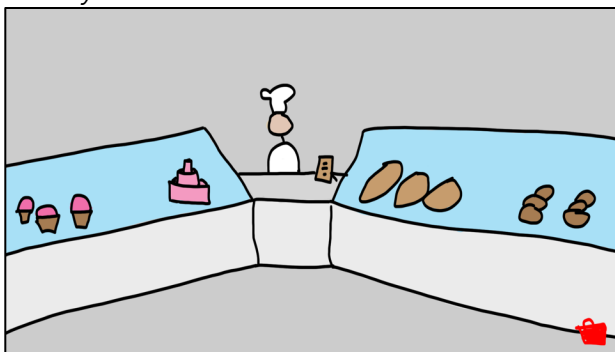
Figure 50: Sketch of the bakery

In the bakery there are four categories with products and one of the categories is bread. The system from the supermarket applies here as well. The player can click on each category to view the products. There is also a grocery basket in this store and for more information, the product can be clicked on. To buy the products the player can click on the baker behind the counter. There is a sign on the counter which shows the expiration date of all the products in the bakery.

Baker
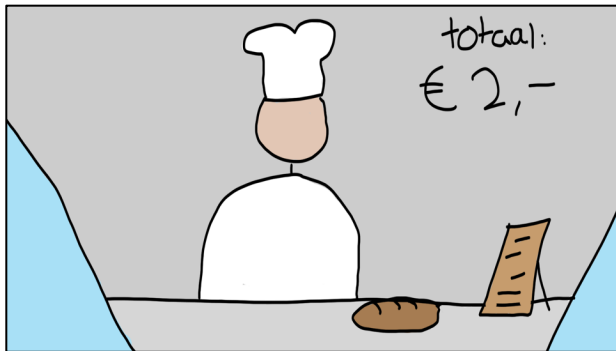
Figure 51: Sketch of the baker

The baker stands behind the counter and here the player can pay for the products.

Butchery
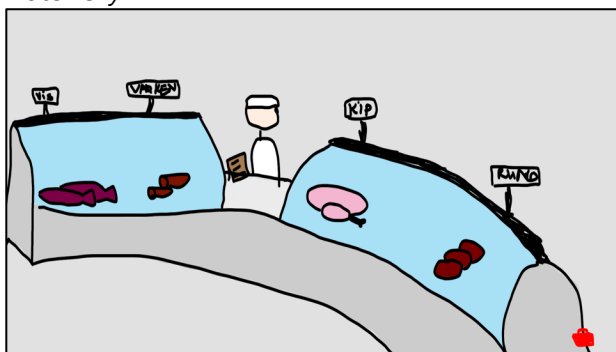
Figure 52: Sketch of the butchery

The butchery has four categories of products; fish, pork, chicken and beef. The supermarket system works in this store as well. The grocery basket and the information on products work the same as in other stores. On the counter there is a sign, that notifies the player on the expiration date of all the products in the butchery. In order to buy the products, the player should click on the butcher.

Butcher

Figure 53: Sketch of the butcher

Behind the counter there is the butcher and this is where the player buys the products.

Grocery store
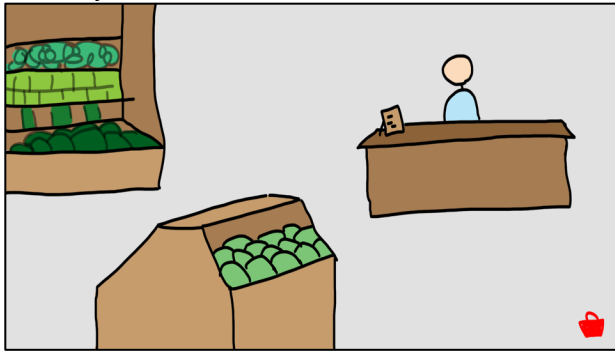
Figure 54: Sketch of the grocery store

In the grocery store there is one option per product. For example, if an apple is needed, there will only be a red apple and not a green one. Besides that, the same system applies here. To view the products on shelves, the player can click on it. There is a sign on the counter, which displays the expiration date of the vegetables and fruits available. To view which products are in the grocery basket, the player can click on it and to leave the store, the player has to buy the products by going to the grocery person.

Grocery person
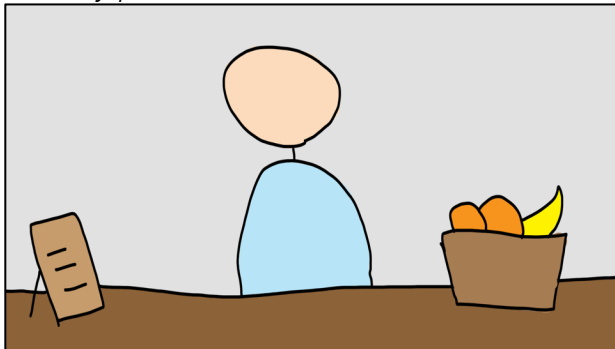
Figure 55: Sketch of the grocery person

The grocery person is standing behind the counter and the player buys the products here.

In-between screen to the castle
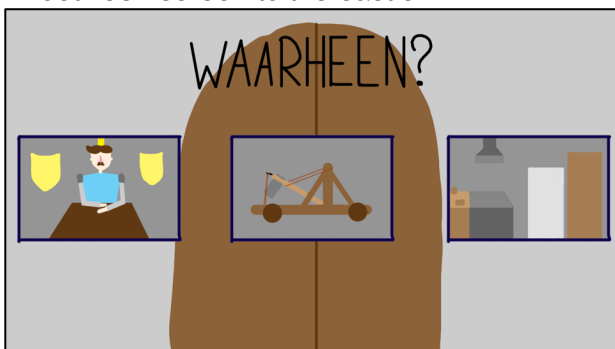
Figure 56: Sketch of the in-between screen to the castle

From the village square the castle can be seen. To enter the castle, the player clicks on it and he gets to the gate of the castle, where he can choose which room he wants to go to. The possibilities are the dining room, the catapult and the kitchen.

Monetary overview
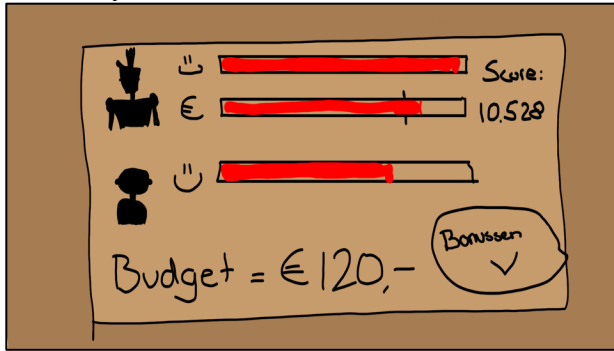
Figure 57: Sketch of the monetary overview

At all times the player can click on the money icon in the top right corner and that will open op the monetary overview. Here the player can view the happiness of the villagers, the king and how much money there is in the game. This is also where the player's score is shown.

Conclusion

For the first test in part one a digital paper-prototype has been created in Unity, a game development platform. In this prototype, the player can navigate through the game, but not actually play it. Test 1 is created to test whether adults like the art, therefore, it is not necessary to have them play the game. The other two tests were created to test if the actions in the game are realistic and thus, two prototypes made by Christiaan are used in these tests. He also created it in Unity.

After these details have been passed on to the client, there remained one question that needed to be answered. Are actions connected to energy and time or will they be unlimited? After some discussion it had been decided to add an element of time. Each day in the game will start at five pm and the king wants his food at six pm. This hour was converted into 200 seconds for the game and this element has been chosen so that the player is forced to go grocery shopping less times per week, because that is part of the target audience. If the player would do grocery shopping every day in the game, the king would be quite unhappy, which would cause the player to have less chance of getting a reward.

The first sketches are drawn into a fuller version and put into actions for the final game. The end result of the first version of this game is explained in the next chapter.

Chapter 7 – final product

In this chapter, the final product will be discussed. This game is playable to the extent of being able to test. Most of the desired aspects have been implemented here, but some details were missing. However, this was not an issue in the testing. Below the final game is shown and described.

Sign in screen

In order to have the data connected to one person, it has been implemented that people can sign in. It does not work optimally yet, but one can sign in. For the background of this screen, the wall from the dining room has been used to already take the player to the more medieval times.
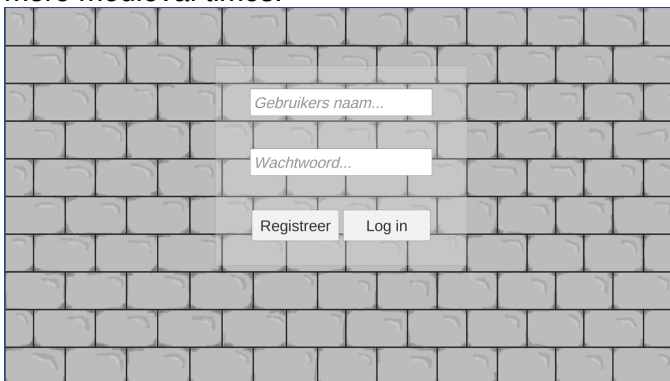
Figure 58: Sign in screen

Opening screen

After logging in, the game starts with an opening screen, where the game is shortly explained, and the king is introduced. The translation of the introduction can be found in appendix 4.

Figure 59: Opening screen

When the player is ready to start the game, he can press the button 'start'. This brings the player to the dining room where the king is seated.

Dining room king

The king can always be found in the dining room. Here the food gets served and it is where the king notifies the player about certain important aspects of the game.
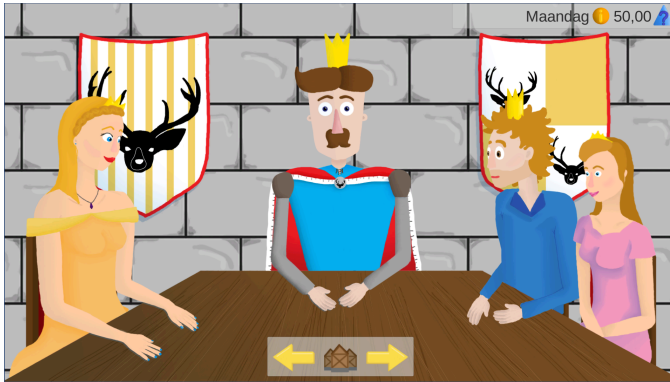
Figure 60: Dining room king

In Figure 60 the neutral state of the king can be seen as well as the queen and the two children, the prince and the princess.

On the bottom, the icons that can be used to navigate through the game can be found. The arrow to the left goes to the catapult and the arrow to the right brings the player to the kitchen. In between the arrows, an icon with three houses is shown, which goes to the village. At the top right, there are a few icons. Starting on the left, it is first shown which day it is, then there is an icon for the info screen, next to that it is depicted how much money the player has. The last icon is an explanation icon, which gives the player a short explanation of what the icons do.

The very first day, as in the figure above, does not have the element of time. This day the player has time to figure out how the game works and what he should do to be able to serve the king his food.

The king talks to the player and expresses what he thinks of the state of the village and the food. Therefore, multiple emotions have been created for him as shown in Figure 61.
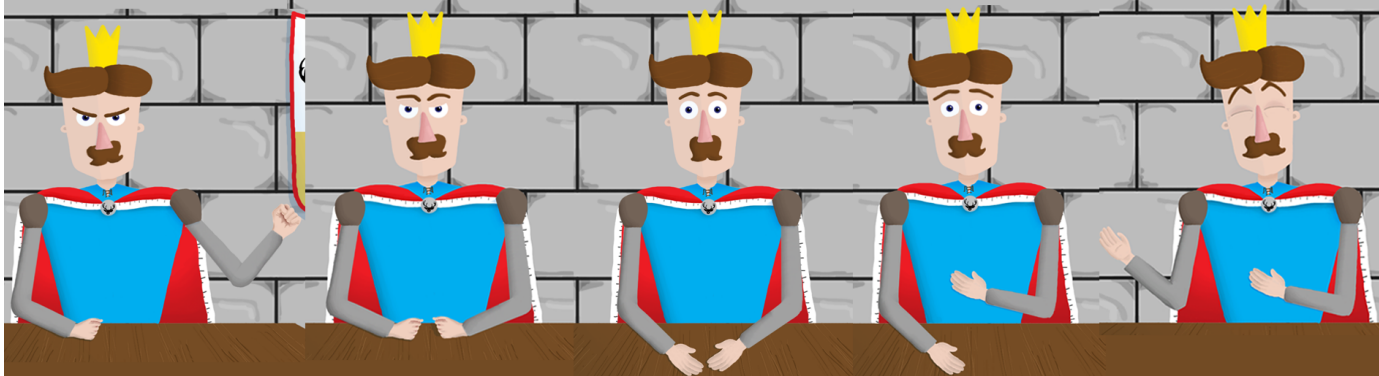
Figure 61: Emotions of the king

In Figure 61 five emotions of the king are shown. From left to right they are; angry, dissatisfied, neutral, satisfied and happy. At all emotions the king is able to talk. This is created by having the bottom part of the moustache go up and down, since the king has no mouth. In appendix 5 a link can be found to a video, where the king talks.

However, the king does not only talk and express emotions, he can also have dinner or push the plate away, when he does not like the food. Both can be seen in Figure 62.
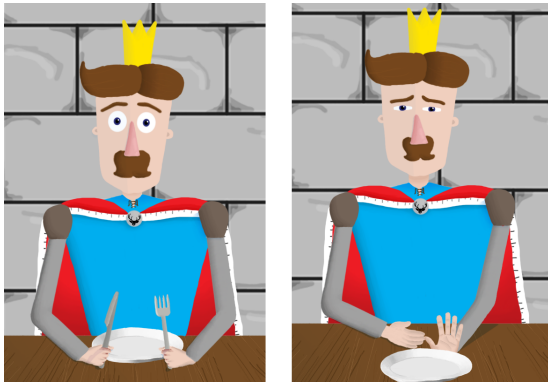
Figure 62: Two extra expressions of the king

Kitchen

From the dining room the player can go to the kitchen.
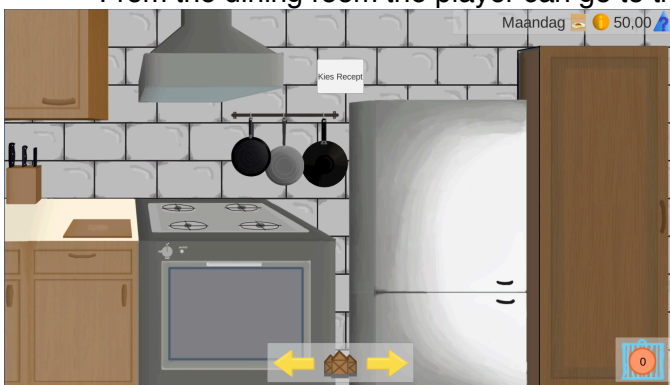
Figure 63: The kitchen

The kitchen shows a total view of both the cooking area and the storage area. There is also an additional icon in this scene.

The cookbook

At the top right, there is one new button, which is of the cookbook. Clicking on it, opens the book and shows the recipes the player can choose from.
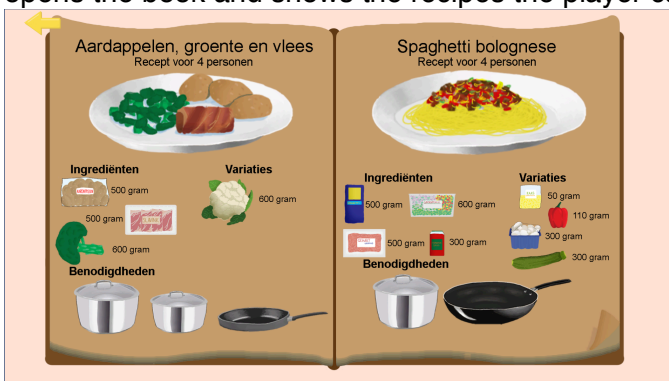
Figure 64: The cookbook with recipes one and two

The bottom right corner of the right page, is folded. Clicking on it, turns the page to find another recipe.
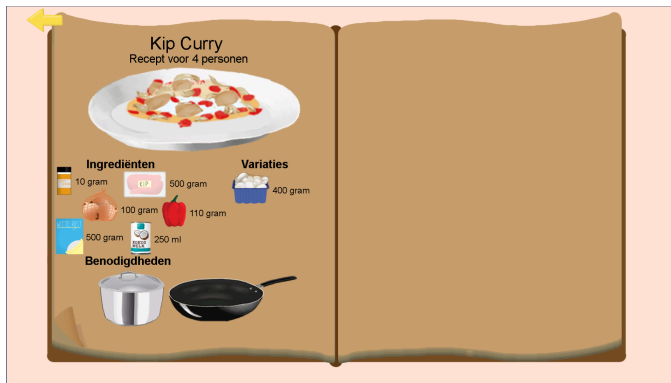
Figure 65: The cookbook with recipe three

There are some fixed recipes with the needed ingredients and their quantity. The recipes can be found in appendix 6. As part of the recipes, it is described for how many people the player will prepare a meal and which tools the player should use to prepare the recipe. Additionally, right of the needed ingredients it is depicted which variations can be used, to serve the king some varied food. If the player keeps the king happy, rewards like a new recipe or a new variation within a recipe can be earned.

