

VR Nanodegree

P4 – Puzzler & Documentation

Susanne Meerwald-Stadler
Austria
hello@xrux.at

Project

In the fourth session “VR Design”, we developed the VR Puzzler game, targeting our self-chosen user group. I have chosen elderly adults as the user group for my Puzzler game. Beside the fact that I have a lot of seniors in my personal surrounding, this decision was based on three considerations: 1) More and more works describe the beneficial potential of VR for elderly adults. Examples are to counteract isolation, to support the therapy of Alzheimer and dementia patients, and distraction from pain [2]. 2) Elderly are the fastest growing segment of the population [1]. 3) Not much work (research and applications) deals with this user group [1].

I call this Puzzler game the “Mnemonic Puzzler”. Seniors should train their memory with this VR game.

Mnemonic Puzzler

The Mnemonic Puzzler VR game should be used by elderly adults to train their short-term memory. According to the findings of work done by researchers at Stanford, virtual reality simulations had a direct impact on how people behaved in the real world, even after they took off their headsets — in fact, as neuroscientists at UCLA discovered, the part of one's brain that responds to VR surroundings is different than the part that responds to the real world, raising questions about the new ways in VR it could affect memory [1].

Video of Mnemonic Puzzler



Figure 1: Watch this video in a VR viewer

Screenshot of Mnemonic Puzzler

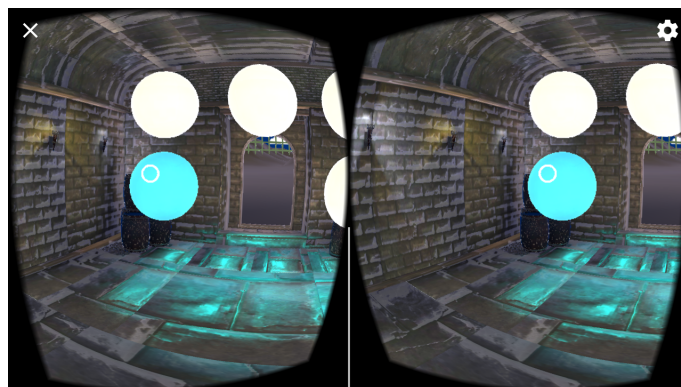


Figure 2: Screenshot Mnemonic Puzzler

Statement of Purpose

Puzzler is a mobile VR application for first time VR users (60+ years) which challenges them to solve a familiar type of puzzle in a new way.

Process Section

Within this section I describe the steps in the development process of the Mnemonic Puzzler. An overview of the whole process is given in Fig. 3, including the persona development, the sketching, VR prototyping and the user testing.

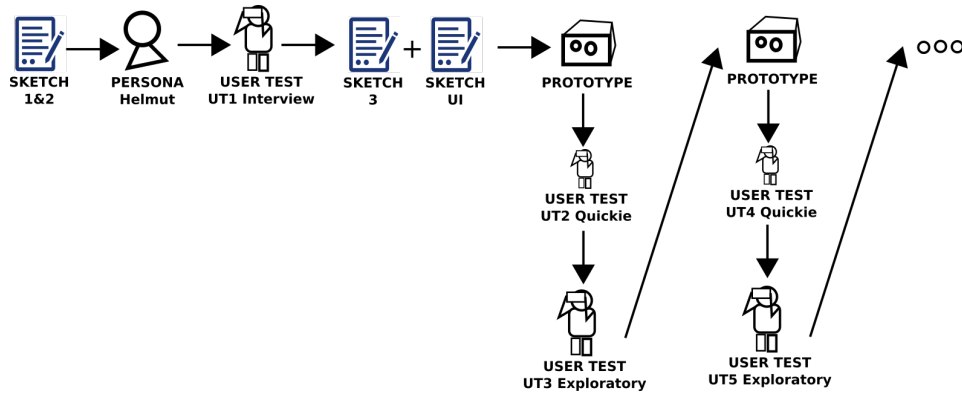


Figure 3: Steps in the development process

Sketches

I made first sketches during the “VR Design” lessons (Fig. 4a & 4b), but without a user group in mind. After deciding on seniors (60+ years) as “the” user group for my Puzzler game, I searched for design guidelines and design aspects for seniors. An interview (see section user testing) with a 68 years old woman helped to make up my mind in terms of room size, brightness of the room and orbs arrangement. In Fig. 4c you can see the adapted sketch which was the basis for the first testing prototype.

