IMT 4313 Design, Creativity and Innovation

The Memory Tile Game

Interactive Digital Design for Elderly and Children

Introduction

For this project, we were tasked with creating an interactive digital design for elderly people in nursing homes where they could also work with children. To complete this project, we did some research, interviewed some elderly people, nurses, and children at a nursing home, gathered our data, created a few concepts, sketched, had a few workshops, created a prototype, and went back to the nursing home to present our prototype to them. We used some of our knowledge from our textbooks (Gamestorming by Dave Gray and Innovation by Curtis Carlson) to help us along the way and help us stay organized throughout our design project.

Inspiration and Design Process

Research

On November 8th, we went to a nursing home in Brumunddal to talk to some of the elderly who lived there as well as some nurses who worked there. We wanted to talk to them as a part of our research to get an understanding of what it is like to live in a nursing home in Norway and what it is like to work there. We got to see what it was like when the children from daycare come and sing for the elderly and say hi, see the elderly in physical therapy, and their craft space. During our visit, we found out that many of the residents have cognitive or physical disabilities. Many of the residents enjoy it when the children come to visit, however all of the elderly that we talked to said that the children don't visit often enough. There are some events and activities to do at the nursing home, however there isn't necessarily enough, and even though they have TV, they can't change channels or pick things to watch.They do have a crafts room where they make a variety of things like cat boot holders to hold tall boots up, little Santa Clauses, angels, things out of foam and felt and they knit. The stuff they create they sell around Christmas time which many of the residents seemed to enjoy quite a bit. It seemed to give them a bit of a purpose. Around Christmas and 17 May they go to choral concerts and sometimes have special events. We heard and saw that the elderly were lonely though. Some of them have no visitors, the daycare only comes once a month, and families don't always come. We learned quite a bit from our visit, but we also learned that there is so much more that could be done for the elderly than is being done, but the nurses are already doing as much as they can. They need more outside help.

We got inspiration when the elderly were having physical exercise in the training room. We came up with the question "How do you make this activity more fun and practical?", which lead us to research our specific direction.

Figure 1: The elderly are having physical exercise

Ideation

Original Concept

Before we came up with our concept, we played Post-It Poker (Gray, Brown and Macanufo, 2010) to try to create some ideas. We came up with four categories: location, object, disability, and action. Each of us wrote down five post-its for each category and we laid out the post-its randomly. After that, we went through each "idea" and moved a few post-its around to get ideas that made more sense to us. After doing that, we did Dot Voting (Gray, Brown and Macanufo, 2010) to choose which ideas we wanted to pursue. At the end of the voting, we had three ideas that we wanted to pursue:

1. Using a tablet in bed for those who can't remember well completing a scavenger hunt to help increase memory and/or make them move around
2. Using a tablet in the bedroom for those who cannot move very much where they can sing or do crafts with the tablet
3. Using a tracker with sound in the gym for those with reduced sight and doing some physical activity

After going through these ideas, we took another look at the photos that we had taken during our visit to the nursing home in Brumunddal the previous day. (A few people in) Our group had participated in an occupational therapy event that went on while we were there and that helped spark an idea based on one of the ideas that we had generated during Post-It Poker.

Figure 2: Post-It Poker

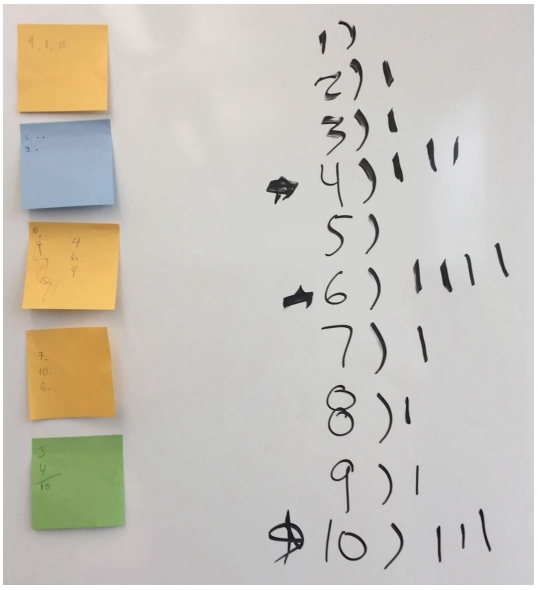


Figure 3: Chosen Ideas

Our idea became: a physical game/activity where the elderly and children could step on tiles and see an image or video come up that was either provided by the elderly person's family or from a defined set. The idea was to motivate the elderly people to move by providing them images and videos that they would like to see of their family, history, or childhood.

When our very first concept was developed, we planned to create interactive tiles that would connect to a projector to display images, videos, etc that were either about history or of a person's family. Each elderly person could have their own images and videos that their family uploaded to a server and someone could make a “playlist” for each person so they would have their own motivation to exercise and in a fun way. The idea was that the elderly would use this either on their own or with a child or another person, so two people maximum. We created an NABC (Wilmot and Carlson, 2006) to better understand our idea, what we wanted it to become, and how we wanted to implement it:

- Needs: Exercise, Social, Brain
- Approach: Sensors, Projector, Arduino, App
- Benefit: Health, Interaction, Playful, Mood
- Competition: Walkers, Exercise Equipment, Sofa Exercises

Some of the keywords that we wanted to be related to our design were movable, customizable, therapeutic, physical, updatable, and photos, sounds and lights. We used these words throughout our design process to make sure that our design would keep our ideals and continue to follow and evolve on the same path and not stray away.

