It's you and me; we're in a kitchen. Behind us; a door. In front of us; a pile of recyclable garbage. The garbage? It talks. The vocabulary? It's vulgar. Degrading. Silly. Two minutes on the clock to recycle as much garbage as possible. Winner gets to leave through the door. Loser leaves in the compost bin with the decomposing chicken feet.

Smart Solutions

Garbage Game Pro

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Content

Abstract

In recent years, the issue of waste management and environmental sustainability has gained increasing attention from policymakers and the general public. Recycling is one of the most effective ways to reduce waste and preserve natural resources. However, many people need to be made aware of the importance of recycling or need to learn how to do it properly.

Our game aims to educate players about the benefits of recycling and encourage them to adopt sustainable practices in their daily lives. The concept is designed for danish youth between 16-20 years of age, as they are more receptive to new ideas and are more likely to adopt sustainable behaviours.

This paper will elaborate on the design process behind our game, including the game mechanics, code behind the game, design guide and its relevance supported by tests. This project aims to provide a fun and engaging way of teaching our target group about recycling while also bringing attention to an important topic. By designing this game, we aim to inspire young people to act towards a more sustainable future.

Problem Statement

How can we effectively teach young Danes between the ages of 16-20 about the new Danish recycling laws in a way that is engaging, informative, and memorable?

The challenge lies in making a serious topic like recycling into an enjoyable and fun experience, while still accurately conveying important information about the new laws and how these are going to impact us as individuals. Our game aims to solve this problem by using a combination of humour and factual knowledge to create a unique learning experience that resonates with our target audience.

The success of the game will be measured by how well it effectively educates and motivates players to adopt sustainable recycling habits, while also entertaining them with engaging gameplay and memorable content.

Project Management

Considering the broadness of the project, we decided to choose an agile project management approach. This approach has allowed us to plan and divide tasks throughout the entire process thoroughly.

The proposed plan was divided into six sprints, which covered six-week period of the project. Those sprints covered the design thinking process, including all its stages combined with its actual functional implementation to the digital solution. Followingly, it has allowed us to test every single decision and adjust the outcome.

Moreover, thanks to daily scrums and backtracking of the progress, we could adapt upcoming sprints, adjust tasks and dynamically readjust our focus when presented with challenges.

To adapt those changes to a single project, we have decided to use GitHub. This platform allows all members to work on the same project with high-risk prevention and the smallest margin of error.

Concept ideation

Our team used a collaborative brainstorming technique called Round Robin to develop a game concept. Each member was given a piece of paper, and the group passed these around the table, with each person adding to the ideas already written down. This method allowed us to quickly generate many ideas while building on each other's thoughts.

As we passed the papers around, we discussed each other's ideas, providing feedback and expanding on each other's thoughts. This process helped us clarify any unclear points and develop existing ideas further. Once everyone had contributed their ideas, we reviewed the papers and discussed which ideas were most promising and how they could be incorporated into the final game concept.

Using this technique, we created a complete game concept, which was justified and remained to be tested to start gathering data and developing the game. The collective effort of the group and the diversity of our perspectives allowed us to create a more creative and successful game concept. Overall, the Round Robin brainstorming technique enabled us to work together effectively and efficiently to develop a solid game concept, which included everyone's unbiased opinions.

Initial pitch

We landed on the idea of recycling. At first, it was a limited subject, with the only real possibility of throwing away the trash. However, after diving deeper into the idea, we realised it fit our task perfectly. We did not have to complicate the actual task, only find an interactive and fun way to teach a boring topic.

The initial idea was to have objects with personalities, arms, legs and faces who would talk to the player and explain to which bin they belong. With the personification of the objects, we hoped the users would be able to remember and retain knowledge learnt. We could have new objects introduced, new bins, and an end level where they start getting random items which they had in the earlier levels.

Research

Primary data

Recycling awareness

Our primary research revealed a significant lack of understanding among the public about proper recycling techniques and the division of recyclable items. Its main part included interviews, conversations and tests with our target audience which revealed that many people often dispose of recyclable materials in regular garbage bins or incorrect recycling bins, contributing to unnecessary

waste and pollution. Additionally, we discovered that while some individuals had a basic understanding of the principles of recycling, they needed to gain proper knowledge about recycling.