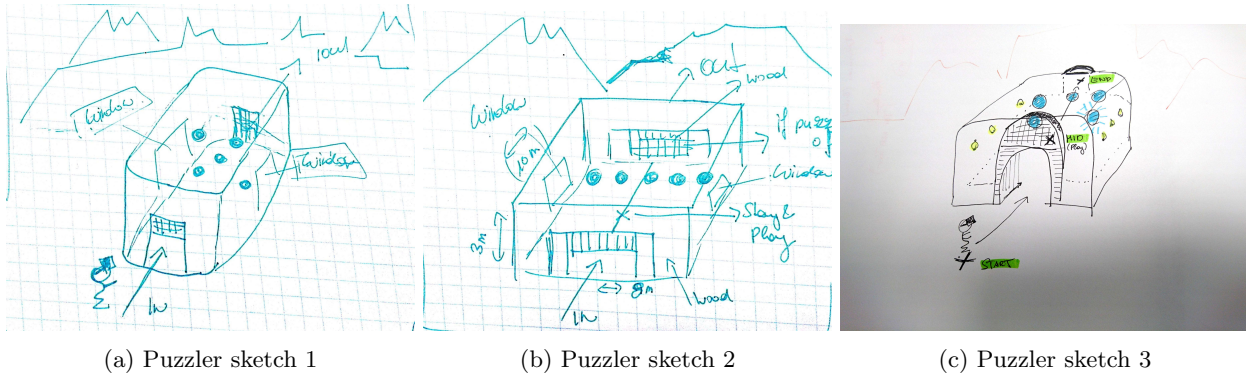


Figure 4: Dungeon design sketches

In between I sketched the UI elements “Start” and “Restart”, see Fig. 5. Finally, I had different designs and decided that the “UI sketch 3” (see, 5c) is the best for the puzzler project. Because Helmut’s fingers are not as movable as for young people and the Reticle movement is new for him, I resolved to make a huge “Start” and “Restart” button.

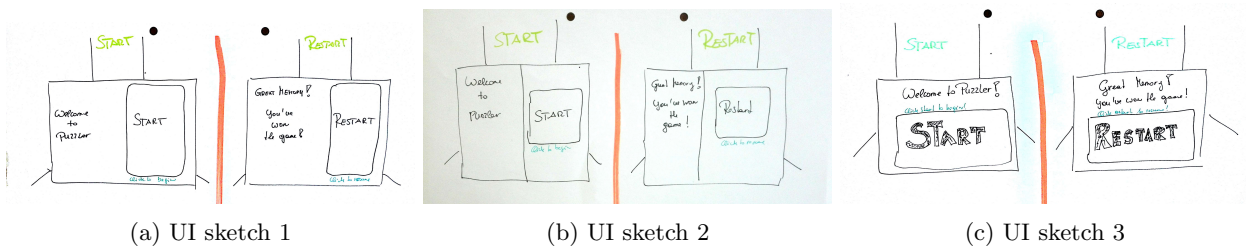


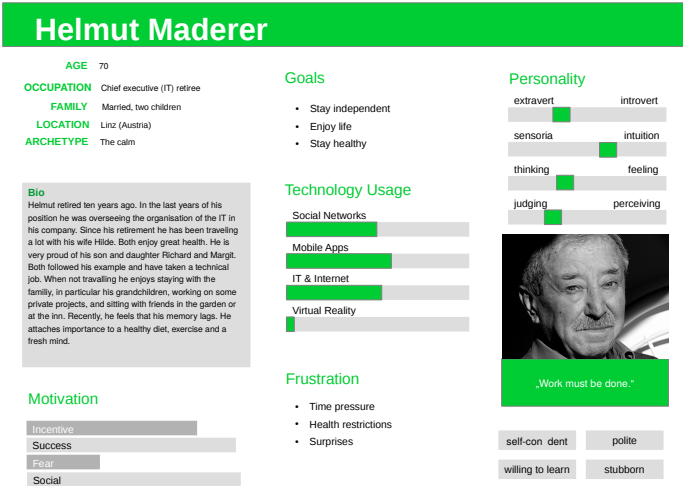
Figure 5: Collection of UI sketches

Persona

At the beginning of the Puzzler project, in the center of interest was, who will use this VR game. The direction was given by “new user”. The user group interesting to me was the senior group starting age 60 and older.

