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Multi-user application for recording physical activity on exercise bicycles for people with intellectual disabilities

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Preface

This thesis presents an exergame made for individuals with intellectual disabilities. This is a group of individuals that are struggling with more health issues than the general population. This makes physical activity very important for this user-group. With this thesis, I can personally help individuals with intellectual disabilities to be more physically active. Something that I have not experienced during my four years of studying at the university. With this thesis, I have encountered a feeling of making an impact.

This project is a part of the project ”Effects of physical activity with e-health support in individuals with intellectual disability,” where Ph.D. candidate Henriette Michalsen is the main contributor. This project is also a continuation of Valter Berg’s master thesis, ”Increasing physical activity for individuals with intellectual disability through indoor bike cycling and exergaming.” I delivered a capstone project where I continued V.Berg’s thesis on the 15. December last year. On this capstone project, I added multi-user functionality to the system.

I want to thank my supervisor, Gunnar Hartvigsen, for his guidance and support throughout these six months. Helping me with valuable input and putting time off every week for supervision. All of my co-supervisors Audny Anke, Andre Henriksen, Letizia Jaccheri, Javier Gomez Escribano, Juan Carlos Torrado Vidal, Santiago Martinez, Antonio Martinez Millana, Keiichi Sato and Mirek Muzny deserves a huge thank you for attending my supervisions and giving valuable feedback and guidance.

Others that have contributed and deserve a thank you are Henriette Michalsen, who have helped me along the way. Valter Berg also deserves a thank you for answering questions I had whenever I asked.

Finally, I would like to thank my family and my girlfriend for their continuous support during six hard months of work.
Asgeir Nilsen - 30.06.20

Abstract

This thesis extends research into the application of an exergame for individuals with intellectual disabilities. Individuals with intellectual disabilities have a more sedentary lifestyle than the general population, and the need for regular physical activity is high. The World Health Organization recommends 150 minutes of physical activity each week. Exergames can contain elements that excite the user and will promote physical activity.

This thesis presents a system that uses an indoor bicycle. Sensors record pedaling data and allow users to watch videos while exercising. The exergame has multi-user functionalities to promote usage of the application in families and daycare institutions. A variety of entertainment is included to give users options when playing the game. The design and development process is customized for users with intellectual disabilities.

Because of the Covid-19 pandemic, the planned execution of the testing of the application could not be done. But the results from testing with an expert shows promise. The thesis provides information about how to design and develop technical solutions that promote physical activity to individuals with intellectual disabilities. However, the results also showed that there is room for improvement and indicates room for further development.

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Acronyms

ASD Autism Spectrum Disorder. 8, 11–14, 55

BLE Bluetooth Low Energy. 2, 14–16, 31, 37, 45

BMI Body Mass Index. 14

ID Intellectual Disability. v, 1, 2, 4, 5, 7–9, 12, 13, 22, 26–30, 32, 47–50, 52–58

mHealth Moblie Health. 1, 2, 55, 57

PA Physical Activity. 1, 2, 4, 5, 8, 14, 16, 22, 29, 47, 53–55, 57

SUS System Usability Scale. v, ix, 22, 48, 49, 52, 53, 56

UI User Interface. v, ix, 2–4, 15, 30–32

VR Virtual Reality. 11, 13, 14

Chapter 1

Introduction

Individuals with Intellectual Disability (ID) have lower levels of Physical Activity (PA) [39] and more health problems compared to the general population [1, 16]. To motivate the individuals to be more physically active can be a challenge, but this master's thesis proposes a solution for this. By using a bicycle connected to a tablet (e.g. iPad), the individuals can watch their favorite videos while pedaling. A sensor or a bicycle roller will detect pedal movement and send data to the tablet. A multi user application is implemented, used to enhance usability in families or on daycare centers. This chapter will look into the background, the scope and the motivation for this thesis.

1.1 Background

This project is a sub-project of a project founded by Helse Nord, "Effect of physical activity with e-health support in individuals with intellectual disabilities" [21]. The main objective of the principal project is to enhance PA in youths and adults with ID. Since low PA is a determinant of health and since increasing PA has positive effects on cardiovascular and psychological health, identifying effective interventions for use in everyday settings is exceedingly essential.

The main aim of the principal project is to integrate theory with users' needs to design a flexible person-centered PA program using motivational Moblie Health (mHealth) support in natural settings. The technical scope of the project is to develop tools that can contribute to increased PA. Where several different applications that record PA must be developed. A further aim is to study the different reward/motivation mechanisms these computer games give.