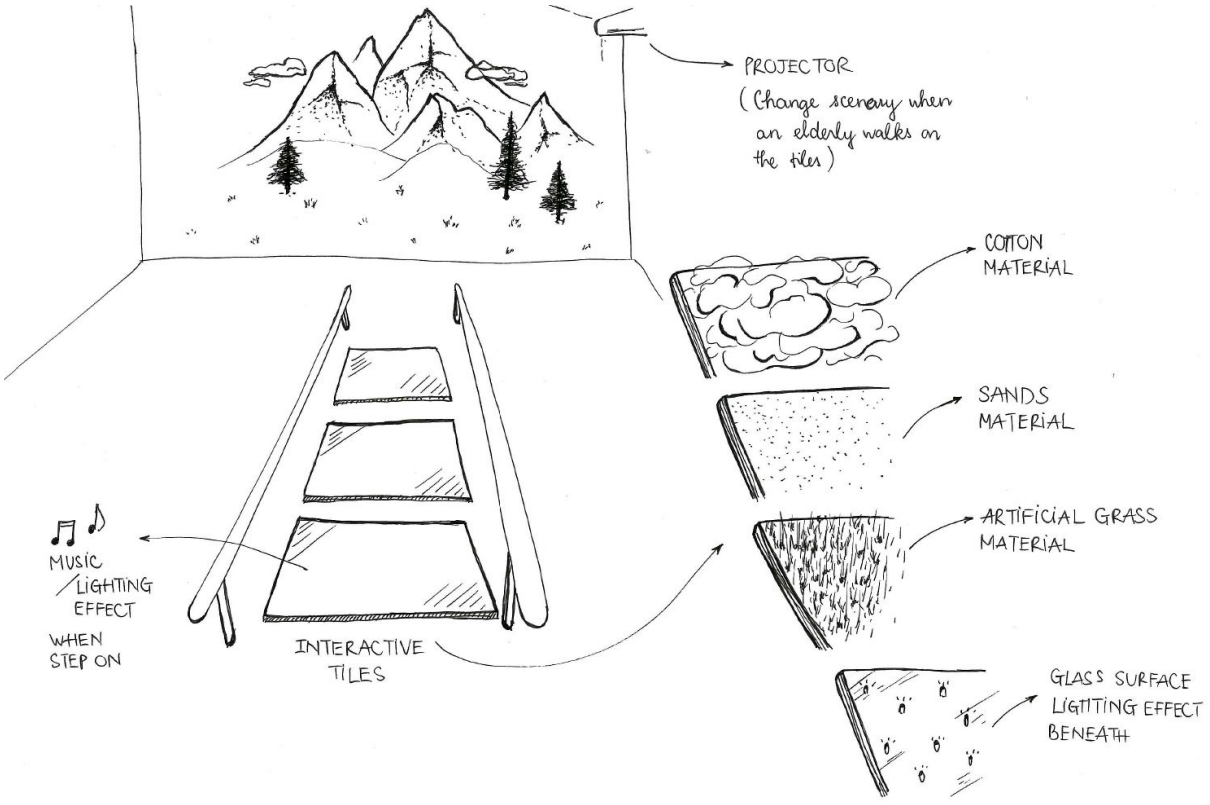
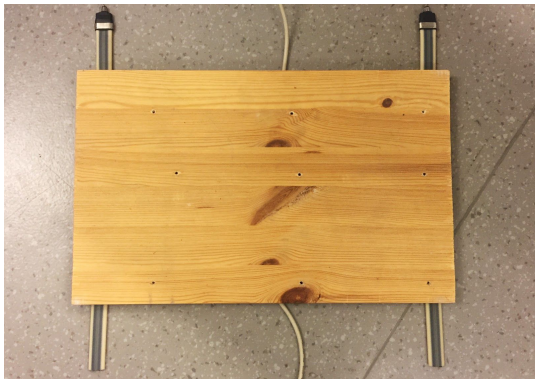


Figure 4: First draft of the original concept

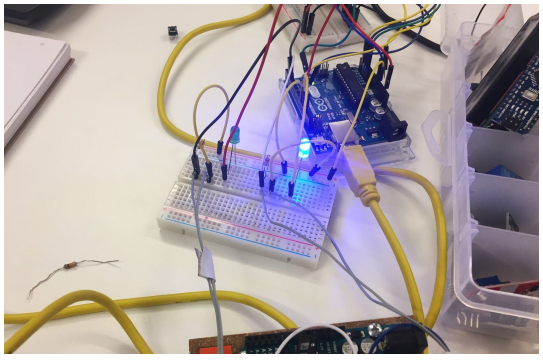
Once we had our concept, we started to think about how to implement it and create a prototype that would function. It was suggested to us to try to use Arduino, so we decided that we would go to the workshop that was provided to learn how to use Arduino. We were trying to decide how we would access the images and videos and how to update them easily and connect them to the tiles and Arduino which proved to be a challenge. We were thinking that we might be able to create an app where all of the images and videos would be stored and have different “playlists” for the different elderly people, and that an occupational therapist would just be able to pick the “playlist” and then those specific images would be used during that time. As we continued to talk about it, we decided that after the workshop to learn Arduino, depending on how it went and what we learned, we stated that we might try Raspberry Pi instead since it has more power (to run video) and sensory inputs.