As end-user group I have chosen people with the age of 60+ years, without any or little VR pre-experience and knowledge. For this project I focus on elderly without heavy physical or visual impairments. The resulting persona is based on fictional beliefs and observations of seniors. In the following you will be introduced to Helmut Maderer (see

Fig. 6, a senior in the prime of his life.



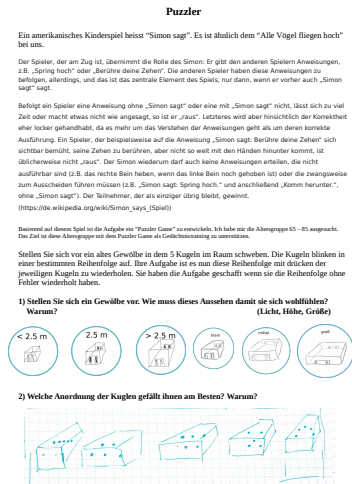
User Testing

Overall five participants (2 female/ 3 male) served as test persons during the project.

I conducted two quick and dirty user tests (quickie), one interview, and four exploratory user tests. All user tests included a warm welcome of the participants, an introduction to the Mnemonic Puzzler, and the advice that only the system is tested, not the person themselves.

Quickies: To identify cock-ups in the design or the game logic, a friend of mine (male 42 years) tested the prototypes in a quick manner. These quickies are preflights and were conducted before each of the exploratory user tests. This procedure helped to figure out if the adopted prototypes maintained or improved their quality, before testing them with the “real” participants.

UT1 – Interview: To get first user impressions I conducted an interview with one person regarding the dungeon design and the orbs arrangement. Therefore, I prepared an interview guide.



The interview guide included the story of the puzzler game (in Austria we have a similar game to “Simon Says” called “Alle Vögel fliegen hoch“), asked to imagine a dungeon and the questions for room size, brightness and orbs arrangement.

UT1 Findings: The outcome of this interview was that the room should be a little bit higher than a normal room (> 2.5m), but not very wide, because the smaller the room the more cosy it feels. The room should be bright, but not too bright such that there is enough contrast when the orbs are blinking. Regarding the orbs, I determined that the arrangement of a five as on a dice was the most comfortable arrangement for playing.

The output was directly used to develop the first version of the puzzler game with Unity.

UT2 – Quickie: This first preflight revealed that I will need a head mount band for the cardboard, because holding the cardboard for a longer period, becomes very exhausting, in particular for seniors.

UT3 – Dungeon Design User Test (DDUT) and Mechanics User Test (MUT): In this test session I conducted four user tests with two test subjects (male 73 years/female 68 years).

Within the DDUT and MUT the participants were told to explain loud what they see and what they will be doing throughout the test (Think Aloud Method¹). All tests were recorded with the AZ Screen recorder app for later analysis. Additionally, I made written notes of the observation of the participants.

The DDUT test dealt with the design of the dungeon including the light setting, general dungeon design, orbs arrangement and user’s feelings in the VR scene. There was no Skybox implemented, the “Start“ and “Restart“ canvas was activated, Orbs were visible but no interaction was implemented.

Within this design user test I asked the following questions:

1. How tall do you feel?
2. How would you describe the atmosphere?
3. What would you improve and why?

The MUT focused on the game mechanics including moving velocity and the orb light up behavior and the user interaction. The MUT was based on the DDUT prototype but additionally implemented the game logic (de-/activate restart) and light up of the orbs and user interaction with the orbs. Beside the Think Aloud and observing the