In this prototype only three recipes with a few variations are in the cookbook and can be prepared by the player. Due to time constraints, not more had been drawn and implemented. However, more recipes for the game have been written down and can be found in appendix 6.

Other icons

There had been the idea to give the player a note block, where they could write notes in or make bullet lists to take with them into the village. Art had been created for it, but due to time constraints it got not implemented. Therefore, the details on this are described in the chapter for future work.

On the top right corner of the screen, there is a blue triangle with a question mark. Clicking on this icon, opens up a screen with an explanation of a few buttons.
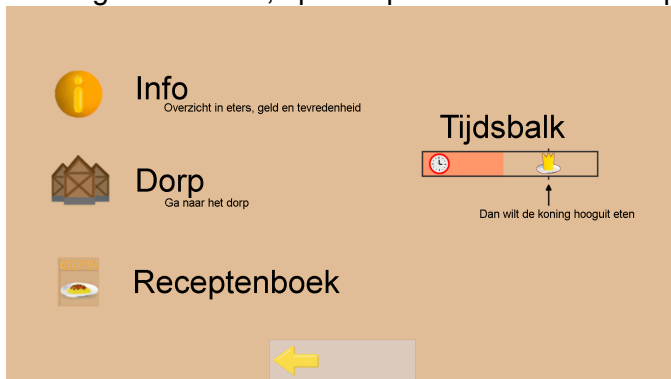
Figure 66: The explanation screen

In Figure 66, the explanation screen is shown. It explains four icons. The first on the top left is the info button, where on overview can be found of the amount of people who eat together with the king each day, the money the player has and the satisfaction of both the king and the villagers. Underneath that icon, it shows the icon that brings the player to the village. On the bottom there is the icon of the cookbook. On the right it shows the time bar, which will be in the game after the first day has been played. The spot with the crown on the plate, is the time the king wants food.

Village square

At all times in the castle, the player can go to the village by clicking on the three houses on the bottom in between the arrows.
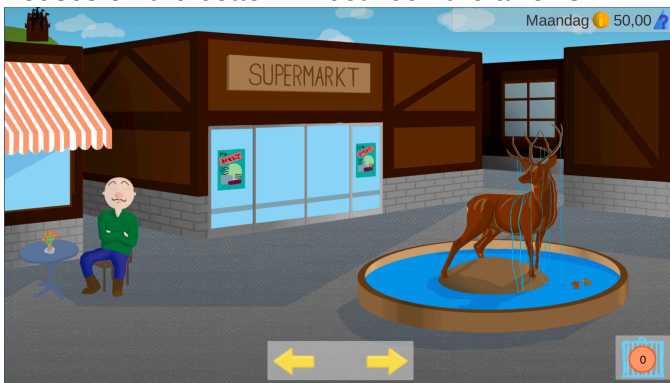
Figure 67: The village square with nothing in the grocery bag

On the village square, the fountain with the king's symbol is placed and from here the supermarket is clearly visible.

In the bottom right corner, there is an icon for the grocery bag, that the player carries around. Clicking on the icon, the products in the bag can be viewed. However, if the player has not done grocery shopping, there will be nothing in the bag, as shown in Figure 68.

Figure 68: The grocery bag

To close this off, the player can click on the icon in the bottom right corner again and he will be back to where he was.

Supermarket

From the village square, the supermarket can be entered. Inside, it always starts with aisle one, which is depicted in Figure 69.

Figure 69: Supermarket aisle one

Clicking on the arrow to the right, brings the player to aisle two.

Figure 70: Supermarket aisle two

In aisle two there is an arrow to the left, which goes back to aisle one. In aisle two, the cupboards and shelves can be divided in two groups. The fruit is one group, but the shelf below has two groups of vegetables. In the cupboard on the right, there are two groups, one of the upper three shelves and the other contains the bottom two. In aisle one the cupboard can be divided into four groups. The bottom right corner of the right cupboard for example, is the category of meat. Click on such a group opens up the shelf with the products as shown in Figure 71.

Figure 71: Products on a shelf of the supermarket

To get back to the aisle, the arrow in the top left corner can be clicked on.

At any time during the game, the player can click on a product to view more information on that product. Figure 72 shows the pop-up that will appear with the information. The added information is about the quantity of the product and its expiration date.

Figure 72: The pop-up with additional information of a product

In the case of opening the pop-up in the supermarket, a 'buy' button appears at the bottom. Depending on the background scene, different buttons will be available. Clicking on the 'buy' button in the supermarket, puts the product in the shopping basket. In order to have more of the same products, the player has to click on it multiple times.

To view the products in the basket, the icon on the bottom right corner can be clicked on and it will open the scene in Figure 73.
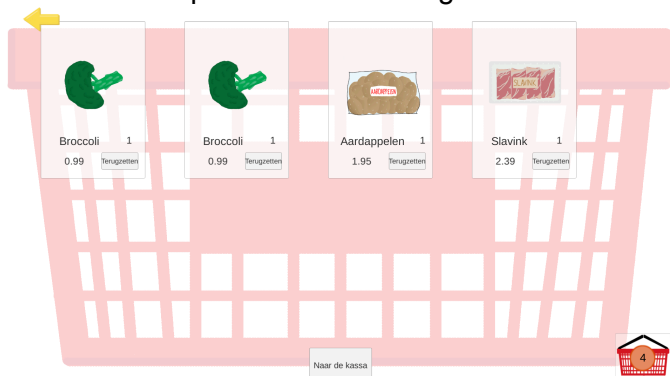
Figure 73: The grocery basket

As shown, a circle with the number of products in the basket is displayed on the icon. This way the player knows how much there is in his basket because this will also be visible in the supermarket.

In this scene the player can perform one of three actions. He can go back to the supermarket, by clicking on either the arrow on the top left, or on the basket on the bottom right. He can put a product back by clicking the button underneath the product, or he hits 'to the cash desk' in the bottom.

Arrived at the cash desk, the total price is shown, and the player can decide to buy it, or to go back to the supermarket.
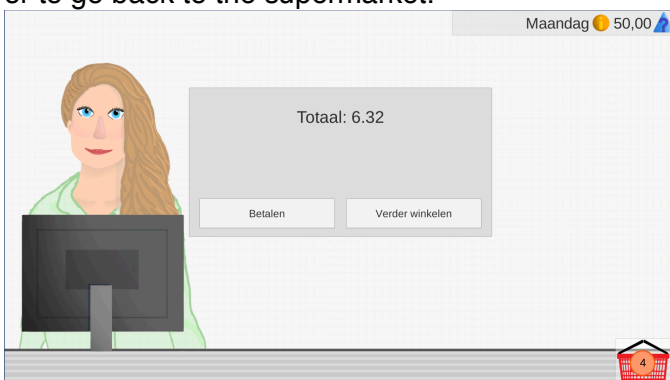
Figure 74: The cash desk of the supermarket

When the player has finished grocery shopping, he is back to the village square.

Figure 75: The village square with four products in the grocery bag

As can be seen Figure 75, the player now has less money. Additionally, if the player clicks on the grocery bag in the bottom right corner, there will be some products in the bag.

In-between screen to the castle

To get back to the castle, the castle on the hill can be clicked on. This brings the player to the gate of the castle, where he can choose which room he wants to go to. These rooms are the dining room, the kitchen and the catapult.

Figure 76: The in-between screen

Storing area

Back in the kitchen, the player can open the grocery bag by clicking on the icon of the grocery bag in the bottom right corner. This opens a split screen, where on the left the storage space can be seen and, on the right, the products in the grocery bag.
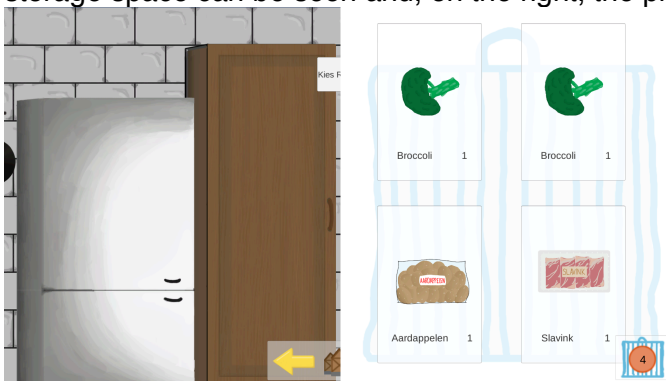
Figure 77: The split screen of the storage space and the grocery bag

In order to empty the bag, the products can be dragged to the storage cupboard of the player's choice. In Figure 78, the broccoli gets dragged to the fridge.
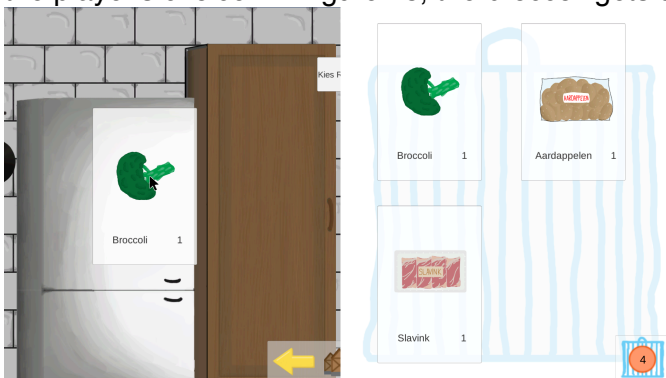
Figure 78: Dragging broccoli to the fridge

To close the grocery bag, the icon in the bottom right can be clicked on again and the kitchen is visible.

In order to view the products in the storage, the player only has to click on it. Figure 79is the inside of the fridge, where the broccoli's and the meat are.
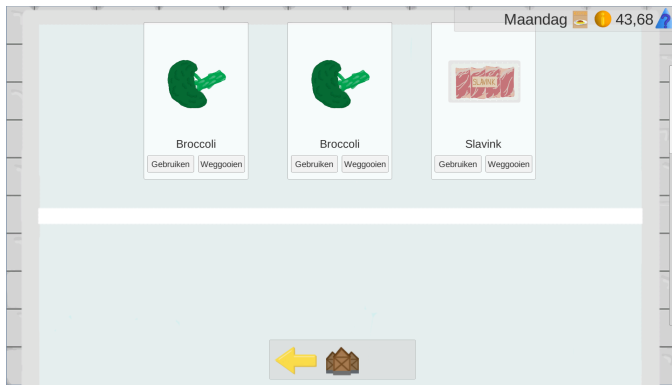
Figure 79: The inside of the fridge

This is the inside of the freezer.
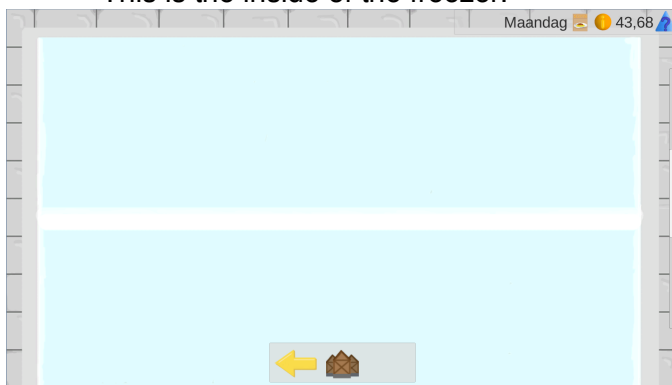
Figure 80: The inside of the freezer

And in Figure 81 is the inside of the cupboard, where the potatoes are.
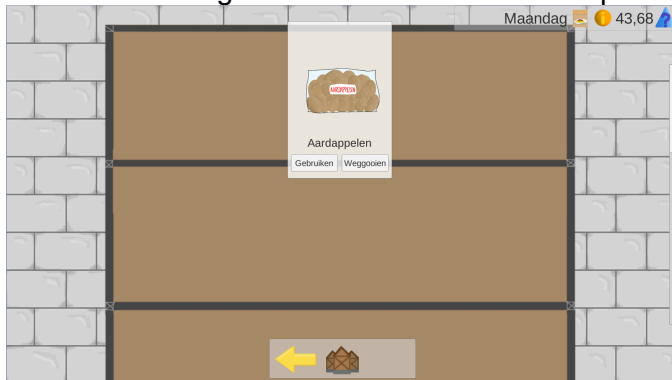
Figure 81: The inside of the dry cupboard

The insides of the storage spaces are faced forward. This has been done, because of a system that had been decided on for storing products. However, due to time constraints it was not implemented, and the description of this system can be found in chapter 10, future work. For now, it is kept like this.

Cooking area

To close the cupboard, the arrow on the top left corner can be clicked on and the player is in the kitchen again. On the top in the middle, there is a button that says, 'start preparing a meal'. If they player is ready to cook, he clicks on this button and a menu appears as depicted in Figure 82.
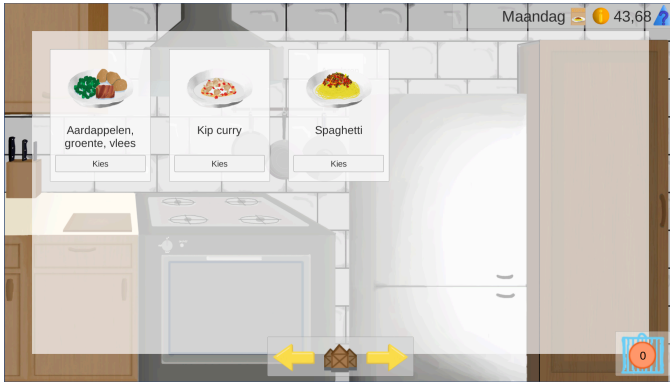
Figure 82: The menu where the player chooses a recipe

In this menu the player chooses which recipe he is going to follow. When a choice is made, the player can put the items he needs from the storage area to the kitchen counter.

In the total view of the kitchen, no actions of cooking can be performed. Therefore, to get closer to the cooking area, the player can click on anything of the left side of the screen, which gets him closer. In order to put products on the counter, the player opens up a cupboard. There each product has two buttons, one to throw it away and one to use it. Clicking on 'use' puts the chosen product on the counter as can be seen in Figure 83.

Figure 83: The cooking area with products on the counter

To put a pan on the stove, the player can click on the pan of his choice. Three pans are hanging on the wall, and two others are in the cupboard below, which can be opened by clicking on it. As soon as a pan is on the stove it is filled with water or has some oil or butter in it. This will warm up and when that is ready, food can be dragged into the pan.

Figure 84: The cooking area with pans on the stove

When the food is dragged to a pan, a bar appears where the player has to fill in how much grams they want to use of the product.

Figure 85: The cooking area with the bar where the player fills in how much food they want to prepare

When food is put in the pan, it will start to cook, and a timer appears above it. The purple triangle above it, slides over the bar to show where the food is at.

Figure 86: The timer

When the triangle is above the green area, the food is ready to be served. This is depicted in Figure 87. To stop the food from burning, the player can click on the pan and the timer will disappear.

Figure 87: The cooking area with cooking food

When the food is ready, the player can click on the button 'serve', which will place the food on plates and on the table in the dining room.
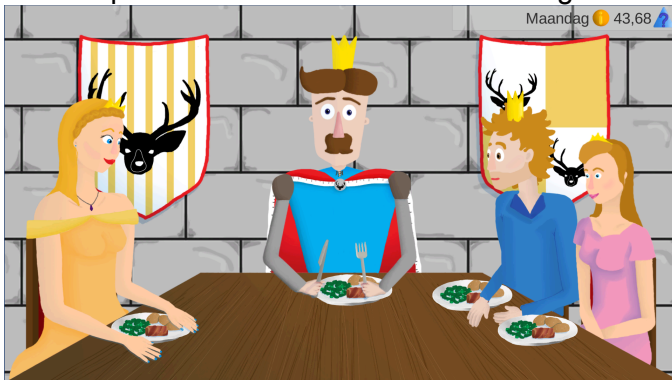
Figure 88: The dining room where dinner is served

While having dinner, the king notifies the player about what he thinks of the food. This also happens afterwards.

Figure 89: The dining room after dinner

When they finished their meal, a button appears on the bottom with 'clearing the table'. If they did not eat everything, because it was either not prepared well or too much, the left-overs are thrown in the garbage bin.

After cleaning the table, it is immediately the day after and the king notifies the player how many people will join him for dinner.

Figure 90: The dining room when a new day has started

After the first day there is a time bar on the top middle and it can be seen that a new has started, because on the top right it now says Tuesday, while before it said Monday.

The time bar will start to fill up and the player has to give the king food on time. When the bar reaches the icon with the crown on the plate.