Workshops

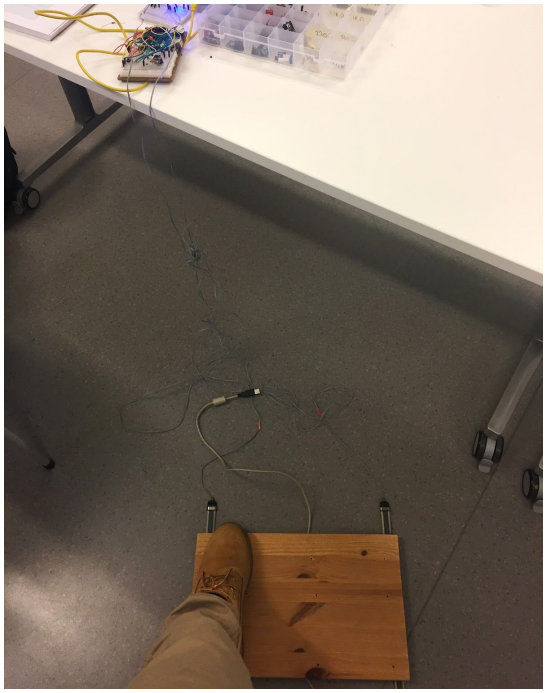
We had a workshop with Eirik, a student assistant, to understand the basic knowledge of how to use Arduino and how to apply it to our project.



The wooden board was used as an interactive tile.



The left and right parts below the wooden board were connected to 2 LED lights (blue and green).



When we stepped on the left part, the blue light was on; and the green light was activated when we stepped on the right part.

Link to the video

Thereafter, we had expanded our idea. We planned to apply this project not only for physical exercise but also kind of playful game that improves on the elderly's memory.

Sketches and Scenarios

Based on findings in our workshop, we met and brainstormed some more around our original idea. We tried to understand all of the semantics of the projects, all of the aspects, and how to make it all function technically, not just in theory and to draw all of it out.

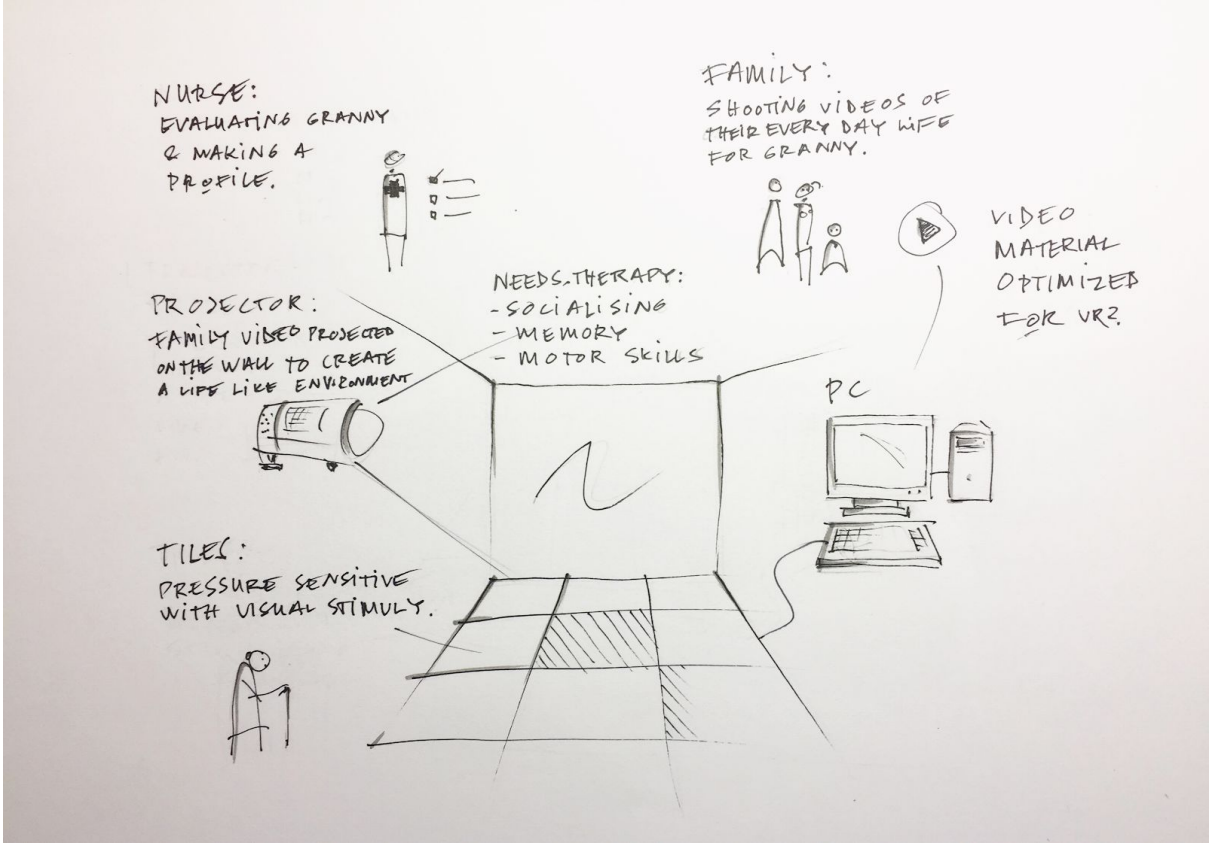


Figure 5: Second draft of the original concept.