¹<https://www.nngroup.com/articles/thinking-aloud-the-1-usability-tool/>

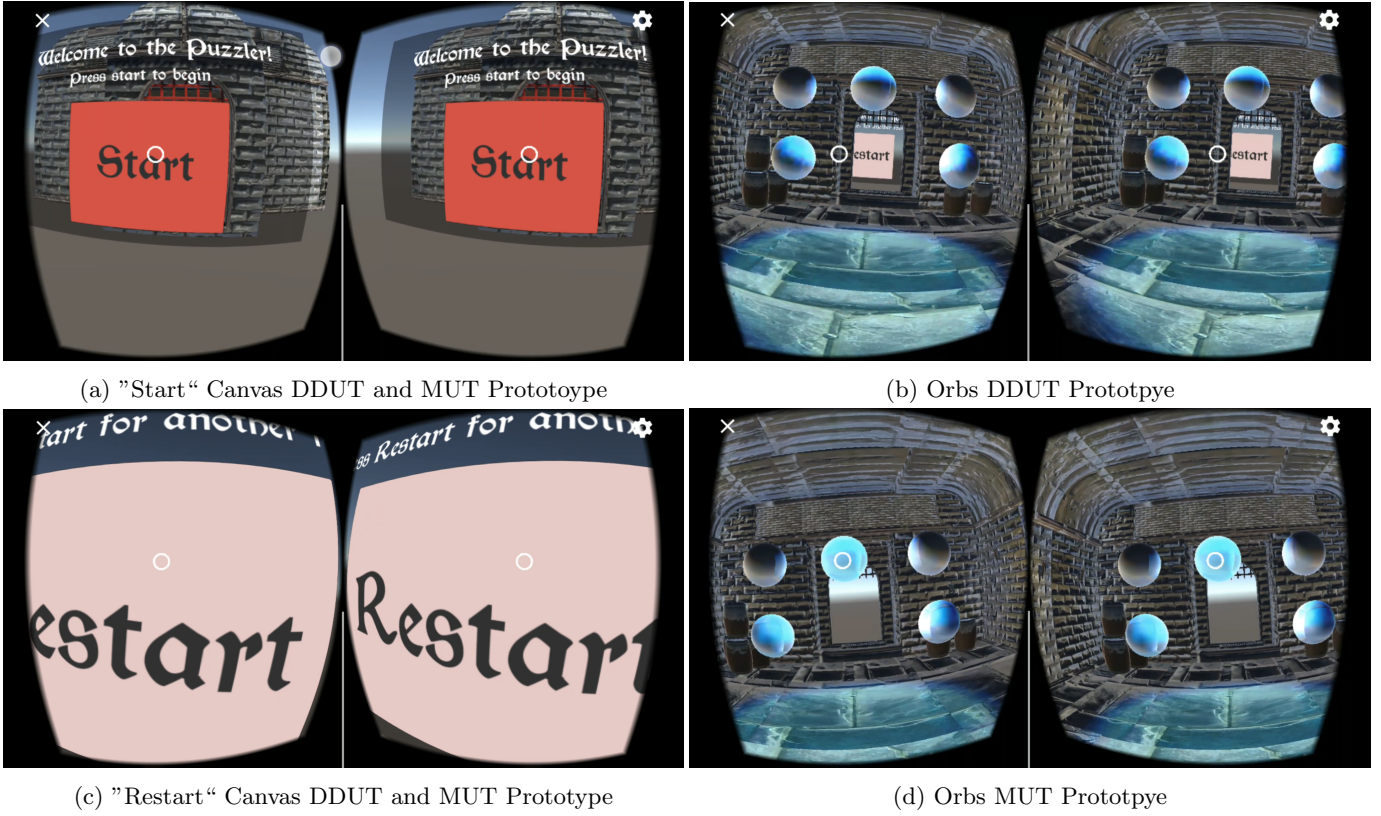


Figure 8: Screenshots of UT3 Prototypes, DDUT (Dungeon Design) and MUT (Mechanics)

participants, I discussed the prototype with the subjects afterwards.

In the following the results from the DDUT and MUT user tests are presented as summary.

UT3 Findings:

- Visual Design
 - “*I feel comfortable!*” respectively “*I like the room!*”. The layout of the dungeon was OK for both participants regarding room size and lighting.
 - “*The orbs should be more in direction of the door*”. The placement of the orbs was too near to the player position.
 - The contrast of the orbs with respect to the dungeon was too weak.
 - “*I would prefer that the orbs have no shadows, they distract me*”. The shadows of the orbs were distracting.
 - “*Maybe I have less problems when the orbs are bigger*”. Participants had problems to remember the light up order and stated as reason a combination of light up speed and too small sized orbs.
 - The participants had problems to recall the light up order, because the light up speed of the orbs in the repeat mode was too high.
 - For the participants it was hard to distinguish between the repeat and reproduction mode.
 - The restart canvas is too close to the player’s end position.
- Acceptance
 - The participants were confused because for them it was unclear that the light up order remains the same as long they have not solved the puzzler game.
 - The velocity of the movements from start point to middle point and from middle point to end point was too fast.
 - Observations revealed that one participant had problems to press the button on the cardboard due to inflexible and thick fingers.
 - At the beginning the participants made only a few head movements. With more rounds player head movements increased.
 - One subject suffered from sim sickness.
 - Both participants felt frustration playing the game. The puzzle was too complex, because of the fast light up of the orbs.
 - The participants developed ambition to solve the puzzle.