Catapult

If there are any left-overs after dinner, the food has to be thrown away in the garbage bin. The garbage bin is part of a catapult.
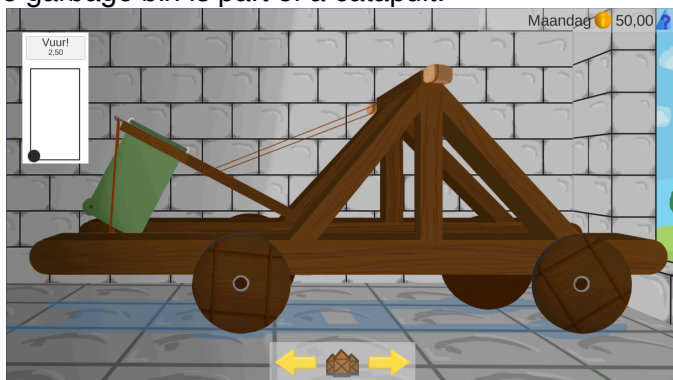
Figure 91: The catapult

On the top left it is visualized how much waste is present in the garbage bin. If that reaches the top, there will be food waste visible just above the garbage bin.
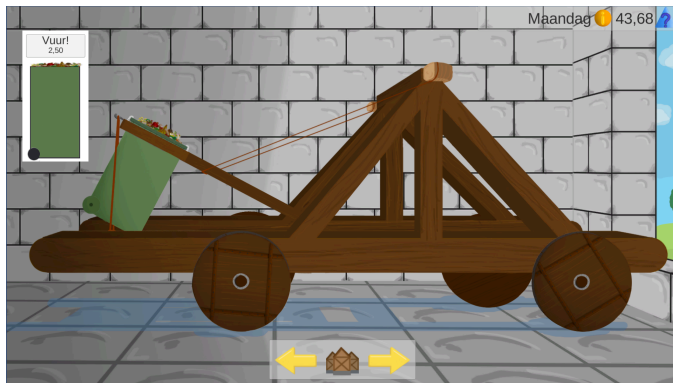
Figure 92: The catapult with a full garbage bin

To empty the garbage bin, the catapult has to be launched, which can be done by clicking the button 'fire!'. It costs two euros and fifty cents to fire the catapult. The food waste is launched to the outside, and the player will not immediately see that the food waste ends up in the village.

In the back-end of the game, it is known that the garbage bin can hold up to 2 kilograms of food waste. However, it is not necessary to wait for the garbage bin to be full in order to empty it. The player can empty the garbage bin anytime, but it will always cost two euros fifty.

The more food waste the player creates, the more food waste there will be in the village.

Figure 93: The food waste on the village square

The other stores

The village consists of more than a village square and a supermarket. When on the village square, the arrow to the right is clicked on. The player goes to another street.

Figure 94: The street with the butcher

In this street the player can find a butcher.

Figure 95: The butcher

At the butcher, chicken, beef, pork and fish are presented. They are all fresher, which is tastier, than in the supermarket, but therefore also more expensive and their expiration date is shorter. Likewise, the player can also click on a product to view more information.

Figure 96: The pop-up with one of the available products in the butcher

Again, to buy the products, the player can go to the cash desk, where they get the choice to buy it or to continue with the shopping.

Figure 97: The cash desk of the butcher

The same holds for the arrow to the left at the village square. This brings the player to another street, where the green grocery is located.
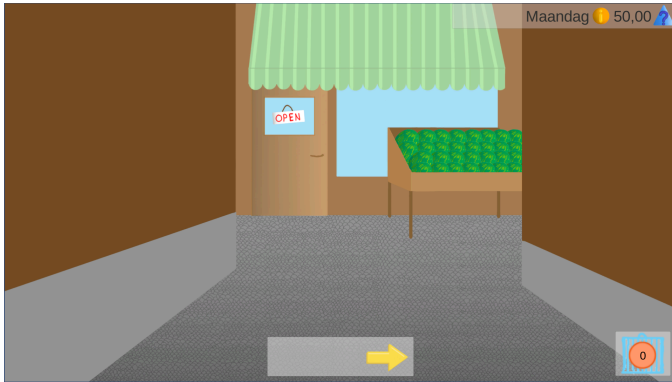
Figure 98: The street with the green grocery
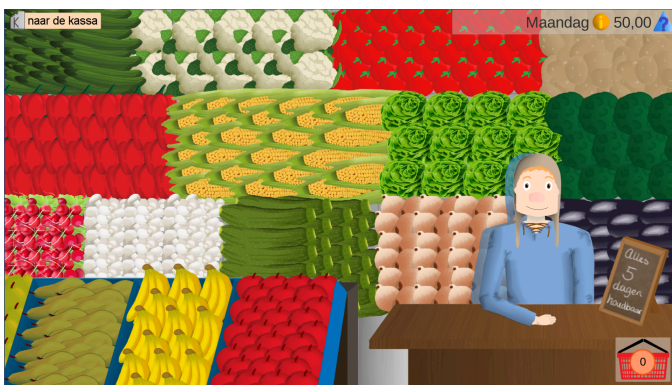
Figure 99: The green grocery

The system from the supermarket and the butcher, also applies in the green grocery. The player can click on a product to find more information and in order to buy the products, the player has to go to the cash desk.
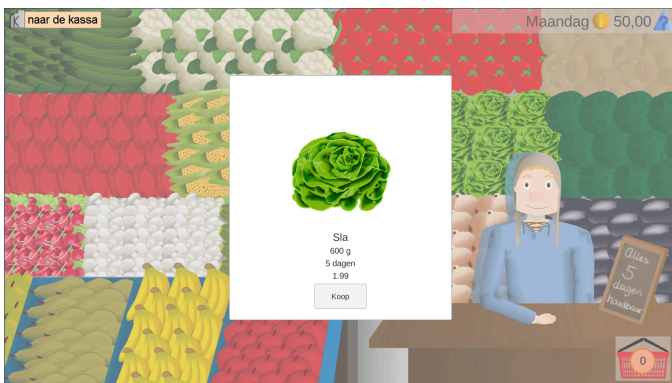
Figure 100: The pop-up with one of the available products in the green grocery
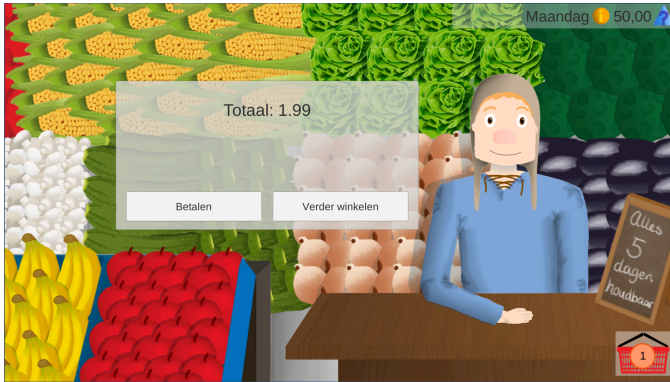
Figure 101: The cash desk at the green grocery

Info screen

At all times, the player can click on the circle with the 'I' in it on the top right to open up the info screen. Here different aspects are shown.
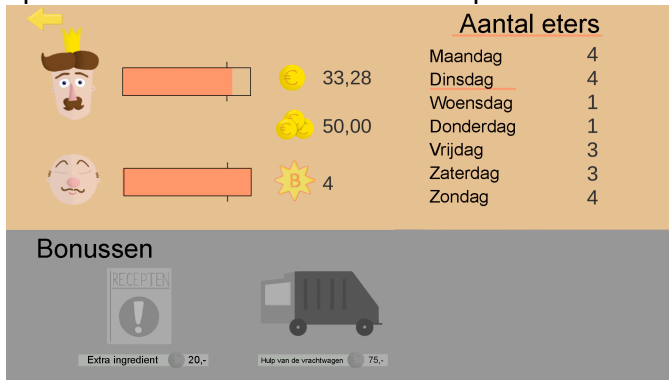
Figure 102: The info screen

On the right, it is described how many people eat that week and on which day. In total, there will be twenty people every week. This can vary each day, but the total amount per week stays the same. The orange stripe underneath the name of a day indicates which day it is and how many people the player should prepare food for.

Then on the left there are a couple of icons. First there is the king and the bar next to him, which shows his happiness. The emotion on the king's face changes depending on how full the bar is. If the king is really happy, his face will be happy, the bar will be full, and the player will get bonus points, which is depicted by the star icon underneath the coins. With the bonus points, the player will be able to get a reward. However, this is not yet implemented in the game.

Underneath the king's bar, there is the bar of the villagers, which depicts their happiness. For them as well, will the emotion on the face change according to the fullness of the bar. If the villagers are happy, the player also earns bonus points. If

Then there are two icons about money. The upper one, with just one coin, is the amount of money the player still has for that week. Below that, the three coins, is the budget of the week.

The time bar

Figure 103: The time bar

At the beginning, the player has a lot of time on the first day to figure out the controls of the game. The second day the player has to serve the food to the king on time. This time is depicted by the bar in Figure 103. The orange slowly fills the bar starting on the left. When it reaches the crown on the plate the king wants his dinner. If the player serves the food after that, the king is less content because the meal arrived too late.

Conclusion

When the final game was finished, it needed to be evaluated. In order to have extra feedback, tests have been performed. Both the evaluation and the tests and their results are described in the next chapter.

Chapter 8 – evaluation

In order to evaluate the final version of the game, different aspects are taken into consideration.

The requirements

First it is checked it the final game meets all the requirements that were set with the client. The requirements themselves are already discussed in chapter two and three. Chapter two consists of a state-of-the-art review and concluded with two elements that should also be used in this serious game. These two aspects are:

- There should be a colored timer to show the progress of the cooking food
- There should be enough detail in the art of the game

It is clear that the first element is implemented in the game. If there is food in a pan, there is a colored bar above it where a purple triangle slides over it to show the progress of the cooking food.

The second requirement is a bit more nuanced. There are parts of the game that have a lot of detail, while other parts do lack certain detail. For example, the kitchen and the village streets missed some details.

In chapter three different requirements were established. At first, the client notified the students what the end product should be. These requirements became:

- The product has to be a serious game
- The product has to collect data
- The product has to be about food waste
- The game has to be in Dutch
- The first version has to be limited, small and simple

It is fair to say that the first four requirements are met. The final product is a serious game about food waste, that collects data. The mother language of the two students working on the game is Dutch and therefore, it was not any trouble to create the game in Dutch. The last requirement of this list is fulfilled to a certain extent. In order to explain this, the requirement is split into three elements; limited, small, and simple.

The final version of the game is limited to the extent of available products and recipes. Not all products that can be bought in real life can be bought in the final game. There are even less possibilities in cooking the products due to the limited number of recipes. More recipes had been created and there are more variations within recipes, but due to the time limit only three recipes with one to three variations have been created to be cooked in the game. Additionally, there is a limitation to how much food waste is visible in the village and to the reactions of the king towards the player. In total, there are one-hundred-and-seven voice lines recorded, but there is still a chance that some reactions are missing or that some details are not included.

The second element of the requirement is that the game should be small. In the final idea of the game, many elements were thought of and there were 100 factors written down that influence the behavior of people. The client highlighted the factors that were the most important to them, but it was still on the big side. This can be caused by the fact that life is complicated. In real life many factors play a part in the decision making, not only when it comes to food, but with anything in life. Therefore, if the game was more simplified, the behavior would be less realistic. However, the game managed to not involve too many factors and there are still possibilities to extent the game.

The last element of the requirement is that the game should be simple. The game is simple in a way that it is fairly easy to extent elements of the game. From this position, more products can be added, more guests, more recipes and more factors can all be added to make the game more complex and possibly more fun to play.

The discussed requirement can be met, depending from the view it is looked at. The game already involves quite some elements and has quite some details. At the same time,

the game is at such a point that it is fairly easy to expand the elements and to make the game bigger and more complex.

Another very important requirement given by the client, that is worth mentioning separately is:

- The game has to incorporate the food cycle in a household (> *provisioning* > *storing* > *preparation* > *consuming* >)

In the final version of the game, the player has to buy the food (provisioning), store the food (storing) and prepare the food (preparation). The last phase, consuming, is not done by the player themselves, but by the king in the game. Therefore, that phase is also included, and the game meets this requirement.

The client is going to use the game as a research tool. Therefore, they established some requirements of the data that should be collected. This gives rise to a second set of requirements:

- They want to keep track of the budget and not have unlimited money
- They want to incorporate the shelf life of products
- They would like to see if there is a balance between money and food waste
- They want to figure out if a person is driven by money, health or the shelf life of products
- They want to be able to check the amount of nutrients, whether the prepared food is relatively healthy
- They would like to be able to see the relation between choices in the supermarket and at the storage to the amount of produced waste
- They would like to see all the player's choices

Since this part of the research on the game focusses on the design, the details of collecting this data is not being discussed further. However, this set of requirements still contains important elements that should have been incorporated into the design, which is discussed here instead.

The first two requirements are met. The player can find the expiration date of products, and when the products pass that day they start to rot and there was even a stinking smell animation created for it. The king decides on a budget for the player to use each week. Therefore, the player cannot use an unlimited amount of money.

The third requirement is already partly met, the other half is incorporated by having a garbage bin. The garbage bin has a certain capacity, which also matches with how much food waste is visible in the village square. Therefore, the third requirement is also met in respect to the design.

The next two requirements involve the element of health. The king should be given healthy food since that is the only way he and actual human beings stay alive. The player has the possibility to give the king healthy food, because there are many vegetables and fruits in the game and in the recipes, there are enough variations and enough in quantity for each nutrient. However, there had been an idea of having the king become either really fat or thin if the player does not give enough healthy food, which could even cause the king to die. Unfortunately, this idea is not corporated in the final game, but it is described in chapter ten about future work.

The last two requirements are about the choices of the player. The player goes through the complete food cycle of households and therefore, there are enough moments where their choices can be collected.

The initial idea

The second aspect for the evaluation is to check if all the elements from the initial idea are in the game. Before creating the game, many aspects had been thought of, but during the creation some details have been changed. This could have been for the better, but

it might have happened that some important elements are missing. Therefore, the initial idea will be discussed part by part and compared to what the final game looks like.

In the initial idea, the villagers would pay taxes to the king. The quantity of the taxes would be depending on the amount of food waste in the village. The more food waste, the less taxes the villagers would pay to the king. The taxes would not have influenced the budget of the player. The money would have passed on to the king, who would have decided what he was going to do with it. In the final game, the villagers do not pay taxes and the player earns reward in another way. Therefore, in the final game the villager's money and the villagers do not influence the player's budget, as should have been in the initial idea. This has thus actually happened by chance since the villagers do not pay taxes in the final game.

The initial idea described the king being animated to have more liveliness in his actions. It had been animated that the player would see the king talk. Unfortunately, due to time constraints it had not been implemented and more details of this animation can be found in chapter ten with the future work. According to the initial idea, there would be around the same number of people eating each week. This has been implemented in the game, where the number of people is actually always the same per week. It is different per day.

The player has to give the king food and the initial idea mentioned three requirements the king would judge the meals:
- There has to be enough variation, both between and within meals
- There has to be enough food in terms of quantity
- The food in general needs to be healthy

The first requirement could have been implemented in the game, but due to time constraints it had not been implemented. Admitted, it might have been somewhat difficult, since there were just three recipes with a few variations, which could have been a lot more.

The second requirement the king judges the meals upon, is that there needs to be enough food in terms of quantity. This has been implemented in the game in such a way that the food, that the player has prepared, could have been too little or too much. If there is too little, the king asks for more, and if there is too much, the king will not eat everything on his plate.

The third and last requirement from the king is that the food needs to be healthy in general. Unhealthy food would have been accepted from time to time, but in the final game the king does not look at it. The king will just eat what is served to him.

These requirements that the king uses to judge the meals, lead to an aspect from the initial game, where the king could become either really fat or really thin, and die. However, since the king does not judge the meals on variety and healthiness, this aspect has not been implemented. The king could have become really thin from not getting enough food, but due to time constraints he had not be drawn really thin.

The initial idea described that the storage space would be empty at the very beginning. In order for the player to fill up the cupboards, they would have to do grocery shopping first. When they get back in the castle, the player could open up the grocery bag by clicking on its icon and then drag the products out of his bag into any of the cupboards. The player not only had to put the products in the right storage space, to preserve the product the right way, but the player also had to fit all the products in the cupboards. The latter had been chosen, because space in a cupboard is limited. If there were too many products the player should find a way to place them in such a way that another product could fit in the cupboard as well. In order to have this system, there would only be looked at the front of the product, such that the space it is viewed in is 2D. This had been decided to decrease the amount of work, because 3D would be more difficult. However, that would have made the game more realistic. Nonetheless, this system had not been implemented in the game this way. There is a limited space in the cupboards, but this limit is not found in the actual available space, but in the number of products placed in the cupboards. Additionally, the initial idea specified that products that stay in the grocery bag rot faster than if they were to be put in the storage space. This could happen if the storage was full, or the products were forgotten. This had

been decided to not have the player use the grocery bag as a storage space. However, this system had not been implemented in the game. In the final product, the player has to put the products in the storage space in order to be able to use them. This is one way of decreasing the issue, because it might still happen that the player does not need the product for a while and he could leave it in the bag. To conclude, filling up the storage space and the faster rotting products in the bag are not implemented the way the initial idea described. However, the final game does start with an empty storage space, which should be filled by doing grocery shopping.

