CUBE FUSION

A cooperative puzzle game to improve procedural thinking

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ABSTRACT

This is Cube Fusion, an interaction-based two-player game that requires the ability to cooperate with each other and exchange information in order two traverse through the levels. The idea behind this project is to show that communication tends to fade away in the digital world despite being important in everyone's life. This report explores how communication and cooperation can be inspired in a video game, as well as describing the path to a final prototype.

1 INTRODUCTION

In the digital world we are living in, people tend to do everything by themselves and thus forget what it's like to cooperate. As appealing as it sounds, the idea of "social networks" is the furthest from social relations one can imagine: instead of enticing real interactions, the real effect they have on society is to isolate people from the each other. This effect can be even stronger on children. By being exposed to social networks and video games from a really young age, it can often slow down children's social development and ability to cooperate and communicate with each other.

However, being able to work and communicate with others is a great asset into achieving things that are hardly accessible when approach alone. One of the biggest stakes we have to face nowadays is to be able to link children using the digital world, instead of making them compete against each other or be on their own[1]. Perhaps rather than trying to protect children from the digital world we should think about making it more suitable for kids instead. How about making a digital environment that encourages gathering, exchange and communication?

Where is the real problem? Digital technologies, or how we use them? CubeFusion is a product that tries to bring people together and make them coexist and communicate.

2 BACKGROUND

This project has been realized in cooperation with the Universeum in Gothenburg, Sweden. The Universeum is Scandinavia's most visited museum with more than 500,000 visitors per year. Universeum asked for projects that can raise interest for certain new technologies such as internet of things, sensor technology, artificial intelligence, big data and programming. The target group should be 12 to 17-year-old girls, as the museum experienced a lack of visitors of that demographic. The project should furthermore encourage teamwork, cooperation and communication. The final prototypes of the projects were presented to the public at a two-day long exhibition at the Universeum.

3 CONCEPT

3.1 What the game is about

Considering the background constraints of this project, we needed to find a game genre that would bring together the fact that the project had to introduce some learning outcome, that it had to relate to new technologies as stated above and that it required some interactions between the players. Moreover, the game had to be appealing to teenage girls, so we really needed to think of something that would be fun for both boys and girls.
Thus, one idea came in mind: to make a cooperative puzzle game. This type of game fits the expectations of the Universeum perfectly. The cooperative part makes players interact with each other and the gameplay we chose for the puzzle game simulates the thinking process you need when programming. In that way, it raises interest in new technologies. In addition, puzzle game are very popular among girls and women, which contributes to fitting the target group [2].
The puzzle game revolved around two characters that are controlled by the two players. The characters find themselves in a maze with the goal to meet each other. The interesting part about this game is that the characters do not respond directly to the

user's input. In fact, the gameplay can be divided into four sections:

- They need to view and analyze the level and try to figure out a solution together.
- They input their commands as a sequence and press play when they are ready.
- When both players are ready, the sequence is executed, and the players can see the results of their plan.
- If the plan was not correct and the execution failed, the players can acknowledge their errors and correct their inputs accordingly.

We wanted our game to be like this in order to relate this gameplay with the concept of programming and create a fun metaphor for it. In fact, it is quite similar, when programming as you undergo similar steps.

- Look at your problem and figure out a possible solution.
- Write and design your code.
- Run the code and hope for the best.
- If it failed, go back to your code to figure out what went wrong.

3. 2 Gameplay mechanics and design patterns

During the development of the game we used certain gameplay design patterns (Staffan Björk [3], [5]) to convey aspects that were important to us. The puzzle solving and action programming draw relations to actual programming of computer programs, which was one of our intended main learning outcomes. The cooperation aspect has been addressed through the level design, as we designed harder level so that they cannot be solved by only one player, but rather require some teamwork.
To make the levels harder we discussed multiple game mechanics [6]. Player can not only move their characters but also have to open doors for each other, wait for one another as well as move boxes to open paths in the levels. There were a lot more ideas in the development process, that couldn't be realized due to the limited time of the development.
In terms of what the intended game experience for the players should be like, we can use the characterization of "kinds of fun" of the MDA model [4]. Players should feel a sense of challenge and pride when they play through the levels than get harder and harder. Players should also feel that fellowship and cooperation are rather important and that they learn new mechanics throughout the game. The latter is characterized as discovery in Hunicke's, LeBlanc's and Zubek's MDA Model [4].