Our idea evolved, and the idea became a game where people use the tiles in a classic Matching Pairs game. This game is a memory game where you need to match the images behind pairs of tiles. The tiles on the screen reflect the tile on the floor, so if there are 16 tiles on the floor, there are 16 tiles on the screen and 8 different images behind the cards. Playing is very simple - you step on one tile and then try to find a matching image tile. The hard part is that only two tiles show at once at most, so they must remember which tile is for which image, thus making it not just a physical game but a mental memory game as well. Granny gets to play with her grand child, and at the same time, exercise both her body (physical) and mind (memory). Elderly and kid could play together in this game. They will walk together and step on any tile, the card according to that tile will be revealed on the wall. The goal of this game is to provide a playful exercise that benefits both physical and mental health to the elderly.

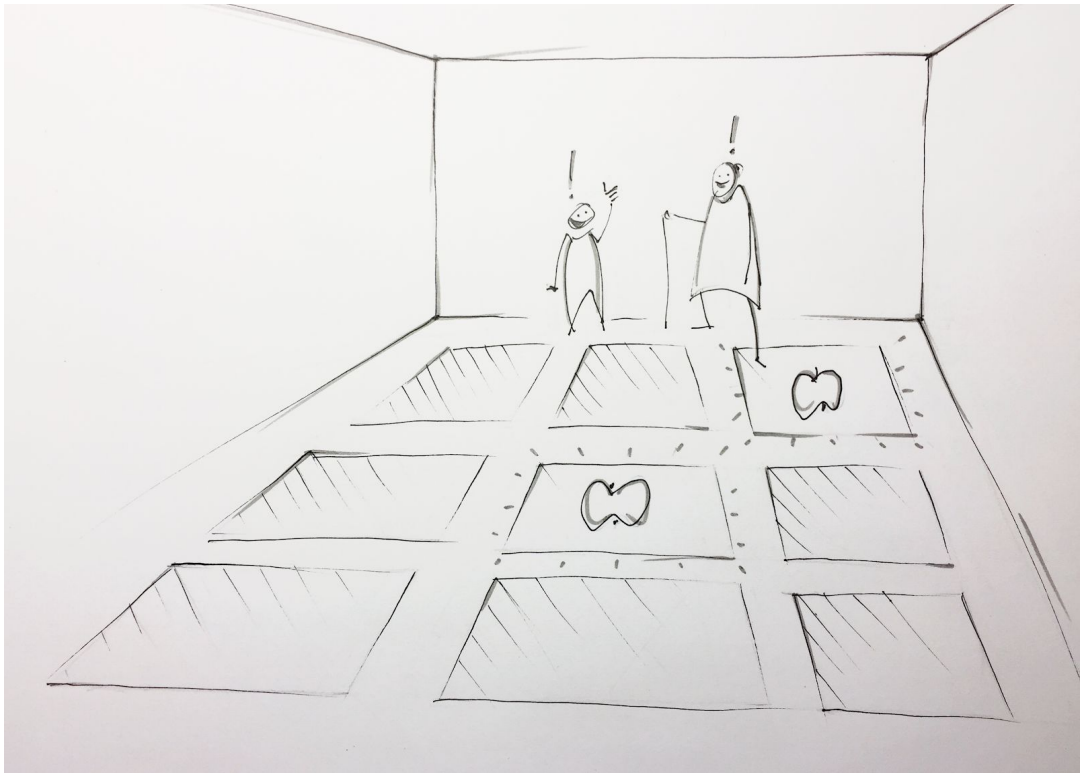


Figure 6: Draft of our second concept.

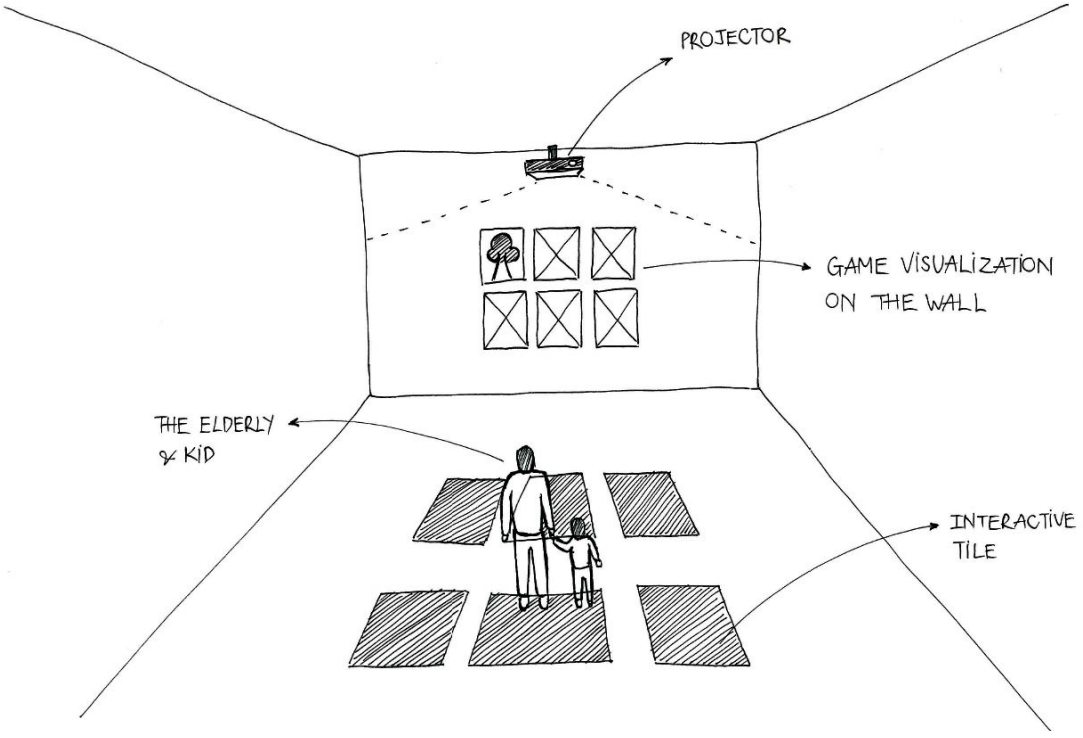
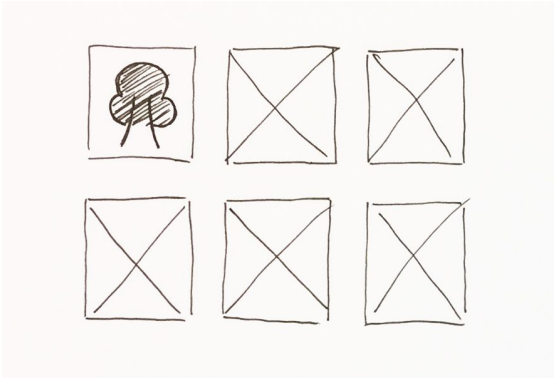