Secondary data

In Denmark, households are required to separate their waste into different categories for recycling and disposal. A "pay-as-you-throw" system is also in place, where households are charged based on the amount of residual waste they produce. Additionally, there are waste reduction campaigns to encourage households to reduce waste and increase recycling efforts.

While our game features eight bins for waste management, it is worth noting that this number may reflect something other than the waste management system in a typical household. In Denmark, a typical household usually has three bins for waste management. Although some households may have additional containers for other types of waste, ensuring that our game accurately reflects Denmark's most common waste management practices is essential.

To make our game work properly, we need to emphasise the importance of properly sorting waste. The most crucial aspect is that all sorts of waste must be free of food remains and liquids, ensuring the waste can be recycled and used in new products. Additionally, it is essential to note that certain items, such as hazardous waste, are not allowed in the containers. By educating users on the proper way to sort waste, we can promote responsible waste management and contribute to a cleaner environment.

Target group

The target group for our game is Danish teenagers and young adults between the ages of 16-20. Our game is designed to be a meme-type game that uses humour and virality to engage users. Our game uses mature language such as "stupid donkey" and "are you riding your horse backwards" to appeal to our target group.

Social media and online platforms play a significant role in their lives, and viral content and memes often spread quickly in the age group. Creating a sharable, humorous, and engaging concept could increase its reach and impact among young people in Denmark.

Concept Testing

As a team, we recognized the importance of testing the concept of our game before proceeding with its development. Our primary goal was to ensure that potential users found the idea exciting and helpful regarding recycling. This approach helped us refine the game's concept and improve its user experience before proceeding with the development stage.

To achieve this, we conducted tests and interviews to assess their general knowledge of recycling and the level of satisfaction and interactivity with our initial lo-fi prototype. We placed respondents in a room and asked them for feedback on our prototype.

From our concept test, we got a generally positive response from our test participants. However, we learnt that our particular test participants did not identify as gamers, and therefore they needed help figuring out the initial controls of the game. Because of this, we determined it was necessary to teach our players what the game's control scheme was. These findings determined our focus of development for the remainder of the project as we looked into ways of teaching players how to interact with our game.

Expression of the Game

Visual Identity

Visual Design Guide

Our project's identity was established based on a visual design guide which we created. We opted for a low-poly modelling approach, which is easier to model and has a charming style. This aesthetic choice contrasts with the crude language used in the game, which was intended to be humorous.

Logo and colour schemes

Our logo features a low-poly planet with a recycling symbol around it, representing our commitment to sustainability and environmental awareness.

When choosing a colour scheme for our menu, we aimed to create a visually appealing and easy-to-read layout. Green, blue and white were selected as the primary colours due to their calming effect, making them ideal for creating a relaxed atmosphere for our users. For our environment, we chose brown as the primary colour to create a warm and inviting atmosphere that evokes a sense of comfort and a homey feeling.

Our Models

Based on prior research, we selected the objects and items to be modelled for our game, focusing on the kitchen environment. We discovered that this is one of the most complex areas in the household to recycle in. Our approach involved showcasing a variety of objects targeted for each bin which can exist in a Danish household.

To make the game more engaging for players, we decided to give the items arms, legs and faces, with each item having a distinct personality type. To achieve this, we modelled these components separately in Blender, allowing us not to model each of the components on all items separately and having editing in Unity easier. Moreover, ragdoll abilities were made to the arms to give them a more interactive look.

To enhance the player's experience, we created a set of fully functional arms for them to use within the game. These arms were used to visually indicate when the player was holding items, and also to show the player a task list. The task list was implemented in the game to help players understand the tasks of each level that need to be finished to progress in the game.

We tested multiple designs and animations to determine the most intuitive option for players. User feedback ultimately determined that having an A4 paper in the player's right hand was the most natural and effective solution.