3.3 Ideas that didn't make it

As mentioned in the previous paragraph, there are quite some ideas we had for the project that did not make it due to the lack of time.

One idea, that would have incorporated further difficulty was to add more rules to certain levels.

- An Ice-themed level could have implemented a rule where each command moves the player to the opposite wall without the player being able to change.
- Each level could have had a limitation for the number of commands, which would have required the players to not find any, but the optimal solution for each level.
- To enable player to do more actions than the limit, players could be able to group commands together to reusable functions. This would have also furthered the metaphor of the game for programming.
- Certain levels could have a restricted use for certain commands. For instance, players can only go into certain directions a limited amount of times or can not use certain commands at all.
- Environmental rules (these are specific rules that would only be there for specific levels and that would change the gameplay. For instance, an environmental rule could be "in this specific level, every command you input are executed twice")
- Adding the third dimension as a dimension to move in, for instance jumping on moving platforms or over obstacles.
- Multiply the number of possible actions for the players were also possible, for example:
  - Interaction command
  - Shooting command
  - Climbing command
- More advanced game mechanics could have also been possible, such as
  - Moving platforms
  - Teleportation devices
  - Water
  - Falling system
- Adding a scoring system with record depending of the number of commands or time used for the level would have added to the more competitive nature of some players.

4 METHODES & PROCESS

4. 1 Brainstorming

Since all the members of the group were part of the game project development, we already knew that we would design a game. Firstly, we met to get to know each other a little more and to decide which technologies we were going to use based on our skillsets.
After this meeting we agreed on the use of the cross-platform game engine Unity[7]. Some of us had never used it and it was a great opportunity to discover a new technology whereas some others would be able to improve their skill in Unity development. Once decided, the following brainstorming sessions were focused on finding the concept and the type of game we were about to make. Keeping in mind the target group and our competences we decided to move towards a game with the theme of cosmos and planets to match with the floor of the museum where we were supposed to exhibit our project.
After some feedback and advices from the supervisors which made us understand that the target group was not targeted, we decided to take some time to brainstorm on different ideas that could fit with the project requirements. Here are some of them:

- A game which's goal it is to designate an AI using statement bubbles to complete a platform level.
  (pros: great learning outcome; cons: Target group may not be reached, not a game that could fit in a museum exposition)

- A game were the children are supposed to take care of a town and would have to make several choices to increase the sustainability of the town (pros: original outcome in harmony with reality; cons: hard to define, requires good knowledge of the subject, big scope)
- A platform game where the control have to be planned in advance (pros: hidden outcome, can be a multiplayer game)

We kept the idea for the platform game which is more like a puzzle game due to the fact that the commands are not in real time.
The next step was to precisely define the game properties.
We then had multiple more brainstorming sessions to distribute tasks for all team members and to slowly build a working base game.

4. 2 Organization

Making a game is not an easy task on its own, so making a game in one month revealed to be very challenging. Thus, we needed a good organization to be able to make it in time. As a group, we decided that working in an agile way was probably one of the best ways to advance efficiently. Therefore, we used online management tools.

- Trello was used as a back log to plan the processing of the project.
    - What has to be done?
    - What tasks are currently in progress?
    - Who does what ?
    - What bugs do we have?
    - Who is correcting the bugs?
- Git was used to enable parallel development and collective code ownership.

These tools really helped to keep the project together because it was also a project divided into two different sides: the client side which takes care of the user interface using tablets where the players could enter their inputs and the server side which controls the communication between the user devices and which displays the actual game.

As Unity allows quick prototyping, we decided we wanted a functioning base game first, before designing any levels or general game flow. The 'offline' and sequential input and movement method turned out to be one of the most demanding features, so addressing that issue early was a good move.

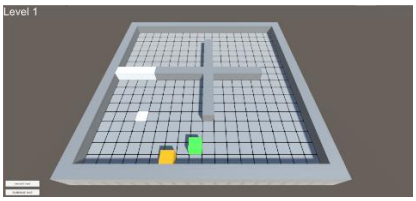

Fig. 1: One of the first test levels. Feature both players (green and orange) as well as a grid that restricts the movement, walls and a door that is activated by a button (both white).