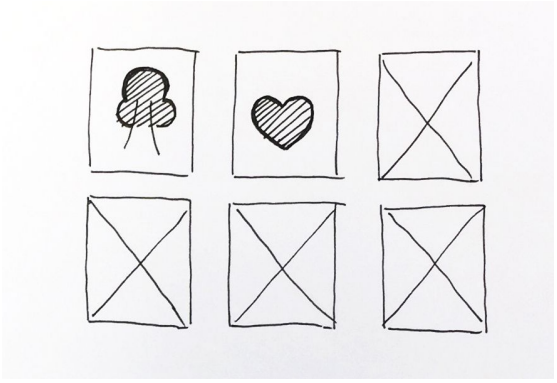
Figure 7: Overview sketch of the scenario

Matching Game Function

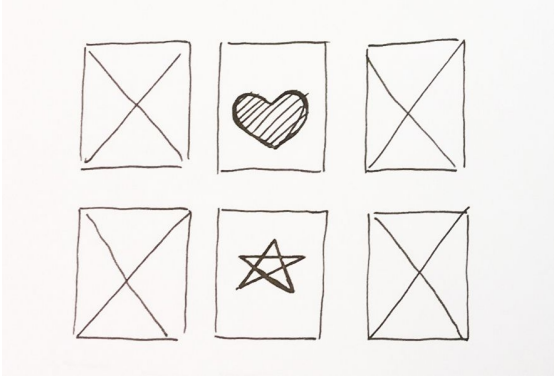
To better understand how the memory game will work, we decided to draw it out and explain it so that it would be easier for us to explain the game and program it. It is based on a basic memory matching game. The main difference is that in our game, the tile is pressed, and the matching square on the screen is the image that shows, making it a physical game as well as a memory game.



When the users step on the first tile, the first card on the wall, for example, shows a tree image.

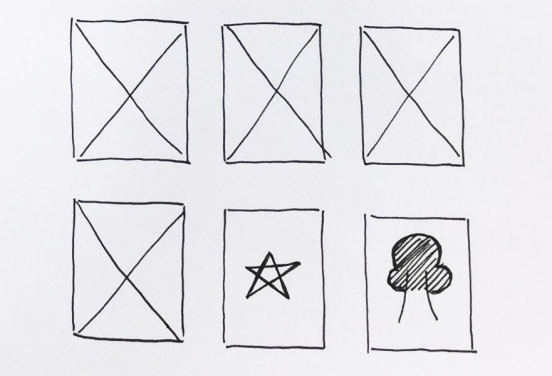


They move on the second tile, accordingly the second card shows a heart.

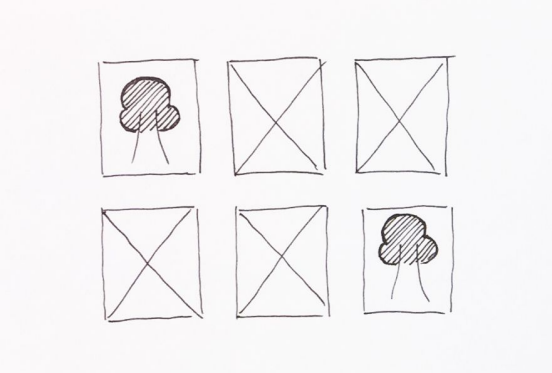


Realizing that these 2 cards are not matching, they step on the third tile, it shows a star.

At this time, the first card is flipped to hide its image



Users move on the fourth tile, the visual shows a tree (the second card is hidden at this stage).



Users recall that the top left tile linked to the tree image and they steps on it. They finally have a match.