In the initial idea the action of the cooking were simplified. The actions would be:
- The player should click on a pan, and it would appear on a stove with butter, oil or water in it and the fire underneath on
- By placing the food on the cutting board, a slider would appear where the player can choose how much food he wants to cut
- The player should choose a knife, place it on the vegetable or fruit on the cutting board, and the vegetable or fruit would automatically be cut
- Before the cutting happens, the player could choose one of two ways of cutting, where one way produces more food waste than the other
- Each pan should have an option to set a timer, which could be achieved by clicking on a button
- If there were to be any left-overs after a meal, the player would get two choices; save the left-overs in Tupperware or throw it away

In the final game the cooking has been simplified even more. The player can click on a pan to put it on the stove with butter, oil or water in and fire underneath, but the vegetables and fruit do not need to be cut. The player can drag the food immediately to the pan in order to cook it. When they dragged the ingredient into the pan, a small input bar appears where the player should fill in how much grams they want to cook. Hitting enter, places the food in the pan cut and ready to warm up. Thus, the cutting of products is not implemented in the final game, even though, it would have made the actions more realistic. However, even though the cutting was not in the game, the participants of the tests did feel that their actions were realistic. In the final game, the player does not have to click on a button to set a timer. As soon as a product is placed in a pan, a timer appears above the pan to show the progress of the food. After a meal, the final game does not provide the player with the choice to save the left-overs or to throw it away. Instead, the left-over food is automatically thrown away. This is not very realistic, and therefore this aspect is taken to chapter ten, future work. The meals that the player can cook should be specified in recipes according to the initial idea. The player cannot improvise, but within recipes there are variations to keep the game interesting. This is the same in the final product. However, while ten recipes were written down, only three were implemented in the final game with just a couple of variations.

The initial idea described that the garbage bin should be a catapult. The player can fire the catapult at any time for a certain cost and the food waste will be thrown outside. It should not be visible at first that the waste ends up in the village. The garbage bin should only be filled with food waste. The packages do not count as waste. This system the initial idea described has been implemented in the final game exactly as described.

A small detail in the initial idea is that the player has access to a note block. They should be able to make notes or list to take with them to the supermarket. Art had been created, but the note block is not implemented in the final game.

In the initial idea the player starts on the village square when they go to the village. On the village square there should be villagers walking around, either happy or angry, depending on how much food waste there is. In the final game the village square is where the player starts and there is one villager sitting on a terrace, whose emotions are visible. Since the drawing of the village square was in perspective, it would have been more difficult to have a villager walking. Therefore, the villager is sitting. There could be more liveliness and more villagers on the village square, but due to time constraints there is only one. The

initial idea also described a garbage man walking around in the village. There has been created art for the garbage man, but he has not been implemented in the final game.

Furthermore, the initial idea specified that the supermarket should be the most accessible store, where the products are slightly cheaper than in other stores in the village. In the supermarket the player should be able to navigate through shelfs to find products and by clicking on a product a pop-up should appear with some additional information on the product, including the expiration date. In order to leave the supermarket, the player should pay for all the products in his grocery basket. If the basket is empty, they should be able to leave the store as well. This exact system is implemented in the final game. The pop-up in the final game shows the name, the quantity, the expiration date and the price of the product. When the basket is empty, the player does have to pass by the cash desk in order to leave the store.

In the village there should be three other streets according to the initial idea. On these streets the player should be able to find a green grocery, a butcher and a bakery. In these stores the food should be fresher, and therefore slightly more tasty. However, the products should be somewhat more expensive than in the supermarket. Besides this additional information, the system from the supermarket should apply here as well. In the final game, two of the three stores are implemented, which are the green grocery and the butcher. The bakery has not been implemented, because the focus of this first version of the game was on dinner and therefore, bread and pastries would not be important. In the final game, the products in these stores are fresher, tastier and more expensive than in the supermarket and the system of looking at products and leaving the store is the same in these fresh stores as in the supermarket.

In order to give the player information on the state of the game, the initial idea describes a monetary overview, which should depict a couple of elements to the player. These elements should be:
- The happiness of the king
- The happiness of the villagers
- The amount of money the king has and the limit it has to pass in order for the player to earn rewards
- Rewards
- The budget of the week
- How much money the player still has for the week
- A piggy bank, where the player can store money in, but not take money out of it

In the final game, the monetary overview is called the info screen since it depicts more than monetary aspects. The info screen does show the happiness of both the king and the villagers. However, the amount of money of the king is not depicted here, because it actually is somewhat weird if a servant could see how much money the king has. In the final game, there is another system used to have the player earn rewards. Therefore, the info screen does depict the rewards, but the player can earn them by having either or both the king and the villagers happy to a certain level. Despite showing the player the happiness of these characters, in the final game he cannot actually get the rewards, therefore, this is further explained in chapter ten, future work. Instead, the player can get bonus points to see how well they are doing, although they cannot do anything with the bonus points. The budget of the week and how much money the player has are two elements that are depicted in the info screen. However, it might not be immediately clear that the budget is given for a whole week. The piggy bank is an element that is not implemented in this version of the game, since there had been a lot of confusion about the function of the piggy bank. In the final game, the money that is left at the end of the week just disappears and the player starts the week again with the budget.

The tests

In order to answer the research questions, tests have been performed. In total there were three tests divided in two parts.

Test 1

The first part consists of two tests. The first test answered the question if the looks and feel are suited for the target audience. This was tested by using a digitalized paper-prototype, where the player can navigate through the game and see all the art that has been made. This digitalized paper-prototype was hosted online such that the participants could run it on their own device, just like the final game. The participants were instructed to run the prototype in full screen. In different scenes, some extra controls were added to allow for some extra actions. In the dining room with the king, the buttons G-H-J-K-L can be pressed, where J is the starting point with a neutral king. The other buttons give another emotion, K for example makes the king content. One step further, L, makes the king happy. Going back with the letters, slowly makes the king angry. At every emotion the button A can be pressed. When pressing the button A once, the king will talk to the participant. At the village square, the buttons Z-X-C-V-B-N can be pressed, starting at Z. That button gives no waste. Going up in the row of letters, more food waste will be visible, going back gives less waste. This little interactivity was created, to be able to show more of the art that had been created. However, the participant was not able to actually play the game, but that was not necessary for this test. This digitalized paper-prototype can be found in the link in appendix 7 and consists of some old art. The cookbook and the info screen are an earlier version and the prototype does not have the extra streets with their stores and the extra characters.

During the exploration of the game, the observer talked to the participant to tell what the player would be able to do in the playable version of the game. Because only looking at art, might not give the participant enough information on what would be possible in the game. Afterwards, the participant filled in a questionnaire, because in a questionnaire everything the participant thinks can be written down easier, than if he told the observer. In that case, the observer would have had to write really fast to get everything the participant said, and he might miss some important aspects. However, while the participants filled the questionnaire in, they talked to the observer, who wrote the important notes down. The questionnaire can be found in appendix 8.

The participants who were involved in this test, were people who fulfill part of the requirements of the target audience. They had to be adults who are responsible for a household. However, it was not necessary that they only go grocery shopping once or twice a week. This was because their actions in the game were not measured in this test. This test was to verify if the looks and feel are suited for these adults.

The participant group consisted of parents from friends, family and acquaintances. In total eleven participants performed this test, where at most times the observer went to their house and showed them the questionnaire and the prototype. The observer knew all the participants, some better than others, but all participants have been instructed to be honest, since it could have influenced the end-result. However, it should still be noted that this might have influenced the results, as the participants might not have wanted to give negative feedback to the observer. Before the participants could test the game, it was explained that the prototype is not a playable version of the game, but that it was created to show all that could be seen in the game.

Result test 1

Of the eleven participants, six were Male and on average the participants had three children. The question about their age included age ranges, therefore an average cannot be given. Instead, Figure 104 depicts the number of participants in each age range that had answers. An option was the age ranging from thirty to forty, but none of the participants had that age.

What is your age?
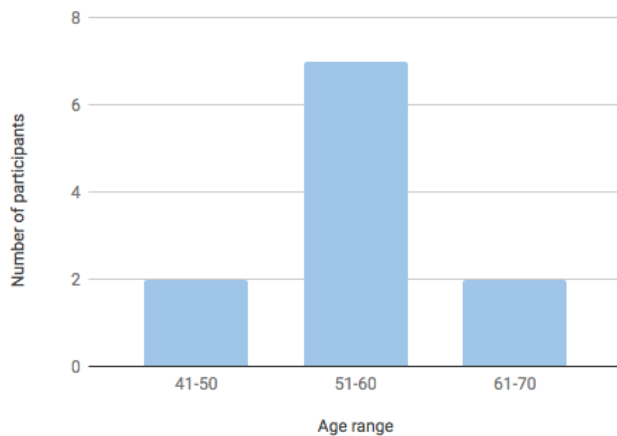
Figure 104: Graph of the age range and the number of participants

The questions about the art in general are responded on a positive side. On a scale from one to five, the lowest score was three and the highest was five. The average was a 3,9. When the participants asked what the feeling was they got from the game, the answers ranged from cheerful to challenging and curious to funny. One participant had some confusion about the balance of the different times in the game, the medieval and the modern times. Although, the results are good, they can be better. In order to see what could be better, the rest of the results are analyzed.

Based on the art, the participants are likely to recommend the game to others. However, they are less likely to play the game for a longer time themselves because that scored on average a 2,5 on a scale from one to five. The scores given for that question has a wide range in scores. Three participants scored it a one and just one participant scored a five. Many of the participants who gave a low score told the observer that they do not play games. One participant even mentioned that their job is behind a computer and therefore, they are happy when they have some time off of the computer. This causes them to have scored lower and thus, they would not be likely to play the game for a longer time. This could very well apply to other participants, because of some of them it is known that they have a job that requires them to sit behind a computer. Although this is not an issue of this specific game, it should be taken into account, because these participants are likely to also be part of the target audience.

However, the question of playing the game multiple times scored on average higher, because it scored a 3,3 on average. This could be because they do not have much free time in one go, but it could also be caused by boredom. Unfortunately, the participants who scored this question higher have not been asked why they did that, so the reason cannot be confirmed. In general, the participants are not very likely to play the game for a longer or for multiple times.

The king and the dining room were generally liked. The participants scored on average a 3,7 when they were asked if they would play a game where they would have to take care of the king. In these answers there was one participant who gave a one. That is the same participant who said that they are happy when they have time off of their computer and do not play games in general. The king and the dining room scored a 3,6 on their likeability on a scale from one to five. Therefore, it was generally enjoyed and the feedback that the participants gave was about adding details on the table, for example a candle or a vase with flowers, and the participants would have liked to see guests and the queen.

The catapult scored extremely high. All the participants would have liked to see the catapult being fired.

The participants were somewhat positive about the village square and the credibility of the food waste. Every participant mentioned that they would have wanted to see people and more details. There should have been more liveliness on the village square. The food waste scored on average a 3,4 on a scale from one to five. There were some participants who did not notice the waste at first or they thought it was something else.

Both in the cookbook and in the supermarket, the participants would have liked to see more possibilities of products and products that enhance certain tastes. There could have been some special recipes, or spices and one participant even mentioned drinks.

The monetary overview was more clear than evident, but the biggest issues the participants mentioned were that some symbols were not immediately understandable and that the categories are not clearly separated. A couple of participants said that the budget is somewhat small in order to please a king.

The general notes that were written down is that there should be more details and more liveliness in the game. The first can be achieved by adding a vase of flowers in the dining room and including more colors in the palette. The latter can be achieved by drawing guests, villagers and adding ambiance sounds. There were some small details that the participants noticed, and they were taken into account for creating the final version.

Test 2

The second test of part one was to find the biggest issues of the game play. An earlier and simpler version of the game had been used in this test. In order to discover these issues, friends have been asked to participate and play the game. Since the focus of this test was finding big issues, the participants did not need to be adults who are responsible for a household and go grocery shopping once or twice a week. However, experience with grocery shopping and cooking was helpful to understand the game.

Before the participants started playing the game, they were asked to think out loud while playing the game. This was to hear their thoughts immediately when they think it, because afterwards people could forget what they thought about the game. The observers did not help the participant, unless they were extremely stuck.

After the play testing, the observers asked the participant a few questions, which can be found in appendix 9. These questions were asked to find more details on what was not clear, what should be better and how it could become better.

Result test 2

The results of test two consisted of the biggest issues of the game that needed to be fixed. In the final game they are fixed and therefore, the results of test two will be described in the big differences of the version used in the test and the final version.

The participants felt stress at the beginning of the game, because the time bar was present from the very beginning and they did not know how the game worked. When they were asked what they would change, they said that it would have been nice if they were given some time to figure out the game controls or if there was some form of tutorial. The idea of having some more time was integrated in the final game. In the final game, there are only time constraints from the second day on and there is a small screen with a bit of explanation on the buttons.

In the version used for this test there were only two recipes available and no options of variations and the cookbook was difficult to find. In the final game, there were three recipes with a few variations available to the player. However, there has not been made any changes to find the cookbook.

The cupboard in the kitchen did not have a door, which caused the products to seemingly disappear. In the final game, there is a door. So, the participants did not panic when they dragged a product to the cupboard and it seemed to disappear.

The icon to the village was smaller and in the top right corner, therefore, the participants had a lot of trouble discovering how to get to the village. In the final version, the

icon was slightly bigger and between two arrows on the bottom of the screen. This was better, but it still had some troubles, which are discussed in the results of test three.

On the top right it was depicted how much money the player still has, but what the participants did not realize is that they could click on the money icon to find additional information, including the king's happiness and how many people have dinner that day. This could have been, because the icon was a coin and right next to it, the amount of money was written. In the final game, this icon is changed to a circle with an 'i' for information in it.

In the game version that was used for this test, the king always sat alone. Even when the game said that there were guests. This was confusing for the participants, also because they could not find the monetary overview. In the final game, three characters were introduced, the queen, the prince and the princess.

Finally, there were also a couple of bugs in the game. One being that the pans reset themselves when the player leaves the cooking area. When the player wants to put food on the counter, they have to go to the storage area. However, when they get back in the cooking area, the pans and the food in it had disappeared and the player would have had to start again. In the final game, the pans and the food stay on the stove. Nonetheless, the timer above the pan do reset themselves when the player leaves the cooking area.

Test 3

The second part consisted of one test, which answered two questions, 1) whether or not the look and feel of the game nudge the player to a behavior that they do in real life as well, and 2) if the game was compelling to the target audience. In order to get such an answer for question one, it needed to be looked at whether the player's actions, or what they want to do, in the game are comparable to real-life behavior. To test that, it has first been asked what the participant usually does in real life. This is done with the questionnaire in appendix 10. This questionnaire gathers information about the participants actions in real life related to food and provides the research a clear overview of these actions.

After the participant has filled in the questionnaire, they played the game, which was the final version that had been created. During the gameplay they were observed and mainly their actions have been looked at. The observers kept track of what happened while the participant played the game by writing it down. The observers also wrote down if there were actions that the participant wanted to perform that he was not able to do. By looking at the participant actions while playing the game, it was immediately clear which aspects of the game worked out well and which parts were unclear.

Because of the test set-up, it is possible after the playtest to verify their questionnaire answers with their actions in the game. On top of that, after the game test, the participant was interviewed. The results of the interview were used to understand the opinion of the participants about the game, but also to further improve the game as part of future research. It had also been asked, if the participant felt like his actions were realistic or not, because their feeling is also important. How a person feels about the game, influences their opinion and their further interaction in the game. The questions that were asked during this interview can be found in appendix 11. The interview had been held, because the participant could tell what he thought. This way it was much easier for the participant to get across what he felt during the game.

Before the test started, the observers notified the participant that while playing the game their actions are being collected. This data was only used as a reference for the observers to match what the participant answered in the questionnaire to what actually happened in the game. The participant was told that this data would not be given to third parties.

Since the focus of this test was to investigate if the game design nudges the player to perform realistic behavior and if the design suits the target audience, adults who are responsible for household were asked to perform the tests. In order to find participants for test 2, teachers, family and friends were asked if they were willing to participate. The game

and questionnaire were set up in a closed room, where the participant could comfortably sit behind the laptop and the two observers could watch along without interrupting the participant. This test was done a whole day, with a minimum of four participants. However, some participants were not able to be present at the location. Therefore, the observers used Skype in order to perform the test. In that case the participants were asked to share their screen, so it was visible what they were doing in the game. It had been planned this way, because it was on a short notice and even though it was not ideal, it still helped in getting useful data.

Result test 3

The four participants were equally divided in male and female, and the results from the questionnaire were scattered. Since the results of the questionnaire were only used to determine if the participants actually used realistic actions in the game, the results will not be further discussed here. However, it was very difficult to compare the results of the questionnaire with the actions in the game, since there were still some major issues that the participants encountered. These will be discussed first.

One of the first issues participants encountered was that they were not able to create their own meals. When the player wants to start cooking, they should first choose a recipe by clicking on the button 'choose recipe'. Only because of the button 'choose recipe' did the participants realize that they had to follow recipes. However, the cookbook was discovered late in the game, which caused some frustration to the participants. Because the game said that a certain product was not part of a recipe, but the participants could not find out which products were. When the cookbook was finally found, the participants had difficulties finding recipe three, which was on another page. All the participants had help finding the bottom right corner folded, which turns the page when clicked upon. One participant was annoyed by the fact that the cookbook does not stay on that page when they were cooking recipe three. When they wanted to check how much of a certain product they should use, they had to turn the page again. All the participants did not read the sentence 'this recipe is for four people' at first and some never read it.