Once we had the base of the game we decided to divide the work into different tasks and spread them to the different members of the group. In fact, we needed to take care of a lot of tasks:

- Network communication between the tablets (serving as use input devices) and the computer serving as a server
- Development of the graphical user interface
- Development of the gameplay mechanics
- Level design
- Animations
- graphics
- Bug fixes

5 RESULTS

5.1 Current Prototype

Fig. 2: Level 7 of the final prototype. Features the two players (green, orange), walls, doors and buttons (marked with letters A and B) and moveable boxes. The graphics mainly used Unity's terrain system.

The final game allows two player to play at the same time on one screen. Each player interacts with the game through their tablet which connected to the server-PC via Wi-Fi. The final game contains nine levels with increasing difficulty. The game mechanics get progressively explained through simple gameplay and are then incorporated in future levels.

5.1 User test

The game has been tested at a two days long exhibition with at the Universeum alongside other projects. Throughout the two exhibition days we had 37 groups of people playing. Mostly, it was siblings or kids with their parents who played the game, with a majority of kids being between 9 and 12 years old. The kids playing our game were ~40% female and ~60% male. This shows that the target group of 12-17 year old girls has not been matched too well, which is arguable due to who visits the Universeum in the first place.
We noticed when advising people on how to play our game and while observing them playing on their own, that the demographic was not too important on how they perceived the game. However, we could notice that kids who have experience in playing video games understood the concept and visual clues a lot better than kids without experience.

5.2 Testing outcome

Overall, the exhibition has been quite a valuable experience for us as the development team. We could see that many dynamics and aesthetics (ref: MDA Model) have been conveyed as intended. For instance, players quickly started cooperating as the levels got harder. They also learned new game mechanics while playing, which is behavior that we intentionally implemented. Players also seemed to enjoy the traps that we built into levels, which forced them to replay the level and fix their commands.

We also learned some things that we could have done better. We noticed, that the best ways to introduce new mechanics was to isolate the mechanic in a level, in order to learn it and then include it in future levels. While we did that in most cases, we noticed that not following that pattern has a negative impact on the player's motivation to play. For example, one level (level four) did not introduce new mechanics, but was rather just a repetition of old known mechanics, which was perceived as boring and frustrating effort. On the other hand, level five introduced two mechanics at once, which confused many players.

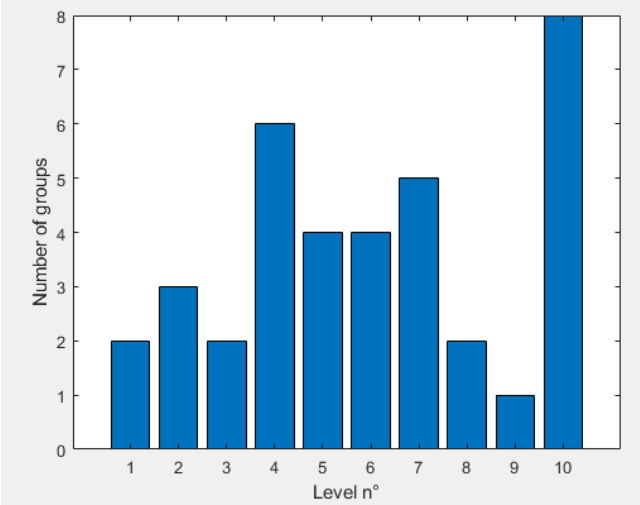

Fig. 3: The graph shows how far the players made it in the game and on which level they decided to stop playing.

From this graph, we can see that indeed, a lot of players dropped that game at level 4, because of its lack of new interesting mechanics; whereas players who really enjoyed the game made it until the final level, level 9.

We also noticed that players who had experience in games had a much easier time than players who had not. This was not good behavior as the game was made for a public exhibition and thus should be easily playable by almost everyone. In order to incorporate that, some of the core mechanics could have had better visual representation. For instance, a common issue of players was that they did not comprehend which of their commands is currently being executed. Showing the current command on screen would help that issue and would ease the use of the game while still maintaining the challenge of the level.

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