How it Works Technically

To make the different components work together and communicate, we ended up choosing a Raspberry Pi as the controller/computer for our project. This is how it is going to be done:

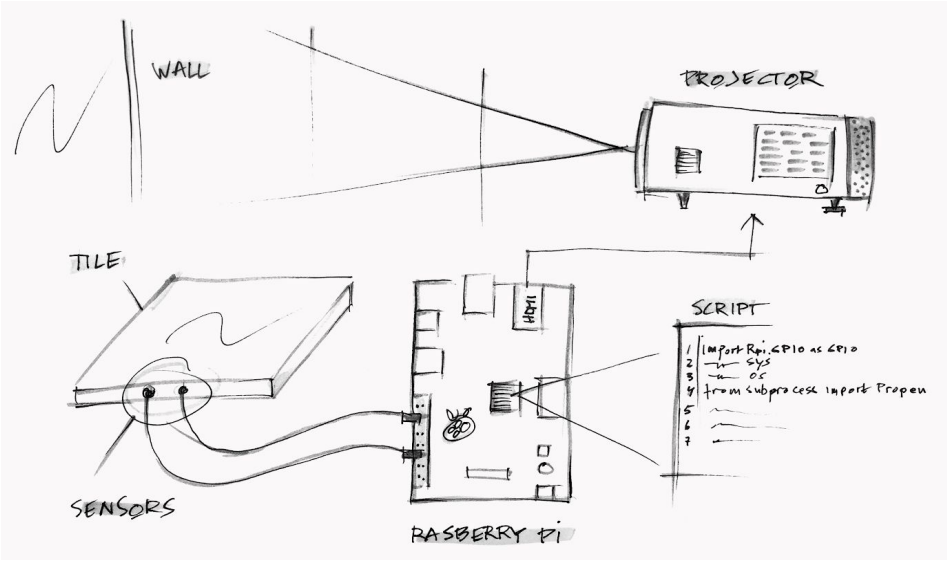


Figure 8: Technical aspect of the project

The Raspberry Pi has the ability to display video and still images on an external display or projector. It also has the ability to read the state of up to 17 digital inputs. With the tiles connected to the digital inputs, a program can be made to read the state of the tiles and act according to the rules of the game, displaying the game graphics on the screen.

Moodboard

To get a better idea of the kind of feeling we wanted to create for our digital design, we created a moodboard (figure 9). It shows the look and feel that we wanted to apply for the card flipping game. We would like to make it a more fun way to attract not only elderly but also children to join in the game.

Figure 9: Moodboard for the Memory Game

We also created a moodboard for our tiles (figure 10). We wanted to better understand the different types of materials that can be used on our tiles and what each of their strengths are. The image below shows 5 different material types and their different advantages.

Figure 10: Moodboard for the Tile Materials

Matching Game Image Samples

Part of our idea is that images, videos, and/or sounds can be customized. Our idea is that families of the elderly can send photos and videos, however not all of the elderly have families, so we decided that there would be a few sets of images that could be updated that any of the elderly could use. These sets would consist of images from their past, photos from history of when they were younger, paintings, or even of things going on in the nursing home. Below are a few examples of images that could be used:

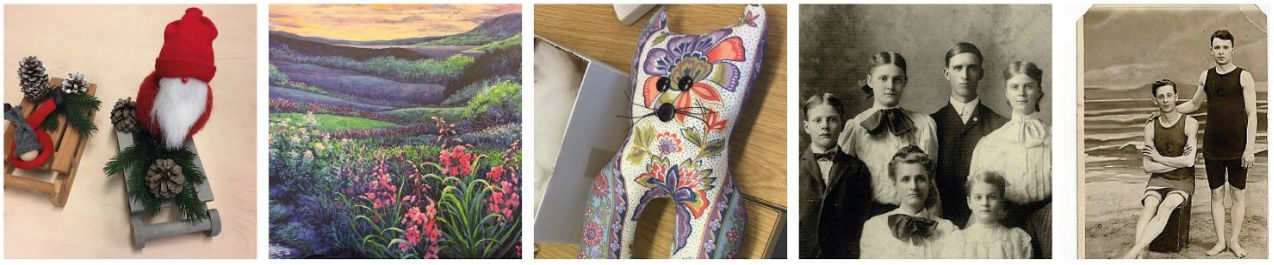


Figure 11: Samples of image for Matching Card Game

Implementation

Prototype

Once we had decided all of the semantics of our concept, we started to make our prototype. We talked about how large our tiles should be and decided to make them large enough for someone to stand completely on it, large enough for a wheelchair or walker to be partially on it, and for an elderly person and a child to both be able to step on it at one time (figure 12). We decided to cut three boards to represent tiles and started figuring out how to get one of the tiles to partially function with Raspberry Pi. We decided to make only two tiles partially functional but have six other tiles as well so that people can understand better how the prototype game would work. We made a Raspberry Pi game that functioned either with buttons under two of the tiles or by a mouse click to simulate the game (figure 13). Once we started building the prototype, we decided that the best way to play our game would be to play it as a competition between two teams to make it more social and fun for the elderly and children.