Many of the participants expected to have a visible list with the ingredients after choosing a recipe, in order to know which products, they should put on the counter. This was partly caused by not having found the cookbook. For the same reason, the participants had bought products that they could not use in any of the recipes and therefore, some participants throwed that food away. This should not happen in order to collect realistic data and thus it needs a deeper look.

In general, all the participants were disappointed by the cooking system and wanted to cook their own meals and variations. Because the participants were not aware of the limitations within the cooking system, the data collected cannot be considered realistic.

Furthermore, another major problem that arose was the game navigation. The navigation has provoked a lot of difficulties for the participants, which is caused by a couple of different elements. It has seemed to be hard to go back to the castle. On the village square the castle can be seen from a far, but it is not clearly visible that the player can click on it. To get back to the castle, the player should click on the castle. Most of the participants needed help figuring that out. This could be, because it is not visible that it is clickable, but it could also be because it is small, and it has very similar colors to the buildings on the square and therefore is less noticeable.

Moreover, the navigation arrow buttons caused issues. This is induced by having the same arrow on the same place mean different things. For example, the arrow on the bottom pointing to the left can do two things. Clicking on it either gets the player to another space in the game, like the dining room, or it means to go back to where the player came from, when zoomed in on the cooking area for example. Because of this, the navigation had caused some frustration.

The village button also caused navigation issues. To two of the participants it seemed like a castle and therefore, they thought it would bring them back to the castle, even though they were already in the castle. The village icon was placed in between the arrows, which caused some participants to think of it as some sort of home button. Both these issues, caused the participants to click on the village icon a lot by accident. The village icon also was visible all the time when in the castle, even when the player was cooking. That should be a time when the village button is not present, to not have the player to go to the village accidentally.

The final problem with the navigation did arise after players had chosen a recipe to cook. When a recipe is chosen, the button says, 'choose another recipe'. This was decided upon, because sometimes it might turn out that certain ingredients are missing, and the player would want to prepare another dish. However, this system has caused some frustration at the participants. For some participants it felt like they were forced to choose another recipe, because they could not make it for some reason according to the game. They did not realize that it was just a possibility to change recipes when they want to for different reasons.

Besides these problems with the navigation, the players also mentioned some smaller issues. One participant mentioned that they do not pay attention to the smaller buttons and details, especially when they have stress. One participant thought that the icons in the explanation screen worked as buttons. Participants also expected that the pop-up of the product would disappear when they clicked on 'buy'. These are all some small aspects that need to be taken in consideration in the future.

In general, the participants felt that the navigation was not clear enough, which prevented the game from collecting actual realistic data in the beginning, while the players were still figuring out how to navigate through the game. To solve these issues, it should be made clearer which images and icons can be clicked on. Making these images and icons clearer, should help in clarifying the navigation of the game.

Besides the major issues that were discovered by the participants, there were also some other issues with the game that were observed.

First of all, all the participants seemed to depend on the visible guests to know how much food they should prepare. This information could also be found in the info screen. However, the info screen was discovered very late in the game and some participants never found it. Therefore, it was barely known how much people were having dinner. The reason the participant could not rely solely on the art was because when a new day has started, the player should first go to another room and then back to the dining room. The final game has not a great system for showing the next day. Consequently, the player has to put some effort in knowing how many people have dinner that day.

Furthermore, zooming in on the cooking area in order to cook had some annoyance to the participants. They would have preferred to be able to do the cooking while the full kitchen was visible, which is easier on a laptop than on a mobile phone, where the game was actually intended on. Therefore, there should be put some research in how to improve this and make it compatible with a phone.

Another annoyance in the kitchen arose when players had to actually put pans on the stove. Participants tried turning on the fire by clicking on some places. They did not realize that it happens automatically. When they had dragged food in the pan, the timer that appeared above it was unclear in the beginning. The participants had the tendency to burn the food at the beginning of the game. When they had discovered that it should stop at the green part, they were confused and could not figure out how to stop the pan from burning the food. One participant wanted different options for the same product. They also wanted to be creative with food, for example having left-overs for dinner and cutting fries from potatoes, which was not possible in the final game.

Moreover, in the beginning of the game it was difficult to know what the player is judged upon. It should be made clearer what the king expects of the player and the food.

One participant throwed food away because there was not enough space in the storage area and the images of rotten food are sometimes unclear.

The first day that the participants played, they all bought something at all three available stores. After the first day the supermarket was mostly visited. In the supermarket it turned out that the meat in the supermarket is difficult to find. When the player clicks 'buy' for a product, a ca-ching sound is audible. This sound seemed to be confusing, because the participants thought they had bought the product as soon as they heard that sound. Therefore, they did not expect the cash desk. One participant suggested to place the sound when clicking 'pay' at the cash desk. Furthermore, leaving a store while there is nothing in the grocery basket is not clear most of the times. It took a while before the participants figured out that clicking 'pay' while it says €0,00 makes them leave the store without paying for anything. A participant proposed to have an exit button.

Finally, some smaller elements that resulted from the test. It seemed that the amount of money is not kept in mind during the game. Until the player does not have enough money to perform certain actions and then the participants tried many things to keep playing. Some participants asked for a garbage man or something to clean up the food waste in the village. As already mentioned earlier, the garbage man was part of the initial idea, but not implemented in the final game. Furthermore, all the participants mentioned that they missed something like a note block. They wanted to bring lists to the stores. At last, it turned out that the balance between the medieval times and the modern times is very much liked and does not disturb the experience of the game.

There was also a technical issue raised during the playtesting of the game. Three of the participants had a MacBook and that has caused a problem for testing the game. The standard ratio of a MacBook is 16:10. However, the game is created in 16:9, which caused the user interface (UI) to be broken. The UI was broken in the sense that part of the elements scaled to their screen, but other parts did not. For example, the castle was only partly visible, and the info screen was not full screen, but had bars above and below where the previous screen was visible. Unfortunately, the ratio could not be changed, but the participants were able to do everything in the game. The only difficulty was that the first product they had put on the counter could not be seen and used. The observers had explained the cause of this, but when the participant had put a product there, they had no issues afterwards. All the observations that were written down can be found in appendix 12.

Evaluation with the client

In general, the client seemed very content with the final game. They do agree with a lot of the results from the test. They discovered the same issues when playing the game. This final version of the game is a solid base for them to work further upon.

However, there was a lot of discussion on how to implement the reward system. At first there were ideas about the villagers paying taxes, then the villagers' happiness did not matter and in the final game the player can get rewards by having either or both the king and the villagers happy. Since the reward system did not get fully implemented in the final game, more discussion and testing needs to be done.

Chapter 9 – conclusion and discussion

In this chapter, the research is concluded by answering the research questions, evaluating if the goals of the game are reached and providing some points of discussion.

Research questions

The main research question focused on the entirety of the game and is 'how can a serious game collect data concerning food waste behavior?' This is difficult to answer because of two processes that play a role in this: optimizing the behavior towards the game's goal and the learning curve of the game.

When a player is new to the game, the player needs to figure out how the game works. This is the learning curve of the game. During the learning curve, the player tries all kinds of actions to see what is possible in the game, which causes unrealistic behavior. Testing has shown that the final game suffers from a long learning curve, caused by unclear navigation and some other issues. This means that all data collected during the learning curve is unusable.

The second process is the player optimizing their behavior towards the goal of the game, which is to keep both the king and the villagers happy. During the game, there will be one point at which players discover the goal of the game. At that point, people will start optimizing their behavior towards this goal. That means that behavior in the game is no longer realistic, but instead is optimized to be better at the game.

These two processes mean that there is only one point in the game at which realistic data is collected, which is between the learning curve and the optimization moment of the game. If the player has not figured out the goal yet, but knows how to control and play the game, realistic data can be collected.

To conclude the first question, collecting data about food waste using a serious game is done by collecting data after the learning curve finishes and before the optimization moment starts. To make this useful for the client, this part of the game should as long as possible. Because the final game has quite a long learning curve and players tend to discover the goal of the game quickly, the moment of having the ability to collect realistic data might be very short or even non-existing. Therefore, the game created as part this research is not suited enough to provide this goal.

The second research question is focused on the design and the art of the game, which is also the focus of this report, and was 'what should the game look and feel like to accomplish the goal of collecting realistic data?'

In the final game, a combination of medieval times and modern times was used. In general, the participants of the target audience liked the art and the design of the game. They could identify with the look and feel. There had been given some feedback about adding more details and liveliness to the game, but other than that, the participants seemed to have enjoyed the art. The balance between the medieval times and the modern times seemed to be right because it was not noticeable or disturbing.

The participants were also asked if they though the look and feel of the game nudged the player to realistic behavior. Although the elements of the learning curve and the optimization still apply when answering this research question, the participants felt that the actions that they did in the game were realistic. This does not mean that the data collected is realistic, but the way of doing grocery shopping and taking items out of the grocery bag for example are actions that were realistic.

So, to conclude the research question, this report has shown one way a game could look and feel like to accomplish the goal of collecting realistic data. This conclusion does not exclude that there are other possibilities for the game art and design. This final game might have achieved the goal, but there could be another look and feel that might work as well, or even better.

The goals

Besides the research question, it is also important to verify if the game accomplishes its goals. The goals of the game were:

1. Data collection to create insight in people's behavior
2. Changing the behavior, both in the game and in real-life

When it comes to goal one, it is possible to collect data. However, there is a big issue on the realism of this data, as was discussed as part of the research questions. Goal two is partly met. The behavior in the game does change when the player realizes the goal in the game and tries to optimize their behavior to achieve that goal. It is unknown if it has had any effect on the real-life situation. In order to do that, the participants should play the game longer and should be watched afterwards in their daily life to conclude if anything has changed.

The client

Additionally, it should be asked if the final game matches with what the client had in mind. To a certain extent it does. This means that there are some elements that could be added from now on to improve the game to their liking and their research. They were surprised with how much was achieved in the final game. However, due to the issues with the learning curve and the optimization moment, the client cannot use it exactly as they wanted it. There should be done some more research with the game, to have it more useful to the client.

In the chapters one and two it was described that the currently used methods to collect data about food waste were insufficient. The client wanted to try out a serious game. This had two reasons. The first reason was that in a serious game the complete food cycle in households could be implemented and the second was because a game has more possibilities in nudging the behavior of the participant to honest behavior. The final game does include the complete food cycle, but it is difficult to say if it collects realistic data at this moment, because of what has been discussed above.

Next time

Although the final game does look good and works well, there are a couple of things that could be done better or differently next time such a game is created.

While brainstorming and finalizing the idea, there had been made a list with one hundred factors that play a role in decision making around food. This list can be found in appendix 1. While some factors were considered, there could have been used a couple more. When a factor is considered, different ways of implementing it should be discussed and tested to verify if it really has the desirable effect. During the preparation phase decisions, requirements and ideas should be written down as soon as possible and with more details. This would prevent confusion and discussion later on.

Navigation had turned out to be a big problem in the game. Therefore, next time it is recommended to put more time in it and test out different design for the navigation. When this is done, it would be possible to make the learning curve of the player shorter, without trying extensive new ideas or research.

The next time such a game is created, the developer and the designer should work more next to each other. They should complement each other to create a good game. This means that they should work on the same part of the game at the same time and keep communicating to each other what they need and want from the game. This would also help in ensuring that everyone working on the game keeps the end goal in mind. This was not always the case for this game. For example, a lot of time had been put in the design of the king and other main rooms. Therefore, the streets in the village were created very late in the

process and have less detail. This could be prevented if the people working on the game remind each other on the goal of the game.

As Jesse Schell mentioned in his book, a good game can only be created when all the people working on it have their heart in the process, which is easier when there is a better communication. This should be taken into account for future projects.

Chapter 10 – future work

In this chapter, it is described what the next steps for this research are. There is now a prototype of the game and results of the tests are gathered. However, the game is not completely finished yet. This chapter is divided in five aspects the next developers of the game can work on.

Existing art

In this section, some extra art is discussed that did not make it into the final game due to time constraints. This art could be used in further development and research.

Kitchen

The higher cupboard in the kitchen can be opened to find plates and glasses. The glasses would not have been used in this prototype, but the plates were created to serve the meals on. The idea was that the player could choose a certain amount of plates and put the food that was ready on the plates, before serving it to the king.
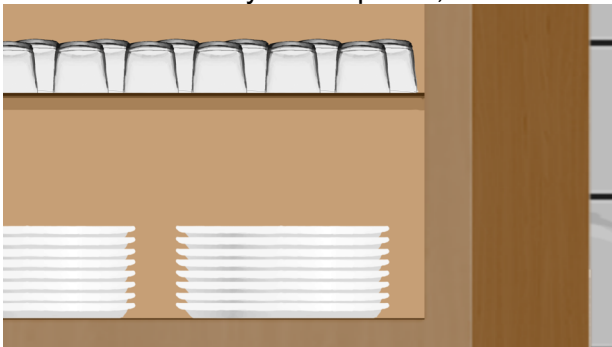
Figure 105: The high cupboard

The drawer in the kitchen can also be opened. However, there has not yet been decided if that will have value in a newer edition of the game.

Figure 106: The drawer

The oven cannot be used in the game, but art has been created for it in order to have the player open it, turn it on and watch the food get ready.
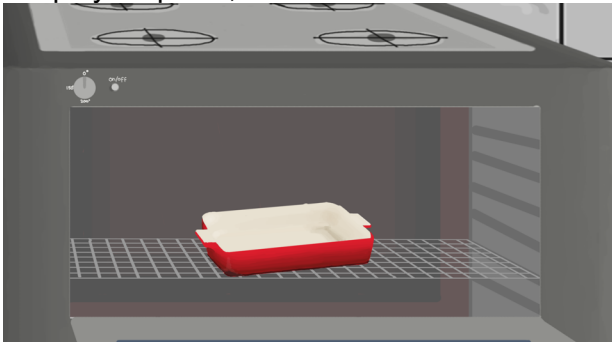
Figure 107: The oven open
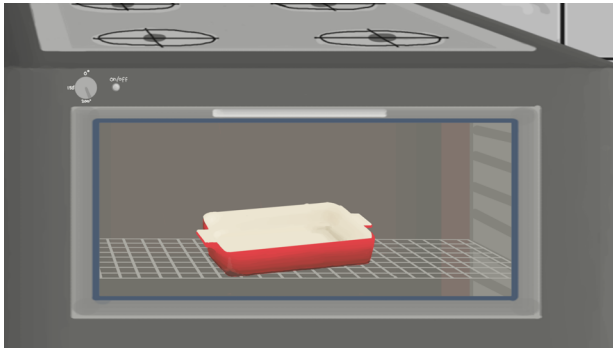
Figure 108: The oven turned on

Products

For this prototype, not all products have been used. However, there were some more made, both in a good state and in a rotten state
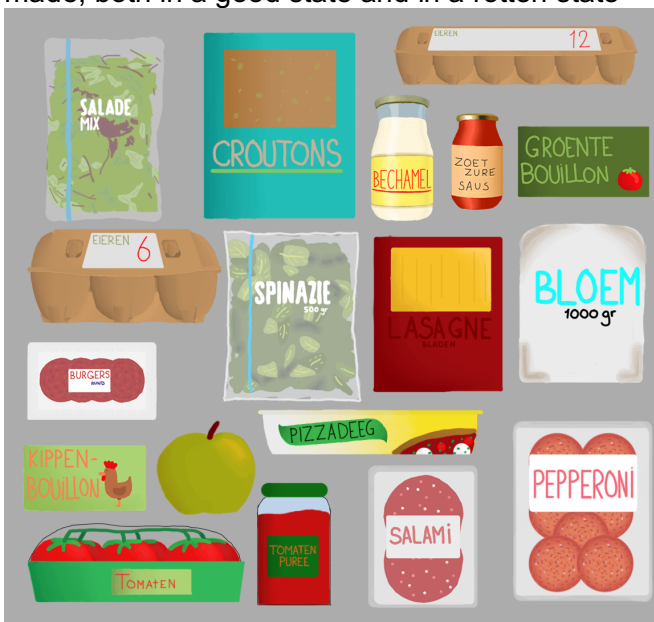
Figure 109: Not used products

Figure 110: Not used rotten products

The same counts for food that has been cut. In the prototype, the element of cutting food has been left out due to time constraints. However, there had been created a couple. There had also been created a smell animation to enhance the fact that the product has passed the expiration date, this animation can be found in appendix 5.
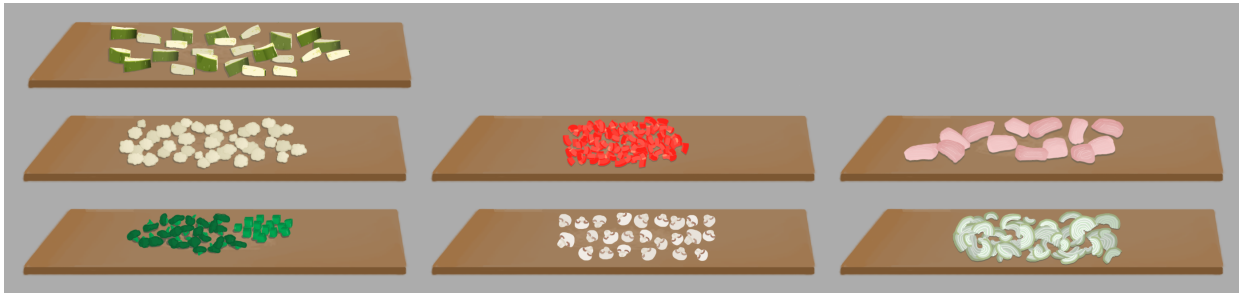
Figure 111: Cut products, from top left in reading direction to the bottom right: zucchini, cauliflower, bell pepper, chicken, broccoli, mushrooms and onion

Cooking

If the cutting would have been implemented, there had to be knifes. There were three knifes created for it.