Audio

After conducting concept testing, we found that users faced difficulty playing the game and understanding its purpose. Therefore, we decided to incorporate an educational element through audio where users can listen to voice lines. We also recognized the importance of giving memorable and quirky personalities to the game objects from the outset. Combining all these attributes was crucial to the success of the game. To summarise, we aim to make the game more user-friendly, educational, and engaging by incorporating audio and giving unique personalities to game objects. The explicit language was chosen to create a sense of controversy to boost player engagement, as the consumers of the chosen target group often view this type of language.
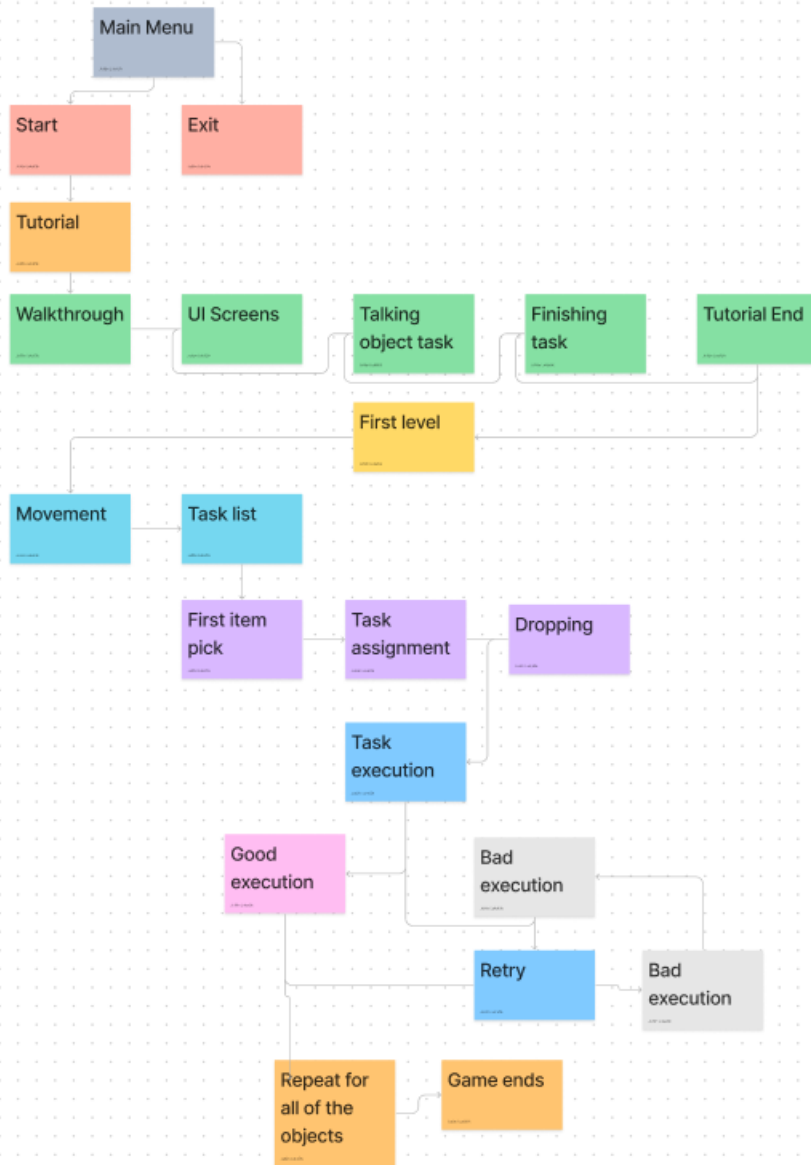
Test

To validate research and supervision on the audio lines, we concluded a test on several participants. We first tested the features and general feel of the game without audio lines, where the participants often needed clarification or guidance in their tasks. Testing this feature was crucial as audio lines were meant to reduce visual smog, which was followingly confirmed by test. Additionally, it has created a sentimental value or a relationship between a player and the objects. Concurrently, the participants appreciate the creativity put into developing the game characters, which makes them memorable and engaging for players. Incorporating audio lines adds to the overall user experience, making the game more immersive and enjoyable.

Programming

User journey

We utilised a user game journey to establish a user's path from the beginning of the game to its completion, including the various stages they encounter along the way. The journey begins at the loading screen and progresses to the UI menu, where users are directed to either the tutorial flow or the main flow for the game's levels. This journey enabled us to understand the game's structure and the steps users take through it, and it serves as the backbone of our game.

```
                        Main Menu


        Start                  Exit


        Tutorial


   Walkthrough    UI Screens    Talking        Finishing       Tutorial End
                                object task     task

                                      First level


        Movement      Task list


                   First item    Task           Dropping
                   pick          assignment

                                      Task
                                      execution


                            Good             Bad
                            execution        execution


                                      Retry          Bad
                                                     execution


                   Repeat for       Game ends
                   all of the
                   objects
```