In the principal project, before and during a period with workshops with previous developers, a qualitative study titled "Family members and health care workers' perspectives on motivational factors of participation in Physical Activity for people with Intellectual Disability: A qualitative study" [13], was performed. Figure 1.1 illustrates how the phases were done before developing. Important factors for participating in physical activities were found to be lack of social support and available activities. In contrast, enjoyable and social activities promote motivation, as well as collaboration in activities. As many individuals with IDs have a tablet they can use for PA interventions, using mHealth with rewards and gamification could increase PA in individuals with IDs.

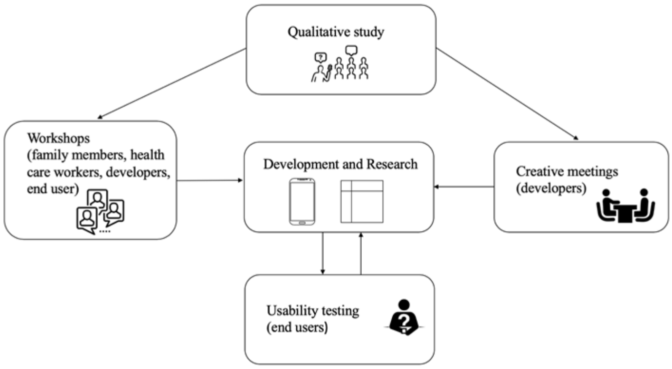


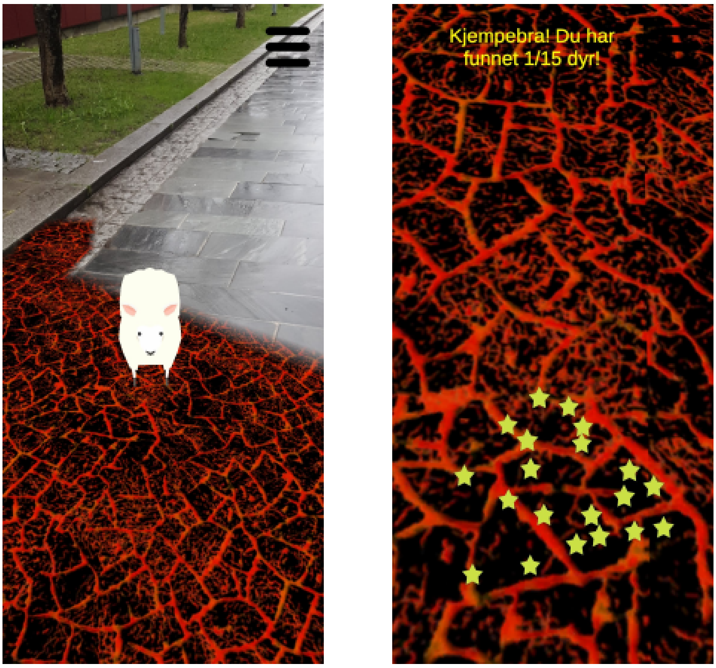
Figure 1.1: Phases from qualitative study to usability testing

Three game-based mHealth solutions for behavior change and health promotion, by influencing PA, was designed and developed for the principal project. [3]. All solutions were found to be promising for people with ID.
The first solution is a guided outdoor exercise where the application tracks the amount of PA in outdoor walking or hiking. An augmented reality game is used to motivate the user to walk. The principal of the game is to walk outside and collect virtual animals. Once the animal is collected, both a supportive message and confetti will be presented as rewards for the user [14]. Figure 1.2 displays the graphical User Interface (UI) of this application.

The second solution is guided mild workouts, where the application works as a coach. The user can customize a virtual character who can lead the user through a set of basic workouts. The application includes text to speech features and reminders [33]. The figure 1.3 displays graphical UI of the application.

This project is an extension of the third solution; "Increasing PA for individuals with an ID through indoor bike cycling and exergaming" [2]. A guided in-door bicycle exercise application tracks and records the amount of PA on indoor bicycles. Both hardware and software modules are developed to record the amount of PA on either a stationary bicycle or an ergometer bicycle. Continuous feedback during the exercise is given. The recorded data is received on an application and displays entertainment for the user. Two prototypes were created. The first prototype uses a Tacx Flow Smart trainer, that supports any bicycle with a power wheel with a size between 26 and 30. The second prototype uses a stationary bicycle with a Wahoo cadence sensor. Both solutions connects, through Bluetooth Low Energy (BLE), to a control unit that continuously displays a video while receiving pedaling data. The activity time during each session is stored and used. Figure 1.4 displays the graphical UI of the application.