Figure 112: Three knifes

in order to keep track of the tastiness of the food, the following system is used. If everything is done correctly, the food will get three points. If an ingredient is missing, one point will be taken away. If an ingredient was added at the wrong time, or if the player stopped the cooking at the wrong time, there will also be one point taken away. The last point can be taken away, if one or more expired products is used.

When the slider is at a blue stripe, extra food can be added. For example, in the case of making red sauce for the spaghetti, the vegetables should be added to the meat at the first blue stripe.

In the recipe it is explained how to prepare the meal and to help with that, blue stripes are used. For some recipes, like recipe two, multiple ingredients have to be added to the same pan, but at a different time. To guide the player in the correct timing, blue stripes are added to the progress bar that will appear above a pan with food, like the bar in Figure 113.

Figure 113: An older version of the timer

During cooking the purple triangle moves to the right, and when it is at a blue stripe a new ingredient can be added. If it reaches the green area, the food is ready. Additionally, when the purple triangle has reached the red area, the food is burned and will not taste good.

Note block

An idea was thought of to provide the player with a note block. The note block could have been opened using a button. In the note block the player can create both notes and lists and delete those lists. The note block should always be available.
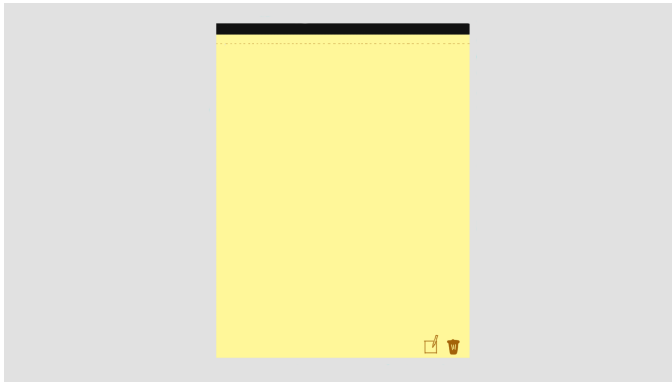
Figure 114: The note block

Supermarket

It might not be very clear to the player, that he has bought a product. Therefore, an animation had been created that follows the concept of downloading a file on a MacBook. It is an animation of an orange circle that pops up and dives into the grocery basket in the bottom right corner.

The link to the animation can be found in appendix 5.

The talking king

There had been created an animation for the king, so it is more visible that he talks. However, this animation has not been implemented in the game, therefore the link to the animation can be found in appendix 5.

Wanted art

There were some art elements that was wanted in the game, but they were not as important. Therefore, they did not get the chance to be made, but it is still wanted in the game.

In the final game there is one villager sitting on the village square, but it would be nice to have more villagers, especially if they could walk around. This latter has not been done with the one villager, because the drawing is in perspective and it would take a lot of time to draw the villager walking in perspective. All the villagers should reflect their happiness towards the player.

Right now, there are two streets and stores. The stores do have enough detail, but the streets could use some more. There should also be a third street with a bakery. This has not been created for this game, since the focus was on preparing dinners and not breakfast or lunch, or a feast.

To visualize the health of the king, he should be able to become really fat or thin and die from obesity or malnutrition. There should also be a couple of more guests, like an old friend and a cousin. There have been created voice lines for them, but since they were not drawn, these lines could not be used.

The cooking could use more detail, like a cooking animation, a cutting animation and a way to show that the fire is off. The rest of the recipes and all the variations could be created, if the recipes stay, which will be discussed later in this chapter.

The add more detail and liveliness to the game, there could be an animation for the fountain and the reactions of the king could be more animated. The other characters in the game should be able to animate as well, and the characters should be able to eat to make that clearer to the player.

Initial ideas of mechanisms

The initial idea of the game describes some mechanisms that are not implemented in the final game. One mechanism is mentioned before, and that is the feedback loop of the

money from the villagers. The idea was to have the villagers pay taxes to the king. The amount they would pay was depending on their happiness of the cleanliness of the village. The more food waste in the village, the less taxes they would pay. The money of the king would be visible and if that surpassed a certain limit because the villagers had paid taxes, that surpassed bit would be given to the player to buy rewards. Eventually another system has been used, but there should be put more thought and discussion in this feedback loop in order to have it working correctly towards the player and within the story of the game.

The rewards a player could get used to be able to be bought by money, ideas about buying it with bonus points have been passed by and now they are available when either or both the king and the villagers are happy to a certain level. The rewards themselves are about food and some rewards that had been discussed are;
- A new recipe
- A new ingredient/variation
- Extra help with cleaning the village
- More time during the day to prepare a meal
- More money in the budget
- An herb that makes the food delicious to get the king happier again

It could also be that the more food waste there is in the village, the less products or different products can be bought in the store.

In the final game the player only has to drag items to the right storage space. Initially the player would have to fit all the products in the cupboards. For example, if there was space left on top of a box of rice, the spaghetti could be put on top of it. With this system, the game would only look to the front of the products, thus, viewing this part in 2D space, to not make it more complicated.

If the king got a lot of unhealthy and fatty foods for a while, the king could become really fat. The same was for the other way around. If the king got not enough food, he could become really thin. This was a visual way of presenting the health of the king. If the king has become really fat or thin, he could die, and the game would be over.

Finally, a couple of participants asked about the left-overs, which are automatically thrown away in the final game. However, initially if there were any left-overs after dinner, the player would have gotten the choice to either save it in Tupperware or throw it away, which is an element the participants would have liked to have.

Future for the game

Besides implementing the mechanisms and art from above, there should be put further thought in the game. This prototype has the focus of collecting data on the player's behavior. However, if this game would be put on the market, there are several questions that should be asked.

For one, what would make the game more engaging and ensuring that people play the game for a longer time? One possibility is that there needs to be a conflict, a second story. An idea for this was to add the character of an inventor. This inventor could help the player improve, but his second motive is to invade the castle. Therefore, the king does not trust him, and the player has to ask himself if he trusts the inventor or not. This might make the game more interesting to play.

A participant gave a tip for this issue. She said that she would be more likely to play the game if she could learn something from it. For example, she would have liked it if she could make some exotic meals.

There has been quite some discussion about the results of the recipes. All the participants would have wanted to be able to create their own meals. Therefore, it should be looked into giving the player such a freedom. It could be created by having more recipes and variations, but also by not having any recipes. However, the latter might become quite complicated in the back-end. Thus, more research should be put into this matter.

There should be more feedback towards the player. This should be about the navigation of the games. The buttons have to be clear in what they do and that they are clickable. There should also be more feedback about what the king expects from the player and the food.

Lastly, the navigation and the user interface (UI) should be improved. It has caused quite some difficulties and that should be avoided in order to have a better experience for the player. Additionally, the game should be able to play on different ratios and therefore on different devices.

Further research possibilities

In general participants of test one have indicated that there should be more detail and that they would like it to have people walking around, to make the places more vivid. However, if this is implemented it should be researched if it does not distract from the actual goal of the game.

Furthermore, it might be interesting to look at extending the part of the game in which realistic data can be collected, by researching how to optimize the learning curve while making the game elements less obvious, such that the player is less likely to optimize their behavior early on in the game.

Appendices

Appendix 1

Factors that play a role in decision making related to food

Product choice
- Price
- Quality
- Health
- Freshness
- Use-by-date
- Discount
- What do I still have?
- Money available
- Visitors
- Product advertisements
- Emotions
- Weather
- Season
- Special occasions
- Number of eaters
- Preparation difficulty
- Preparation time
- Preparation knowledge
- Variation
- Eat rhythms
- Allergies
- Ingredients
- Weekday/weekend
- Diet
- Weight
- Calories
- Principles
- Religion
- Habits
- Luxury
- Combinations
- Brand
- Pre-cut
- Shop arrangement
- Product popularity
- Product in stock
- Portion size
- Recommendations
- Doctor's advice
- Packaging exterior
- Packaging size
- 35% discount sticker

Shop choice
- Service
- Atmosphere
- Distance to home
- Distance to other shops
- Payment methods
- Shop advertisements
- Discounts
- Opening times
- Cleanliness
- Shop reputation
- Delivery service
- Business
- Cooled drinks
- Free coffee/tea/cookies
- Wi-Fi
- Relationship with staff
- Self service

Time choice
- Weather
- What time is it?
- When should dinner be ready?
- When do I have time?
- When do I feel like it?
- One-day discounts
- Business

Frequency choice
- Time effort
- Storage size at home
- Storage size of vehicle
- Effort of vehicle
- Speed of vehicle
- Forgot a product
- Planning

Storage choice
- How much storage do I have?
- How much cooled storage?
- How much frozen storage?
- How full are the storages?
- What products do I need to add?
- Does that fit?
- What products can go away?
- Use, move or waste?
- Is product expired?
- Does product still taste good?
- Are there things I forgot I had?

Preparation choice
- What do I want?
- What do I have?
- What had I planned?
- Use everything or a bit?
- Number of eaters
- How much do eaters eat?
- What do eaters like?
- Better too much than too little or not?

Eating choice
- I am full
- I am not hungry
- I am in a hurry and cannot finish everything
- The food was not prepared well
- An ingredient was expired
- Wrong time of day
- Throw away remains or save for later?

Appendix 2

Set one of the voice lines of the king

1. Het eten is lekker
2. Dit heb je erg goed gemaakt
3. Wat was dat lekker!
4. Het eten is niet gaar. Dit ga ik niet opeten
5. Bah, het is nog niet gaar. Dat ga ik niet opeten
6. Het eten is aangebrand. Dit ga ik niet opeten
7. Bah, het is aangebrand. Dat ga ik niet opeten
8. Er is te weinig eten
9. Heb je meer? Ik heb nog lang niet genoeg gehad
10. Ik heb te weinig gehad. Heb je nog meer?
11. Er is te veel eten
12. Pfoe, ik krijg de rest niet op. Ik zit zo vol
13. Ik heb genoeg gehad. Dit is te veel
14. Er is precies genoeg te eten
15. Dat was lekker. Ik heb goed gegeten
16. Alweer aardappelen, groente en vlees? Ik wil wel eens wat anders
17. Alweer spaghetti bolognese? Ik wil wel eens wat anders
18. Alweer lasagne? Ik wil wel eens wat anders
19. Alweer kip curry? Ik wil wel eens wat anders
20. Alweer rijst, vis en groente? Ik wil wel eens wat anders
21. Alweer wraps? Ik wil wel eens wat anders
22. Alweer salade? Ik wil wel eens wat anders
23. Heel lekker die pizza elke dag, maar ik word er niet slanker van
24. Heel lekker dat patat elke dag, maar ik word er niet slanker van
25. Heel lekker die burgers elke dag, maar ik word er niet slanker van
26. Het was lekker, maar ik miste iets
27. Het smaakte goed, maar ik miste nog iets
28. Het viel wat tegen. Er miste een ingredient
29. Het dorp is blij met hoe schoon het is
30. Het dorp is mooi schoon. Dat stemt de dorpelingen en dus ook mij tevreden
31. Een schoon dorp doet iedereen goed
32. Het dorp is wel erg vies, de dorpelingen zijn niet zo blij
33. Het dorp is vies. Daar worden de dorpelingen en ik niet zo blij van
34. Het dorp is niet schoon. De dorpelingen zijn daar ontevreden over
35. Pas op, het dorp wordt zo wel erg vies
36. Het dorp is niet heel schoon meer, pas je op?
37. Mijn vrouw en kinderen eten vandaag mee
38. Mijn vrouw komt mij vandaag vergezellen
39. Een oude vriend van mij eet vandaag mee
40. Vandaag eet een oude vriend van mij mee
41. Een oude vriend van mij heeft op het laatste moment afgezegd en eet niet mee
42. Mijn neef heeft op het laatste moment afgezegd en eet niet mee
43. Mijn neef eet vandaag mee
44. Vandaag eet mijn neef mee
45. Het is mijn verjaardag morgen, dus ik verwacht een feestmaal
46. Morgen is een belangrijke dag, ik ben namelijk jarig. Dus ik verwacht een feestmaal
47. Morgen ben ik jarig. Dat moet gevierd worden met een feestmaal!

48. Ik heb veel belasting binnen gekregen, en ik ben tevreden over je kookkunsten, dus je mag een bonus kiezen
49. De dorpelingen hebben veel belasting betaald en je maakt lekkere maaltijden, dus je mag een bonus kiezen
50. Ik heb veel belasting binnen gekregen, dat moeten we vieren
51. De dorpelingen hebben veel belasting betaald, dus dat moet gevierd worden
52. Ik zou je willen belonen voor je kookkunsten, maar de dorpelingen hebben maar weinig belasting betaald, dus dat kan ik me niet veroorloven.
53. Je kookt lekkere maaltijden, maar er is maar weinig belasting binnen gekomen, dus ik kan je helaas geen bonus geven

Appendix 3

Set two of the voice lines of the king

Dag 1 (uitprobeerdag)

A) Begin
1. Hallo, jij moet de nieuwe kok zijn. Mijn naam is Karel. Het is nog vroeg, dus kijk maar een beetje rond in het kasteel en in het dorp, en sla vast wat eten in, want de voorraden zijn nog leeg. Ik zal je elke week een budget geven om eten van te koken.
2. Doe nu dus nog rustig aan, maar aan het einde van de dag wil ik wel wat eten.
3. Vandaag mag je dus rustig rondkijken, als ik aan het einde van de dag wel wat kan eten.
4. Vandaag eet ik alleen. Je hebt nu wat tijd om rond te kijken, maar vanavond wil ik wel eten.

B) Als de speler nog niet in het dorp is geweest
1. Wat ga ik vandaag eten?
2. De winkels zijn nu nog open.
3. De dorpelingen zouden je graag willen ontmoeten. Ga naar het dorp om ze te zien.

C) Als de speler terugkomt van boodschappen doen
1. Zet de boodschappen maar in de kasten en begin met koken.
2. Haal de boodschappen uit de tas en begin met koken.
3. Je hebt boodschappen gedaan! Wat ga ik eten?

D) Als de speler niet weet hoe hij moet koken
1. Ga je nu koken? Ik krijg een beetje honger.
2. Zet je de pannen op het vuur? Dan kun je de ingrediënten erin doen en iets lekkers voor mij koken.

E) Als de koning eten heeft
1. Dat was een goede maaltijd voor de eerste keer.
2. Dat was een prima maaltijd voor de eerste keer. Vanaf nu kan het alleen maar beter gaan.
3. Dat ging niet zo goed he? Morgen moet het wel beter zijn.
4. Je hebt het laten aanbranden. De eerste keer kan dat gebeuren, maar vanaf morgen mag dat niet meer.

F) Als de koning heeft gegeten
1. Nu je alles ontdekt hebt, wil ik morgen eerder mijn eten.
2. Vandaag had je genoeg tijd, morgen wil ik het eten eerder.
3. Dankjewel voor de maaltijd. Je hebt goed kunnen oefenen vandaag, dat is goed voor morgen.
4. Morgen zal je wat minder tijd hebben, maar dat komt vast goed want je hebt vandaag al kunnen oefenen.

Andere dagen

<u>G) In het algemeen</u>
1. Snel aan de slag! Ik wil zometeen al eten!
2. Ik heb trek. Geef mij zo snel mogelijk eten.
   <u>H) Als hij in z'n eentje eet</u>
   De zinnen van set 1 (41-42)
1. Vandaag hoef je alleen voor mij eten te maken.
2. Ik eet in mijn eentje vandaag.
   <u>I) Als er 1 iemand mee eet</u>
   De zinnen van set 1 (38-40 en 43-44)
1. Vandaag moet je voor twee mensen koken.
2. Ik heb één gast vandaag, dus je moet voor twee mensen koken.
   <u>J) Als er 2 mensen mee eten</u>
1. Alleen mijn kinderen eten mee, mijn vrouw is naar een vriendin van haar.
2. Mijn vrouw eet helaas niet mee vandaag, maar mijn kinderen wel.
3. Mijn dochter heeft muziekles en eet niet mee vandaag. Mijn vrouw en zoon zijn er wel.
4. Mijn vrouw en zoon eten vandaag mee, maar mijn dochter niet, want ze heeft dansles.
5. Mijn zoon heeft training en eet niet mee vandaag. Mijn vrouw en dochter zijn er wel.
6. Mijn vrouw en dochter eten vandaag mee, maar mijn zoon niet, want hij is op jacht.
   <u>K) Als het hele gezin mee eet (4 mensen in totaal)</u>
   De zin van set 1 (37)
1. Vandaag eten mijn vrouw en kinderen mee. Dus je moet voor vier mensen koken.
2. Mijn gezin eet vandaag gezellig mee. Je moet dus voor vier mensen koken.
3. Ik word vandaag vergezeld door mijn vrouw en kinderen. Kook je iets lekkers voor ons vieren?
   <u>L) Als de koning honger heeft</u>
1. Is het eten bijna klaar?
2. Ik heb wel trek in eten.
3. Ik begin honger te krijgen, staat het eten al op het vuur?
4. Waar blijft het eten?
5. Is er nog steeds geen eten? Ik rammel!
6. Probeer je me te verhongeren?
   <u>M) Het eten is niet lekker</u>
1. Het eten smaakt niet zo lekker.
2. Het eten is niet helemaal goed.
3. Volgens mij was er iets over datum, het smaakt een beetje raar.
4. Het eten smaakt niet zo vers.
5. Bah, dat was niet lekker.
   <u>N) Het eten is heel lekker</u>
1. Ik heb nog nooit zo lekker gegeten.
2. Zelden zo lekker gegeten.
3. Mmm, dat was heel erg lekker!
4. Dat heb je goed gemaakt, dat was heerlijk.
   <u>O) Als het eten te laat is</u>
1. Het eten is laat.
2. Dat heeft lang genoeg geduurd, hopelijk is het wel lekker.
3. Ik had eigenlijk wat vroeger willen eten.
4. Beter laat dan nooit zeggen ze dan.