Class Structure Diagram
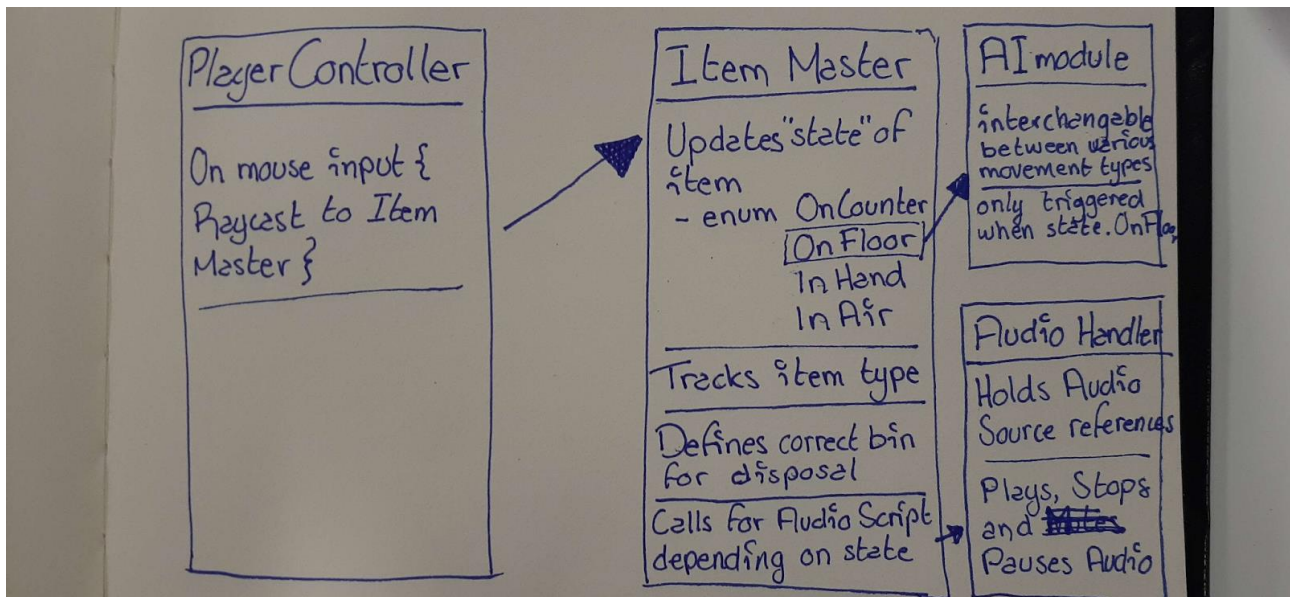
The most important interaction between scripts happens between the Player Controller and the Item Master Script (IMs), as the player is the primary source of changing any item's current state.

The IMS keeps track of an item's current state, updates it depending on the information given by the Player Controller, and makes sure the items behave correctly depending on their Recycling Type.

Item Master Script

The Item Master Script (IMS) was developed to be a master script which could be dragged onto any object in a scene and instantly create a basic item AI for fast implementation. The script automatically applies the necessary components an item needs and also assigns most of the variables in the inspector, minimising the amount of manual work we as developers would need to otherwise do. It was written this way to make it so any team member would be able to add an item model to a scene and immediately be able to run various tests on this item.

The IMS interacts with two secondary item scripts: the Item Audio Handler, which keeps references to and plays all of the relevant audio sources an item may have, and an interchangeable MovementAI module. The MovementAI module can currently be occupied by either a RunnerAI or a HarasserAI script, which are two self-contained movement scripts that dictate how an item moves once its state is OnFloor. By separating the MovementAI scripts from the IMS, it enables us to rapidly write different movement scripts that make it easier to experiment and test AI types, without adding excessive functions to the IMS which may create conflicts.

Tutorial Script

The code provides a step-by-step onboarding process for players to learn how to use various controls in a game by displaying overlays on the game screen that guide the player through the

required actions. The code uses boolean variables and delays values to keep track of the player's actions and control the time when the overlay is displayed to ensure that the player has enough time to understand the rules. It also uses Unity's Coroutine feature to execute a sequence of steps to guide the player to the desired outcome.