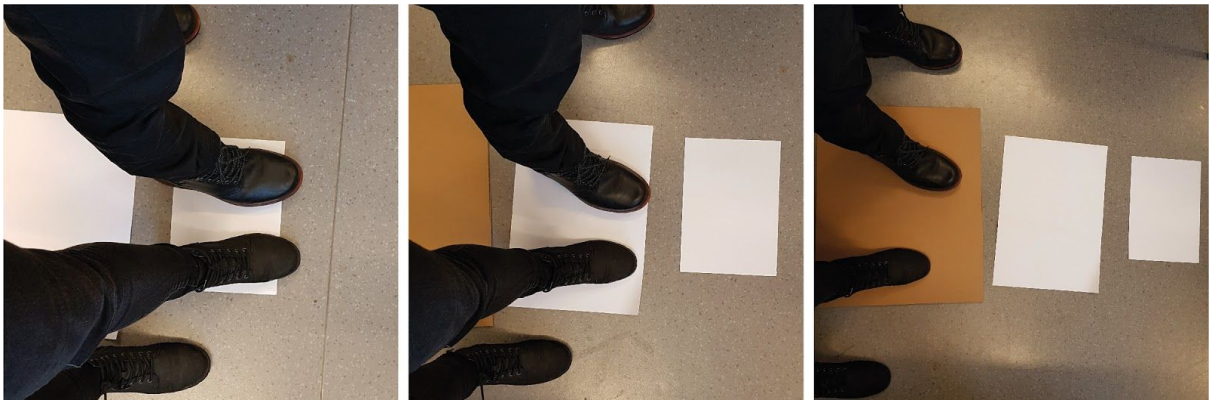


Figure 12: Testing to choose the proper size for a tile

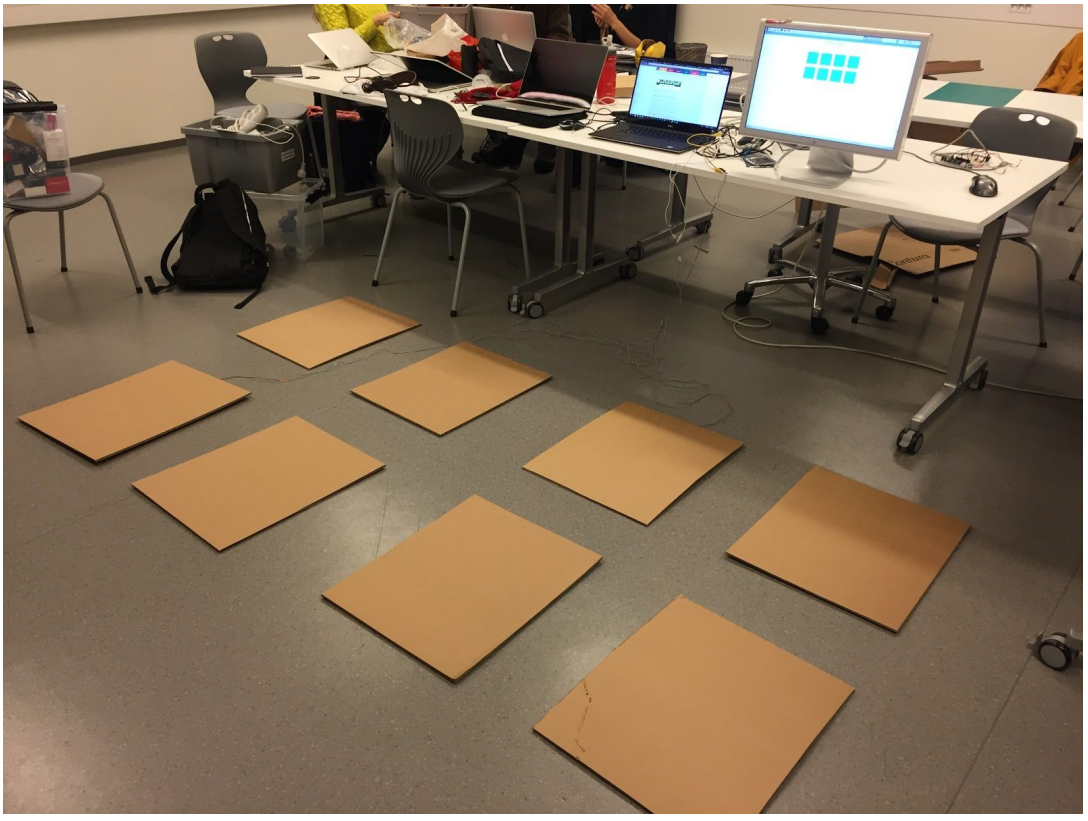
```python
def mouseclick(event):
    global flipped, game_state, moves #to access, not declare again? except game_state
    g.nrOfMoves.config(text='Antall trekk = ' + str(moves))
    for card in cards:
        card.flipped = card in flipped
    for card in cards:
        clicked = card.clicked(event)
        if not clicked or card.flipped:
            continue
        card.flipped = True
        if not game_state:
            flipped.append(card)
            moves += 1
            if(len(flipped) == 16):
                g.nrOfMoves.config(text="You win!")
        else:
            if card.value == flipped[-1].value:
                flipped.append(card)
            else:
                flipped.pop()
        game_state = not game_state
    if(len(flipped) == 16):
        g.nrOfMoves.config(text="You win!")
    draw(g.canvas)


def draw(canvas):
    index = 0

    #draw all cards
    for x in range(4):
        for y in range(4):
            #get card at first index then second, etc..
            card = cards[index]
            #set each cards position on screen in an array coordinate system, x = index0
            card.pos[0] = (card.size[0] * x) + card.size[0] // 2 + 400
            card.pos[1] = (card.size[1] * y) + card.size[1] // 2

            #draw the card
```

Figure 13: Raspberry Pi Matching Game Code



[Link to the video of our interactive prototype]

Related Research

Beside the course's literatures that we have applied to this project, such as Gamestorming for the ideation process, visualization by sketching, value proposition - NABC and user-centred design techniques, we found a related project which also developing games to increase cognitive function for elderly. This project was conducted by Joung-Won Ko and Sung-Jun Park (Dept. of Game Engineering, Hoseo University, Korea). Different with us in execution, while we used Raspberry Pi and interactive tiles, they employed Arduino and wearable device. However, both our and their projects have the similar concept which aim for motivating physical function and improving brain function at the same time.