Appendix 4

Tekst on the opening screen

In Dutch:

Welkom in Schoondorp.

Jij bent aangenomen als persoonlijke kok van koning Karel. Jouw taak is om iedere dag op tijd een lekkere maaltijd voor hem neer te zetten. Dit doe je door boodschappen te doen in het dorp, de boodschappen op te slaan in de opslag in de keuken, en het eten voor te bereiden. Als de koning tevreden is over jouw kookkunsten zal hij je rijkelijk belonen.

Nog een klein dingetje, de keuken heeft geen afvalbak, maar een katapult. Maak je daar maar vooral geen zorgen over, het werkt net zo goed.

The translation to English:

Welcome to Cleanvillage.

You are hired to be the personal cook of king Carl. Your job is to prepare a meal on time for the king every day. You can do this by going grocery shopping in the village, storing the food in the storage area in the kitchen, and to cook a meal. If the king is happy with your cooking skills, he will happily give you rewards.

One small detail, the kitchen does not have a garbage bin, but a catapult. Do not worry about it, it works just as fine.

Appendix 5

The link to the animations

https://drive.google.com/drive/folders/1AqU4dqMF19gzEQuXa8lo2rnxsz19nwJg?usp=sharing

There are four video's:
- BuyingStuff; an animation to show the player that they have bought that products
- KingAngry; an animation of an angry king talking
- KingHappy; an animation of a happy king talking
- SmellAnimation; an animation of a stinking smell that would have been put above a rotten product

Appendix 6

Recipes

Order of writing:

Recipe #:
<u>Title</u>
First ingredient
- Possible variation (1)
- Possible variation (2) etc.

Second ingredient
- Possible variation (1)
- Possible variation (2) etc.

Third ingredient
- Possible variation (1)
- Possible variation (2) etc.

Etc.

Recipe 1:

<u>Vegetable, Meat and Potato</u>

Broccoli
- Green beans
- Spinach
- Cauliflower

Slavink (Pig)
- Chicken leg

Potato
- Fries
- Mashed potatoes

Recipe 2:

<u>Pasta Bolognese</u>

Spaghetti
- Penne

Minced meat
- Meat balls
- Or just do none

Vegetable mix
- Add: bell pepper
- Add: zucchini
- Add: eggplant
- Add: tomatoes
- Add: mushrooms

Tomato sauce (in a pot)
- Tomato paste

Grated cheese
- Grated old cheese

Recipe 3:

Chicken curry
White rice
- Brown rice

Chicken thigh
- Salmon pieces

Some vegetables
- Mushrooms
- Onion
- Bell pepper

Chicken broth
- Vegetable broth

Coconut Milk
Curry spices

Recipe 4:

Burgers
Burger
- Vegetable burger

Hamburger bread
- Brown bread bums

Toppings
- Tomatoes
- Lettuce
- Cucumber
- Bacon

Sauce
- Mayonnaise
- Ketchup

Fries
- Sweet potato fries

Recipe 5:

Rice, vegetable and fish
White fish
- Salmon
- Tuna

White rice
- Brown rice
- Couscous

Spinach
- Zucchini
- Broccoli

Zoetzure saus

- Pindasaus

Recipe 6:

Pizza; bought or self-made (see recipe)
Pizza dough
- Whole wheat pizza dough
- Croissant dough

Red sauce
Grated cheese
- Mozzarella cheese
- Roquefort

Salami
- Pepperoni
- Tuna

Vegetable mix
- Bell pepper
- Zucchini
- Mushrooms
- Tomatoes
- Onion

Recipe 7:

Lasagna
Lasagna sheets
Tomato sauce
Vegetable mix
- Zucchini
- Mushrooms
- Zucchini
- Tomatoes
- Eggplant

Extra
- Minced meat
- Feta cheese
- Mozzarella

Béchamel saus

Recipe 8:

Pancakes
Flour
- Whole wheat

Eggs
Milk
Topping:
- Powdered sugar
- Sugar
- Chocolate
- Apple
- Syrup
- Banana
- Bacon
- Grated cheese

Recipe 9:
      <u>Wraps</u>
      Wraps
          -   Whole wheat wraps
      Chicken thighs
      Lettuce
          -   Cucumber
          -   Tomato
          -   Kidney bonen
      Tzatziki
          -   Garlic sauce

Recipe 10:
      <u>Salad</u>
      Lettuce
          -   Lettuce mix
          -   Arugula

          -   Spinach
Vegetables
      -   Cucumber
      -   Tomato
      -   Bell pepper
      -   Radish
      -   Corn
Egg
      -   Feta cheese
Extra
      -   Pear
      -   Apple
      -   Croutons
Vinegar dressing
      -   Ranch dressing

Appendix 7

The link to the digitalized paper-prototype
      camille.tworem.nl

Appendix 8

Questionnaire test one

First some general questions:
1. What is your gender?
    a. Male/Female
2. What is your age category?
    a. 30-40/41-50/51-60/61-70
3. How many children do you have?
    a. Open question

Then questions about the prototype:
1. How interesting are the drawing in general?
    a. Scale 1-5 (very uninteresting to very interesting)
2. Are the drawings in general appealing?
    a. Scale 1-5 (very unappealing to very appealing)
3. What is the general feeling you got from the game?
    a. Open question
4. Would you recommend this game based on the appearance?
    a. Scale 1-5 (not likely to very likely)
5. Would you play this game for a longer time?
    a. Scale 1-5 (not likely to very likely)
6. Would you play this game multiple times?
    a. Scale 1-5 (not likely to very likely)
7. Would you describe the opening screen (with the explanation) as clear?
    a. Scale 1-5 (very unclear to very clear)
8. Would you play a game where you have to keep the king satisfied?
    a. Scale 1-5 (not likely to very likely)

9. Are the king and his dining room appealing to you?
    a. Scale 1-5 (absolutely not to absolutely yes)
10. What would you change to the dining room and the king to make them more appealing to you?
    a. Open question
11. Would you like to see the catapult in action?
    a. Yes/no/maybe
12. Is the catapult appealing to you?
    a. Scale 1-5 (absolutely not to absolutely yes)
13. What would you change to the catapult to make it more appealing to you?
    a. Open question
14. Is the kitchen appealing to you?
    a. Scale 1-5 (absolutely not to absolutely yes)
15. Is there something you miss in the kitchen?
    a. Open question
16. What would you change to the kitchen to make it more appealing to you?
    a. Open question
17. Is the cookbook appealing to you?
    a. Scale 1-5 (absolutely not to absolutely yes)
18. Are the recipes clear?
    a. Scale 1-5 (very unclear to very clear)
19. Is there something you miss in the cookbook?
    a. Open question
20. What would you change to the cookbook to make it more appealing to you?
    a. Open question
21. Is the village square appealing to you?
    a. Scale 1-5 (absolutely not to absolutely yes)
22. Is the waste on the village square believable?
    a. Scale 1-5 (not at all to very believable)
23. Is there something you would like to see on the village square to make it more attractive?
    a. Open question
24. What would you change to the village square to make it more appealing to you?
    a. Open question
25. Is the supermarket appealing to you?
    a. Scale 1-5 (absolutely not to absolutely yes)
26. Are the products on the shelfs believable?
    a. Scale 1-5 (not at all to very believable)
27. Is there something you miss in the supermarket?
    a. Open question
28. What would you change to the supermarket to make it more appealing to you?
    a. Open question
29. Is the monetary overview clear?
    a. Scale 1-5 (very unclear to very clear)
30. Is the monetary overview evident?
    a. Scale 1-5 (not at all to very evident)
31. Is there something you miss in the monetary overview?
    a. Open question
32. What would you change to the monetary overview to make it more appealing to you?
    a. Open question
33. Are there still other parts that were appealing to you?
    a. Open question
34. Are there still other parts that were not appealing to you?

a. Open question

Appendix 9

Interview test two

1. Did you understand everything in the game? If not, what did you not understand and why?
2. Did actions in the game feel realistic, such that they reflect what you would do in real life? If not, why?
3. What would you change to make the actions feel realistic?
4. What would you change to make the game easier to understand?
5. Were there any annoying aspects?
6. Do you have any more comments?

Appendix 10

Questionnaire test three

First general questions:
1. What is your gender?
   a. Male/Female/other…
2. What is your age?
   a. Open question
3. Please fill in a username
   a. Open question

Then questions about real life actions:
1. How many times per week do you go grocery shopping?
   a. One time a week/two times a week/three times a week/four times a week/five times a week/six times a week/seven times a week/more than seven times a week
2. How often do you deliberately choose the cheapest option of a product?
   a. Scale 1-5 (never to always)
3. Do you pay attention to the expiration date of the product you buy?
   a. Scale 1-5 (never to always)
4. How often do you visit fresh stores, like the butcher or the grocery store?
   a. Scale 1-5 (never to always)
5. What are the main factors that decide whether you go to the supermarket or to fresh stores?
   a. Open question
6. what are the main factors that decide how often you go grocery shopping?
   a. Open question
7. What are the main factors that decide how much money you spend on food?
   a. Open question
8. How many products in your fridge/freezer/cupboard have specific spots?
   a. None/some/most/all
9. Do products get pushed back to the shelf of the fridge/freezer/cupboard?
   a. Scale 1-5 (never to always)
10. How often do you forget about products that you still have in your fridge/freezer/cupboard?
    a. Scale 1-5 (never to always)

11. How often do products in your fridge/freezer/cupboard pass the expiration date?
    a. Scale 1-5 (never to always)
12. What are the main factors that decide if you save left-overs?
    a. Open question
13. When cooking a meal, do you first finish the last bits in a package?
    a. Scale 1-5 (never to always)
14. Do you try to use as much as possible from a vegetable or fruit?
    a. Scale 1-5 (never to always)
15. What do you generally do with a vegetable or fruit that is partly rotten?
    a. Throw away entirely/cut out the bad parts/eat entirely/other…
16. Do you take your time to make a good meal?
    a. Scale 1-5 (never to always)
17. Do you follow recipes?
    a. Scale 1-5 (never to always)
18. How many times do you prepare the right amount of food for the people who eat it?
    a. Scale 1-5 (never to always)
19. Do you save left-overs in Tupperware?
    a. Scale 1-5 (never to always)
20. How often do you throw away food saved in Tupperware?
    a. Scale 1-5 (never to always)
21. What are factors that decide which meal you are going to prepare?
    a. Open question

Appendix 11

Interview test three

1. Did you understand everything in the game? If not, what did you not understand and why?
2. What is the overall feel you got from the game? Did you have the feeling that you were playing a game?
3. Did the actions in the game feel realistic, such that they reflect what you would do in real life? If not, why?
4. Did actions in the game feel like chores? If yes, why?
5. What would you change to make the actions feel realistic?
6. What would you change to make the games easier to understand?
7. Were there any annoying aspects?
8. Do you think the medieval times are balanced with the modern actions in the game?
9. Do you have any more comments?

Appendix 12

Results test three

For each participant the observations are divided by the two observers

Person 1

Camille:
- They go to the village without having looked at the cookbook
- They did find the grocery store. However, it happened by accident, because they actually wanted to go back to the castle). In the grocery store they just bought some things, because the king had said "just buy some food"
- They could not find how to get back to the castle and eventually got some help from the observers

- They only discovered that there were recipes when they clicked on the button 'choose recipe'
- They tried to turn on the fire of the stove, because they did not realize that it goes automatically
- Actions did not always happen immediately, so they went clicking on other objects
- They could not figure out how to get the products in the pans
- The meat in the supermarket is difficult to find. They eventually got some help from the observers
- The sentences of the king are stopped too early
- It took a long time before they figured out everything
- The second day went much faster and they were able to find the order of the actions
- They had quickly realized how to get the products from the counter to the cupboards
- They had not seen on day two for how many people they should prepare food
- The food waste in the village did not stand out the first time
- The corner of the cookbook is not clear
- They do not keep track of the amount of money they have
- They throw away food because there was not enough space in the cupboards
- There should be an exit button in the supermarket, so it is possible to leave when there is nothing in the grocery basket
- The question mark button is never used
- The time seems not to provoke much stress to the participant
- At some point they saw the food waste in the village and they knew quite soon that the food waste used to belong to him
- The clickable elements should stand out!
- On Thursday of week one they go to the store with only €3,30
- Big troubles!
- They say "I did not play serious enough"
- Now they try to cook with some last bits of food
- They say "it is late again"
- They click a lot on the village icon by accident
- They are going to prepare rotten minced meat
- They do not pay attention to how many people have dinner each day. They seem to rely on the visual cues
- They figured out that in order to let the king talk they have to go back to the king (arrow to the left and back with the arrow to the right)
- They ask the king for a garbage man to get rid of the waste in the village
- They say "he, I have money. Now I can buy some tasty expensive product"
- At the beginning of the second week they pay close attention to the recipes and the amounts of food. They buy the broccoli from the grocery store though instead of the supermarket
  During the interview:
- In the beginning they did not know what they would be rewarded for
- It was quite clear that there was an expiration date on the products
- The visuals of a rotten food was not clear at first
- They would have preferred to perform actions in the full screen of the kitchen
- The arrows are somewhat unlogical
- When zoomed in on the cooking area the button to the village should not be there
- Also, on the in-between screen should the village button not be there
- The navigation in general could be clearer
- There is no immediate feedback about the food waste in the village
- Answer to question 2. "It is difficult to say". The game is a fun educational game. It is really a game with a message
- Answer to question 3. Yes, it did feel like a simulation

- Answer to question 4. Yes, they want to score points. It was not necessarily annoying, except that the grams should be remembered. Actually, the reason why they play the game should always be visible
- Answer to question 5. They would rather make certain aspects less realistic. The players should make a consideration about how to play the game the best way. To enhance that, the aspects in the game should be asked if they tribute to the dynamics of the consideration
- Answer to question 6. All clickable elements should stand out, especially the castle to get there. The elements could glow when the mouse is on it. There should be some more explanation in the beginning, especially where the player gets judged upon
- Answer to question 7. No, except for the grams
- Answer to question 8. Yes, it is something where realism is not very important
- Final comment: it is very well made and there are a lot of aspects involved in the game
  Christiaan:
- They listen to the king
- They look around the castle by use of the arrows
- They go to the village to the supermarket
- They buy vegetables that are not part of a recipe
- They want to go back to the castle, but instead they click on the arrow to the right to the street with the grocery store
- They buy some vegetables
- They go back to the village square
- They want to go back to the castle, but instead they click on the arrow to the left to the street with the butcher
- They click on the bag
- They could not find the castle button, the observers helped them
- They put pans on the stove and expects the food to be cooking
- They think it does not work, because they are missing a product and goes out to buy that product
- After messing around a while, the observers told them that the products are in the bag
- The food is burning
- The second day they buy products for the spaghetti. The store, the bag and the cupboards are clear now
- After the dinner, they fire the catapult
- They go to the village, but does not see the food waste
- They are searching for recipe, but it is not clear how to turn the page
- They buy rice, even though they still had some
- So far, they had put every product in the fridge, but the fridge is now full
- They throw away the wraps
- They put the minced meat from the last day in the cupboard and say jokingly "that is going to smell"
- They prepare curry, which gets burned. They fire the catapult and goes to the village to find the food waste
- They want to make spaghetti and looks for the first time what they had left in the storage
- On Thursday all their money is gone
- They prepare curry, which does not get burned or undercooked, but it gets served too late
- They use minced meat that had passed the expiration date, the visuals were not clear enough
- They throw away the products that are not in a recipe

- They fire the catapult and go to the village to find more food waste
- Looking for the grams in a recipe is annoying, especially for the third recipe
- The village button looks like a home button