During each iteration of the coroutine, the code visually displays an action and checks whether the player has performed it. Once the action is completed, the overlay is hidden. This process repeats for each required action until the player has completed all the steps. Finally, an overlay image is displayed to indicate that the onboarding process is complete.

Preferred Splash Screen Test

As informed by our initial Concept Test we found it necessary to somehow teach our players what the control scheme of the game was. Here we thought to make use of a splash screen which would be shown to the player at the beginning of our first level.

We wanted to test which splash screen design amongst three variants our players would feel introduced them to the control scheme of the game the best. These designs were labelled as A, B and C.

This test was facilitated by arranging interviews with our target demographic, in which we would present our test participants with design A and B next to each other. We would then request feedback on the layouts, after which we asked our test persons to vote for either design A or B. We then repeated this same structure comparing B and C, and C and A against each other.

An important factor we accounted for in a preliminary interview with our test persons, was whether they were familiar with first person desktop games in a 3D environment, as we believed the results would be affected by this.

When comparing the three variants, our test participants generally only preferred variant A when they indicated they were highly confident in their own ability to know from experience what the control scheme of the game *might* be.

In contrast, our test persons were more likely to prefer variant B when they wanted to be able to quickly identify what the key binds of the game were. They didn't indicate that they wanted to know what every individual button specifically did, as the primary feedback was more in line with quickly identifying which buttons had a positive key bind and would do something when pressed. The actual function of the button wasn't what was valued, but instead the fact that there was an indication that the button was simply interactable.

Design C was preferred when our test participants wanted a clear visual guide to the controls of the game. The layout was praised for being the most informative and structured, as it clearly indicated which keys are interactable and had arrows pointing to a short description of what that interaction was.

As the purpose of this test was to figure out which splash screen would best teach new, non-gamer players about the game's control scheme, we can therefore conclude that design C would be the best option.

Splash Screen vs Dynamic Tutorial

The purpose of this test was to gauge the theory that users may prefer playing a tutorial which teaches them the controls of the game one by one, instead of having all the controls presented at once only at the beginning of the game.

To test this, we created a build with two identical levels. Level A would only show our test participant a splash screen of the available controls right at the beginning, while Level B would walk the player through every interaction one by one. The task we asked our players to complete was the same in both scenes, with the only difference being that participants would be asked to begin with the opposite level than the previous participant before them began with.

Our test found that simply showing a splash screen once was not enough to adequately teach players what the control scheme of the game was. We found that introducing every possible interaction step-by-step made it easier for players to learn how to interact with the game.

What we also discovered was that while teaching our test persons using plain text prompts was easy and efficient, it was not engaging for our players to interact with. We now know that players don't just want to know what the objective control scheme of the software is, they want to be fully immersed and engaged into the setting of the game by use of graphics, audio and dynamic interactions prompted by the player's own agency and curiosity.

Usability testing

To evaluate the final concept, we decided to test the entire project with all the functionalities we developed throughout the process. We aim to validate whether the features make sense while being together instead of being tested separately.

The four participants were placed in the open game without guidance and were meant to finish the game and evaluate their experience. All four participants completed the game effortlessly. Their level of knowledge before the test was minimal, and they needed to learn how to recycle several objects. The day after our test, these participants were asked if they remembered how to recycle the items. With one exception, the participants remembered all the objects in the testing. Therefore, we assess our concept goal as met and validated.

Future improvements

To integrate interactive and immersive learning experiences into the training process, we would elaborate on a virtual environment where the players can interact with the game and its various elements more intuitively and engagingly. The use of graphics, audio, and dynamic interactions can be combined more thoroughly to create a more immersive experience that encourages the player

to explore and experiment with the game mechanics. Additionally, incorporating gamification elements into the learning process, such as rewards and achievements, can motivate players to engage with the training materials. Therefore, we would elaborate on the existing functions, assessed as engaging and broadening, which would elaborate on the player-to-game relationship.

Conclusion

In conclusion, our project is an innovative solution to the challenge of educating Danish teenagers and young adults about new recycling laws. By combining humour, factual knowledge, and engaging gameplay, we have created an informative and enjoyable learning experience. Our game's low-poly modelling and natural colour scheme, user-friendly controls, and short tutorial make it accessible to users of all skill levels. Moreover, our game's focus on sustainability sets it apart from other educational games and competitors.