Adjustments for an iterated prototype:

- Decrease the speed of motion between play points.
- Redesign of orbs: Placement of orbs next to exit; enlarge orbs, avoid shadows on orbs, decrease light up speed in repeat mode
- Make the transition between repeat mode and reproduction more clear.
- Fix displacement of restart canvas.

UT4 – Quickie: The subject stated that the transition between the repeat mode and reproduction mode is more noticeable as before, however he desired a more direct solution, like a textual link. I decided to test with the implemented version to explore if changing light could be a supportive way.

UT5 – Puzzler User Test: In this session I tested the Puzzler game with two subjects (m 73 years/f 75 years). Because both subject had not prior experience with VR, they started with an other VR Game to get first impressions of the recticle pointer and how to select an object. The findings presented in the following are based on Think Aloud, Observation and taken notes. In this session I recorded no AZ screen recorder videos, because ”uups“ I have forgotten to start the screen recorder.

UT5 Findings:

- Sound Design: One person mentioned that the sound of wrong and right pressed Orb is imperceptible.
- Visual Design:
 - The basic design of the dungeon was OK for both participants. Although, one test person stated that a more ”clean“ room setup instead of the dungeon, like only white walls, would be more helpful for the purpose of a mnemonic training in the game. The other person stated for the purpose of training the memory, the environment is meaningless.

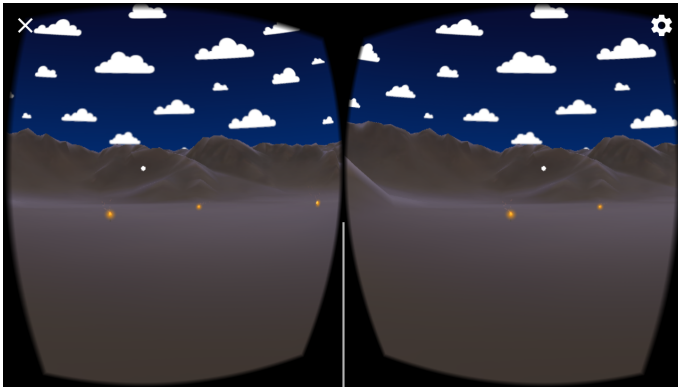
- “*I don’t feel like I am welcomed*”. “*The blue color is very cold*” The color cyan for the blinking orbs, had negative influences on the user experience for one test person.
- One subject desired a forest or a meadow as environment for the dungeon and to switch from a night scene to a day scene.
- The orbs size as well as the contrast with the dungeon was mentioned as good from both participants. One subject mentioned the blinking color as unsatisfactory.
- From the Think Aloud and the discussion afterwards it turned out, when looking straight forward in the reproduction mode the orb in the middle is accidentally selected. This confused the participants and led to wrong solutions.
- The button press mechanism of the cardboard button in combination with the recticle pointer confused and frustrated the subjects. From the observation and the discussion afterwards it turned out that subjects had problems to select the orb while pressing the button. Than they got nervous which led to wrong solutions and frustration. Furthermore, pressing the button with hands up on the button was very exhausting for both participants. Further, one subject is suffering from arthrosis which made the interaction more difficult.
- “*When I made a mistake, I watched at the light up order again, and continued from the point of my mistake*”. Participants were confused, at the first tries, what they should do. The repeat and reproduction mode was communicated too vaguely . One test person stated that it was unclear to repeat the whole light up order when he made a failure before.
- The transition between the repeat and reproduction mode has to be made more visible. Although I added the glow on the floor to easier identify the repeat and reproduction mode, the participants stated that it was still confusing.