Person 2

<u>Camille</u>
- The user interface is quite broken, because their laptop ratio is 16:10, instead of 16:9 and this cannot be changed
- They miss recipe three (chicken curry) in the cookbook
- They buy some random products at the butcher for €25 and at the green grocery
- They are wondering if they have to follow recipes
- They practically use the whole budget in one day (only €4,40 from €50)
- They do not understand how to leave the store. It does not feel logical to click 'pay' in order to leave the store, even though it says €0,00
- They found the bought product really fast
- The castle was not clear (partly caused by the broken UI which made it only partly visible
- They were not able to take out the products from the grocery bag at first. They thought it would happen automatically. Eventually they got help from the observers
- At first, they did not realize that they had to choose a recipe, before they could start cooking
- They say, "I do whatever I want", because they want to be creative with food
- They say, "can it cook faster?"
- It was not immediately clear that a new day had started
- The timer did cause some stress
- They left products in the grocery bag
- The second day also took long
- They had a tendency to click on everything instead of dragging
- As soon as they were out of money, they were wondering what they had left in the storage space
- They got more help from the observer than the previous participant
  During the interview:
- Answer to question 1. It was understood at first in which order the products needed to be used. The expiration date was overlooked and therefore, not immediately clear. The player is not free to create meals for themselves and this participant usually does not follow recipes
- Answer to question 2. Yes, not to win something, but it is a gamified way to learn how to deal with grocery shopping, cooking etcetera
- Answer to question 3. Yes, except the catapult, but that is fun
- Answer to question 5. They would add an overview of what is in the fridge and that they have the choice to use a product or to throw it away (this was present, but is probably overlooked)
- Answer to question 6. The budget was not clear and that it was meant for one week. €50 may be too little for one week
- Answer to question 7. The kitchen is in two parts and at the beginning the pans could not be found
  <u>Christiaan:</u>
- The button 'choose another recipe' sounds like a have to instead as an option
- The village icon is not clear
- They end up in the grocery store by accident
- They buy products for €25 at the butcher
- They do not know how to get back to the castle

- They find it very strange that they have to click on 'pay' when they do not have products in their grocery basket
- The grocery bag in the kitchen is not clear
- The castle button is not clear
- It is not clear that they should drag the products out of the grocery bag to place them in the storage area
- The village button looks like a home button
- The timer causes stress
- They try to get the wrong pans
- They expected to see the ingredients of the recipe when they had chosen one
- It is not clear that the folded corner of the cookbook is clickable
- They expect to be able to choose a recipe in the cookbook
- They leave products in the grocery basket
- On Wednesday the cooking was quite clear
- They are not free in recipes
- It was not clear that the left-overs go into the catapult
- They want a better overview of what they have in the storage spaces
- The zooming in on the cooking area is annoying

Person 3

<u>Camille</u>
- They say, "oh shit, I click on everything. I do not think it goes well"
- They say, "I will just look around"
- They just buy some products at the green grocery
- They just buy some products in the supermarket
- They miss something like nuts
- They do not know how to cook
- When they had found their grocery bag, they discovered quite fast how to place the products in the storage area
- It took a bit longer before they discovered how to get the products out of the storage area
- They do not use the cookbook yet
- They are wondering if they should follow something
- At some point they discovered that they had to follow a recipe
- They say, "oh, the pan with food is getting warm" and then waits until the pan is hot (therefore the meat is ready) before adding more ingredients
- At first, they did not understand the timer
- They do understand that they have to choose a recipe, but they do not discover the cookbook
- They could not find the chicken in the supermarket, so they bought it at the butcher
- They have not seen the info screen yet
- They think that the recipes are not fair, because they make things differently
- They use the complete product instead of checking how much they should prepare
- They usually make vegan/vegetarian meals, so this does not feel realistic. The recipes are very traditional
- There does not seem to be a logic in their buying behavior
- The budget is not kept in mind
- At some point they had discovered how to stop the pans from cooking
  During the interview:
- It felt very frustrating that they could not make what they wanted to make
- They do not pay to small icons, they just click on everything and especially on the bigger things
- The village icon looked like a castle

- The food waste looked like flowers, they did not realize that the food waste was there after the catapult was fired
- The following five points are answers on question 3
- It was not clear what every button meant
- The navigation was not always clear
- They do not understand well the meaning of the streets and the corresponding arrows
- Sometimes they were looking for faster ways
- The cookbook could not be found, because it was to small and they felt the pressure of the time
- Answer to question 4. They love cooking, but it was frustrating that they had to follow a recipe, but that they did not know about the existence of the cookbook
- They had the intention to not produce food waste, but they failed because of the recipes and because the king said "just buy some food"
- They did not realize that the king did not eat everything. They did realize that the first time they prepared a meal it got burned
- Usually they let the food simmer for a while and they would have liked to do that in the game as well
- The second time they were cooking, they had figured out that they should stop the pan at green
- Answer to question 3. Yes
- Answer to question 4. You have to score points. They started with the idea "I am not going to produce food waste", but they got confused by the king saying, "just buy some food"
- Answer to question 5. This is dependent on the goal of the game. They thought it was to reduce the production of food waste and for that they would have wanted more possibilities to do that. For example, a dinner with left-overs. They wanted to be creative with cooking. They wanted to produce less food waste, but they did not have the tools to do that
- Answer to question 6. The cookbook and that the king does not say "just buy some food". The king should actually say something like "in the cookbook are recipes that I like. Choose one recipe from there"
- Answer to question 6. It should be made clearer what is expected from you and what the food is judged upon
- They were wondering what the target audience is, because depending on the products the players eat themselves (for example meat) they will prepare that, or they know how much they should prepare. Therefore, it should be actually depending on the player what the king likes
- Answer to question 7. The king was very strict. It can be more encouraging
- Answer to question 8. It was very well made and realized
- Answer to question 9. It was mostly fun
- Finally, if there is a product in the cupboard, they would like to be able to see in which recipes that product is in and what good combos are with that product, when they click on the product
  Christiaan:
- They immediately go to the village
- They want to go back with the arrow to the left, but ends up at the green grocery
- They want whole wheat options in the supermarket
- They cannot find the castle button
- They try to cook, but the products are still in the grocery bag
- The grocery bag icon looks like a jail
- They do not see the error messages
- They do not know how to continue
- They choose a recipe

- They say, "I would not buy this myself"
- The way to fill in the grams is not intuitive
- The product info screen is intuitive
- They wait until the minced meat is baked before they put in the next product
- Because of that the food is burning
- They serve the meal and clean up the table. Now they see the timer and they think that they have earned something
- They know fairly well how to make the recipes without the cookbook
- They say, "this is unfair, because I usually put other products in the recipe"
- They say, "I cannot make what I want to make"
- The cookbook icon looked like an omelet
- The icons need to be bigger
- They feel the time pressure
- It is not clear that the left-over go to the catapult
- The guests are not clear
- They want to be more creative with food
- They think that the king is too strict

Person 4

<u>Camille</u>
- They think that only the arrows can navigate
- They just tried the village icon
- They are doubting, because they had not seen the villager, but the king had mentioned them (the villager is overlooked)
- They guess the budget right and understand the grocery basket icon
- In the explanation screen, the icons seemed to work
- They have not seen the cookbook, so they just buy some products
- They expect the pop-up to disappear when they click on 'buy'
- They try the buttons to see if something happens
- They understand quite quick how to leave the store when they do not buy anything
- At the cooking they realized that their actions were performed in the 'wrong' order
- They use the cookbook to see what they have to do/use
- They click on the icons in the cookbook
- They do not know how to start with the cooking, because they could not find their products. By going to the king by accident, they knew what to do
- They click a lot on the village icon by accident
- They use the cookbook well, but did not see for how many people the recipe prepares food
- The spaghetti is burning, but they do not realize that, the same counts for the vegetables. Because of the bug of going to the storage area and going back, the timer resets itself. But they still do not see that the food is burning
- They ask if they could go to the store during the cooking
- They want to see the recipe in the store
- They take the time to do grocery shopping during cooking
- The navigation is difficult, and they would want to see instructions to let the pop-up disappear
- They burn the pasta and vegetables again
- It takes a while before they do something on the second day
- They look first for the cookbook and then realizes they do not have much money left
- They do not feel the pressure of the time
- They say, "how can I see what I still have?"
- They do not see recipe three
- They want something like a note block

- In the store they want to know what they still had and what the recipe was
- They throw away products, because they had bought it, but they could not use it
- They put the pans on the stove before they start cooking
- They lost their products for a moment
- The button 'choose another recipe' is confusing
- They fire the catapult, because it is fun
- They did not see the food waste in the village
- They still have not found recipe three, even when they were looking for it. They eventually got help from the observers
- They did not realize that the catapult costs money
- They want to create something for themselves instead of following a recipe
- They still have not seen the waste in the village
- They did not realize how to stop the pans from cooking and keep burning the food
  During the interview:
- In the beginning, there should be an explanation of how to start the game. They propose an instruction video about how to play the game
- It is well made
- There is actually not a lot of money to please the king
- There could be added some beginner levels to guide the beginner more
- Answer to question 3. Yes, the navigation was problematic, but the style is somewhat animation and they like that
- Guidance is something though that would make it more fun
- It was not clear how many people had dinner. They relied on what they saw and what the king told them
- They did not realize that the recipes were for four people and that it does not change per day according to the people who want dinner
- Answer to question 2. If is different and fun. It creates insight, because just buying some products results in food waste
- The note block should always be available
- Eventually you would want to satisfy the king
- The game is pretty, and it is nice that the characters were not too realistic
- The navigation was somewhat clumsy and annoying
- The context depending navigation was unclear. The arrows on the same spot and pointed to the same direction were used for different things
- Answer to question 8. It did not bother
- the village icon looks like a castle
  Christiaan:
- They look around in the castle
- The village button is not clear, it looks like a home button
- The supermarket in not visible clickable
- They do not see the villager
- They just buy some products
- They want to see how much money the products in the basket will cost
- They expect the product pop-up to disappear when they buy it
- They cannot find the castle
- They get back in the castle and looks in the cupboards, which are empty
- They choose a recipe, spaghetti
- They cannot find their grocery bag immediately but later they do
- They cannot find the pans with water at fist
- They put the pans on the stove, but the products are still in the grocery bag
- It is not clear that they should drag the products out of the grocery bag
- They follow the recipe and put everything according to the recipe in it, which is for four people, but there are only three people having dinner

- They do not have enough mushrooms
- They say, "I am not going back to the store, the king has just some bad luck"
- The progress bar of the pans seem not to be clear
- They did not see the button 'serve'
- They eventually do go to the store, while they were cooking
- They want to see the recipe in the supermarket
- They buy minced meat, go back, look in the cookbook, go back to the store and buy vegetable mix and tomato sauce
- They forgot the grocery bag again
- The navigation is illogical and zooming in on the cooking area as well
- The food is burned
- It is not clear that it is the next day
- They want a note block/shopping list
- They forget for the third time how the grocery bag works
- The button 'choose another recipe' sounds commanding
- They make spaghetti without spaghetti
- They do not see the food waste in the village
- They cannot find recipe three in the cookbook, the folded corner of the page is not clear
- They throw away the fish and fire the catapult
- They decide that chicken curry is too complicated
- They throw away some more products and fire the catapult again. They go to the village where there is quite some food waste, but they do not realize that
- The button 'choose recipe' stays unclear
- They want the option to see a tutorial video
- The actions in the game are realistic
- The player needs more explanation
- They did not see the food waste
- The amount of people eating each day was not clear
- They thought that the cookbook changed the grams according to how many eaters there are that day
- The game is fun and looks good
- It creates insight in that just buying some products results in food waste
- A shopping list is essential
- The navigation is confusing

References

Aljanaki, A., Bountouridis, D., Burgoyne, J., Van Balen, J., Wiering, F., Honing, H., & Veltkamp, R. (2014). Designing Games with a Purpose for Data Collection in Music Research. Emotify and Hooked: Two Case Studies. In A. De Gloria (Ed.), *Games and Learning Alliance. 8605*, pp. 29-40. Cham: Springer International Publishing.

Amanita Design. (2009). *Machinarium*. Retrieved Juni 2018, from Machinarium.net: http://machinarium.net

Bellemare, M., Çakir, M., Hanawa Peterson, H., Novak, L., & Rudi, J. (2017). On the measurement of food waste. *American Journal of Agricultural Economics, 5*(99), 1148-1158.

Chun, J. (2015). *The Food Fight: A gamified approch to food waste collections at Philadelphia University.* Thesis Master of Science Sustainable Design.

Dimitrov, I. (2018). *New supermarket shopping app and household food waste fight tool. Fast list building, smart home grocery management.* Retrieved Juni 2018, from CogZum: http://cogzum.com

Eidos Interactive. (2009). *Mini Ninjas - YouTube Gaming*. Retrieved Juni 2018, from YouTube Gaming: https://gaming.youtube.com/game/UCR4LecgrHYg-6X2nXdD8HRw#tab=0

Electronic Arts. (2018). *Overzicht kenmerken De Sims 4 - Officiële website De Sims 4*. Opgeroepen op Juni 2018, van Electronic Arts Inc.: https://www.ea.com/nl-nl/games/the-sims/the-sims-4/pc/features/overview

Erasmus+. (2018). Opgeroepen op Juni 2018, van EFFECT: http://foodwasteeffect.eu/pl/the-game

Favaro, P. (1986). *Alter Ego | Life Simulation Game*. Retrieved Juni 2018, from Playalterego.com: https://www.playalterego.com

Food and Agricultue Organization of the United Nations. (2013). *Food wastage footpint: impacts on natural resources: summary report.* Rome: FAO. Retrieved from Rome: FAO.

Foodbattle.nl. (2018). *Ik doe mee aan de FoodBattle! Ga je ook de uitdaging aan om minder eten weg te gooien?* Opgeroepen op Juni 2018, van https://foodbattle.nl

Growth Engineering. (2018). *What are serious games?* Retrieved Juni 2018, from http://www.growthengineering.co.uk/what-are-serious-games/

Gustavsson, J., Cederberg, C., Sonesson, U., van Otterdijk, R., & Meybeck, A. (2011). Global food losses and food waste. Study conducted for the International Congress SAVE FOOD! Düsseldorf: Food and Agriculture Organization of the United Nations. Rome.

Hebrok, M., & Boks, C. (2017). Household food waste: Drivers and potential intervention points for design - An extensive review. *Journal of Cleaner Production, 151*, 380-392.

Hughes, T. (2018). *NOUR - experimental food art game / interactive food sim*. Retrieved Juni 2018, from Kickstarter: https://www.kickstarter.com/projects/terrifyingjellyfish/nour-experimental-food-art-game-interactive-food-s

Kang, J., Liu, M., & Qu, W. (2017). Using gameplay data to examine learning behavior patterns in a serious game. *Computers in Human Behavior*(72), 757-770.

Kidsciencechallenge.com. (2018). *Zero Waste - Play the Game! - Kids' Science Challenge: Fun Educational Science Resources!* Retrieved Juni 2018, from The Kids' Science Challenge: http://www.kidsciencechallenge.com/year-four/zw_game.php

MaFa.Com. (2014). *Supermarket Shopping Spree - Play The Girl Game Online*. Retrieved Juni 2018, from MaFa.Com: http://www.mafa.com/Supermarket-Shopping-Spree

Mattson, L., Williams, H., & Berghel, J. (2018). Waste of fresh fruit and vegetables at retailers in Sweden - Measuring and calculation of mass, economic cost and climate impact. *Resources, Conservation and Recycling*(130), 118-126.

Quested, T., Marsch, E., Stunell, D., & Parry, A. (2013). Spaghetti soup: The complex world of food waste behaviours. *Resources, Conservation and Recycling*(79), 43-51.

RCTO Productions LLC. (2018). *RollerCoaster Tycoon | RollerCoaster Tycoon - Official Site - The ultimate theme part sim experience*. Retrieved Juni 2018, from RollerCoaster Tycoon: http://www.rollercoastertycoon.com

Reutter, B., Lant, P., Reynolds, C., & Lane, J. (2017). Food waste consequences: Environmentally extended input-output as a framework of analysis. *Journal of Cleaner Production*(153), 506-514.

Schell, J. (2008). The Art of Game Design: A Book of Lenses. In J. Schell, *The Art of Game Design: A Book of Lenses* (2nd edition ed., p. 512). Taylor & Francis Inc.

Sinnot, R. O., Han, J., Hu, W., Ma, X., & Yu, K. (2015). Application of Mobile Games to Support Clinical Data Collection for Patients with Niemann-Pick Disease. *IEEE 28th International Symposium on Computer-Based Medical Systems*, (pp. 1-6).

Sony Computer Entertainment Inc. (2011). *Ni No Kuni: Wrath of the White Witch*. Retrieved Juni 2018, from PlayStation: https://www.playstation.com/en-us/games/ni-no-kuni-wrath-of-the-white-witch-ps3/

Stenmarck, Å., Jensen, C., Quested, T., Moates, G., Buksti, M., Cseh, B., . . . Östergren, K. (2016). *Estimates of European food waste levels.* Stockholm: IVL Swedish Environmental Research Institute.

Surrey.recycle.game. (2018). *Rethink Waste*. Retrieved Juni 2018, from City of Surrey: https://surrey.recycle.game/en/

YouTube. (2016). *Cooking Chef Food Games iOS/Android Gameplay*. Retrieved Juni 2018, from YouTube: https://www.youtube.com/watch?v=AMJrUEQ0NSY