Ko and Park also illustrated the typical cognitive skills about dementia, which we may apply to our project and make it more practical:

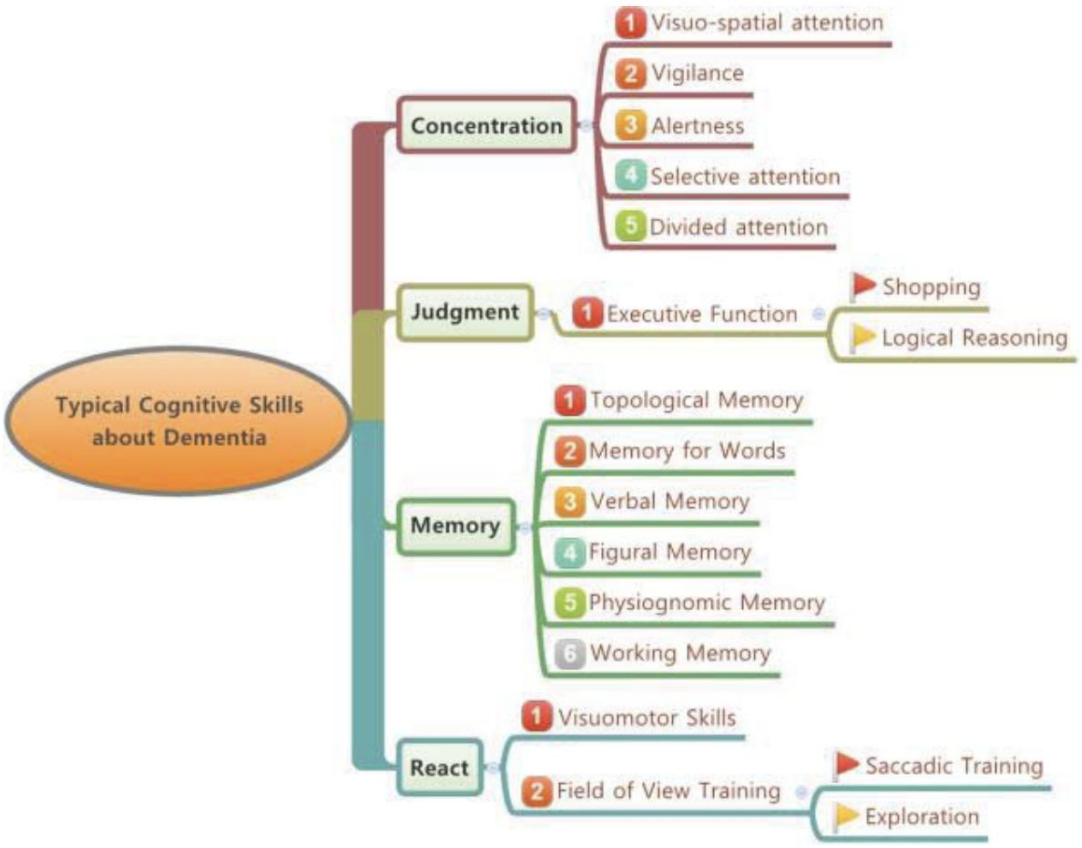


Figure 14: Typical cognitive skills about dementia (from Ko and Park)

Back to Brumunddal - Presentation and Prototype Testing

On December 5th, we went back to the nursing home in Brumunddal to present our project to to the health personnel (figure 15). Although we did not have chance to set up our prototype in the physical room and connect the game visual from Raspberry Pi to the projector, we were able to deliver our design concept to the health personnel. They believed the game potentially could enhance memory, mood and physique through activity and socialising. For it to be physical health beneficial, they gave us valuable input that we have included in our conclusion.

Figure 15: Present our design concept to the health personnel

Conclusion and What to do Next

This project taught us the importance of communicating with our target audience and stakeholders involved. Through communicating with the elderly and nursing assistants we learned how to design a product with our users in mind. Based on the input given from the health personnel at the nursing home in Brumunddal, we concluded with the following:

- In the future make tiles light up in response to being stepped on.
- Make a profile of the elderly's health condition in collaboration with nurse/physiotherapist. Suggest therapy based on the profile and needs.

- Potentially make the tiles stick to the floor or debate whether to go for a more secure and user friendly tile «floor».
- Exercise and activity are not the same thing; to make the tiles physically beneficial, add some resistance to the tiles. Benefits: The game is potentially enhancing memory, mood and physique through activity, and socialising.
- In our final game it is possible for two teams to compete about matching the most tiles/images) with the fewest moves. The game consist of two matching card game sets, and there can be as many people per team as we/they like. The teams can take turns, playing as long as they make a match. Both Raspberry Pis (in each game set) can communicate when one team win.
- In addition of beautifying the game visuals and using photos/images which related to the elderly, we have also thought of including natural sounds or familiar melodies into the game. It will enhance the elderly/players' sensation and thus, motivate them to interact and gain better health.

References

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- Gray, D., Brown, S. and Macanufo, J. (2010) *Gamestorming*. Sebastopol, CA: O'Reilly.
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