- Acceptance:

- Both subjects had no VR pre-experience. “*Why I have to turn my head?*”, “*Why I’am seeing only a part of the scene?*”, “*The virtual reality confused me.*” In the discussion afterwards, it turned out that they had problems to understand the concept of a virtual room. Both test persons stated that they won’t play such a game in the VR world, because they would prefer the ”real world“.
- Both subjects mentioned that this game is not helpful to train the memory and desired a game with a more ambitious content.
- “*If I know the solution and I am not able to solve the game because of the non-functional button, that gets on my nerves!*”. Both participants were frustrated, and felt insecure, based on the problems with the selected orb by mistake and the inaccurate button behavior for them.
- After playing the Mnemonic Puzzler both participants had weeping eyes.
- Immersion: Participants were very ambitious to solve the puzzler.
- “*I hate the Simpsons*” One participant mentioned that the comic style Skybox is ugly.

Break down of the final piece (Prototype UT5)

Environment:



The dungeon is surrounded with mountains. It is night and small torches are placed around the dungeon. I used a comic style Skybox to highlight the game aspect.

UI Canvases: For the *Start* and *Restart* Canvas I used the font MorrisRoman-Black² to give the text a medieval aspect. The *Start* and *Restart* button is very huge, so that new users can press it easily.

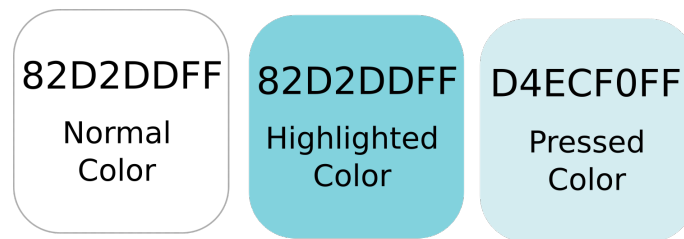
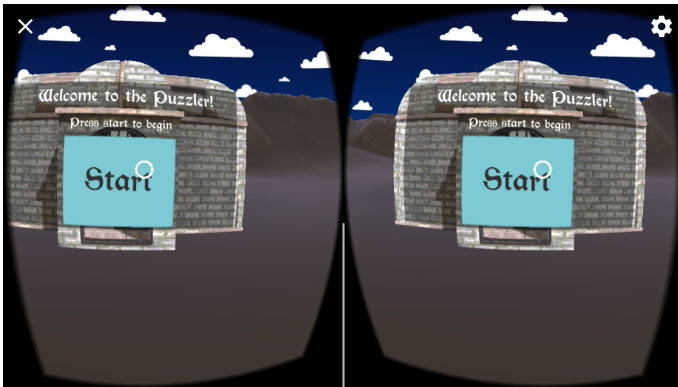
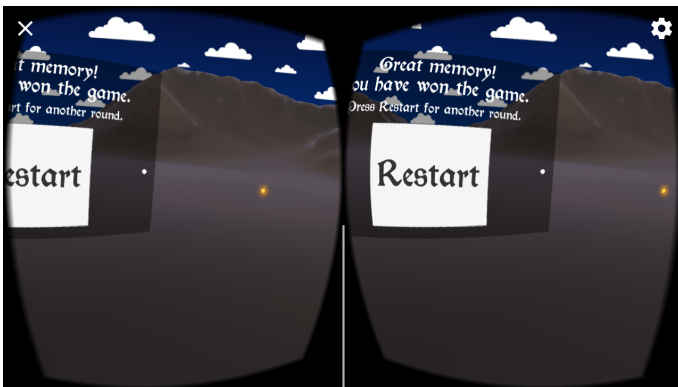


Figure 10: Color scheme of buttons



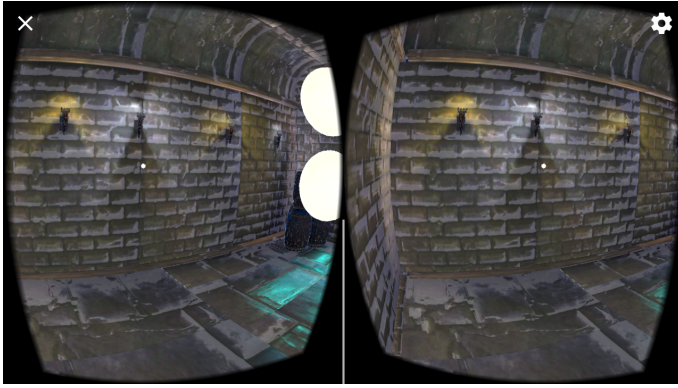
Start Canvas: After a lot of tries I decided to place the canvas directly in front of the dungeon entrance to ensure readability. After pressing the start button, the canvas will be deactivated and after pressing the restart button the start canvas will be activated again.



Restart Canvas: The canvas is placed further far away. By default the canvas is deactivated. When the puzzle is solved, the restart canvas will be activated.

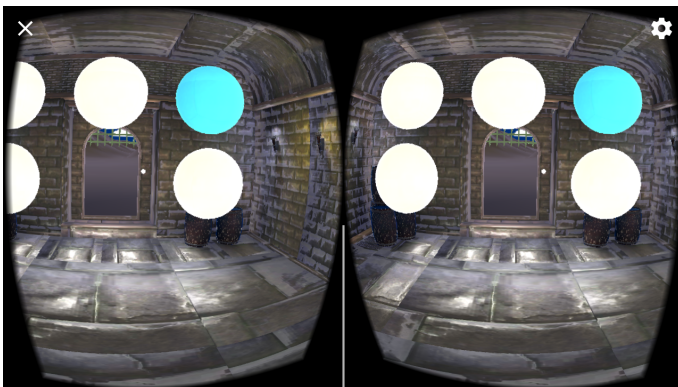
²http://www.1001freefonts.com/morris_roman_black.font

Dungeon:



The dungeon was designed in a threshold of "spooky" but also bright atmosphere. Therefore, I mixed white and yellow point lights with the mounted torches on the wall.

Orbs: The orbs glow and are bigger than in the first prototype, with small gaps in-between. The contrast is very high to the dungeon.



To distinguish between the repeat and reproduction mode the color on the floor glows in white (repeat) or cyan (reproduction). In repeat mode the interaction with the orbs is deactivated. In the reproduction mode the interaction is enabled.

Conclusion

The user testing process uncovers problems overlooked by the designer. For the "Mnemonic Puzzler" the seniors revealed several improvements. Using the Cardboard V2 the subjects stated that the puzzler looked sometimes blurred. I am not sure how to fix that with the Cardboards, playing this game on a Vive or Okulus could fix it. In the course of the project I equipped the Cardboard with a head mount band, to simplify the cardboard interaction for the seniors. Otherwise the game would be too exhausting. In the user tests with the seniors, this was very helpful. However, for a further iteration of the project, an alternative should be found for the button mechanism, because the mechanism is not working well with seniors. The participants chosen for the experiments ranged from a very inactive to a very active life style. One assumption is that seniors with a very active life style are less interested in such a game than seniors which stay more in their home. Further, it seems that the attitude towards the puzzler increases with VR pre-experience. Future versions of the Mnemonic Puzzler should be more self-explanatory in terms of purpose and procedure. To conclude, the current version of the Mnemonic Puzzler is a good basis for further development. However, a lot of more work has to be done that seniors sense a positive user experience with this game.

Next Steps

- Persona: Further iteration of the persona. Include prior playing games behavior, diseases (like arthrosis, visual impairments), adjust the life style.
- Cardboard: Equip the cardboard with an alternative button mechanism, for example external button.
- Testing of alternative recticle pointer color.
- Testing of different approaches to easier distinguish between repeat and reproduction mode, for example darken the room, additional textual sign, different orb colors.
- Testing of several environments for the start point, for example forest, day scene, and enlarge or delete torches.
- Repositioning of the middle orb, so that it is not selected accidentally.
- Testing the influence of visual impairments on the VR experience.
- Deactivate the orbs when the puzzle is solved, that it is impossible to select them from the end point.

- Adding different difficulty levels: playing with different orb sizes, number of orbs, space between orbs, colors of orbs, and velocity of blinking.
- Include hints for a better understanding of the procedure and the task.

Link to additional Work see References

References

- [1] For senior citizens, the future of VR lies in the past. <https://www.wired.com/2017/04/vr-for-seniors/>. Accessed: 2017-06-26.
- [2] How virtual reality helps older adults. <https://www.forbes.com/sites/nextavenue/2017/03/14/how-virtual-reality-helps-older-adults/#14a3a95c44e2>. Accessed: 2017-06-26.