An extension of the guided in-door bicycle app was developed as part of the the capstone project "Multi-user application for recording PA on exercise bicycles for people

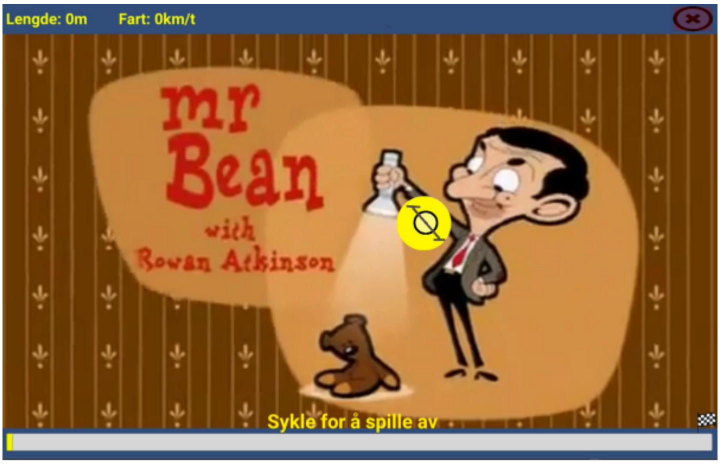


[14]

Figure 1.2: Graphical UI of the guided outdoor exercise app.

[33]

Figure 1.3: Graphical UI of the guided mild workout exercise app.



[2]

Figure 1.4: Graphical UI of the guided in-door bicycle app.

with intellectual disabilities." In the capstone project, the application was redesigned to be a multi-user application where each user can store their progress and data.

1.2 Scope and research questions

In this project, the scope is to contribute to increased PA in youths and adults with IDs.

The main goal of this master's thesis was to extend the current prototype with improved multi-user functions. A smart log-in function, monitoring of PA, and entertainment content are the three parts that need to be focused on. We also wanted to study different reward/motivation mechanisms, so a gamification addition in this project was also a goal. Since this is a multi-user application, there needs to be a log-in function for the users. This could be a challenge for individuals who often have difficulties with intellectual functions and practical skills. A smart log-in function to separate the users easy and secure is therefore essential.

The project's overall goal is to see what motivates individuals with intellectual disabilities to do PA. This project uses an exergame application with a stationary bicycle. The main research question of the project is this:

"How to motivate individuals with ID to do PA with exergaming and indoor bike cycling?"

We can divide this research question into sub-questions.

1. What type of exergame elements would motivate individuals with intellectual disability to use a stationary bicycle?

2. How can you design an exergame to make it suitable for multiple individuals with intellectual disabilities on a single device?

The main question of the overall goal of the project was the motivation for doing PA on an indoor bike cycling for people with ID. The main question of this thesis has to be divided into sub-questions to be answered correctly. Sub question 1 is looking at the elements of the exergame that will help individuals with ID. Sub question 2 is looking at the design of the exergame. Individuals with ID needs a system that is not too complicated to prevent the user to quit because of impatience.

1.3 Personal motivation

Since health issues are a big problem for people with ID, this is a problem that I believe needs to be solved and researched. There are many challenges with getting individuals with ID to do PA, which makes this an exiting problem where I have to think outside the box to solve. There are few to none exergaming applications for this target group, which is terrible because this is a group that might need it more than others. I have worked with an individual with ID for several years and know that this user group need to be more focus.

1.4 Organization of the thesis

Chapter 2: Theoretical background and equipment

This chapter provides relevant information about ID and exergaming. It presents a literature review with the scope of ID and exergaming. The chapter also provides information about the equipment used in the system.

Chapter 3: Research Methods

This chapter presents the methods that were used to design and work on this project.

Chapter 4: System and Software Development

This chapter describes the requirements for the project. While also presenting the design process alongside the final design. This chapter also explains how the design is implemented with details about the important aspects.

Chapter 5: Test and Results

This chapter explains the tests used in the project and presents the result of this testing.

Chapter 6: Discussion

This chapter discusses how the requirements were met, the results, and the research problems.

Chapter 7: Conclusions and Further Work

This chapter presents the concluding remarks and indications on what can be done to improve the application in feature work.

Chapter 2

Theoretical background and equipment

2.1 Intellectual disability

Intellectual disability is a disability characterized by ”significant limitations both in intellectual functioning and in adaptive behavior as expressed in social and practical skills. This disability originates before the age of 18” [26]. Consequences often are reduced ability too understand new or complex information and to learn and apply new skills, which results in a reduced ability to cope independently [36]. To fall within the definition, three requirements must be true:[15]:

- The ability level must be significantly impaired. Mental functioning should be below an IQ level of 70.
- Social maturity and ability to adapt must be significantly impaired.
- The functional difficulties should have appeared before the age of 18.

Statistically, 1.5% of the population have ID, which is around 80 000 of Norway's population in 2019.

The diagnoses can vary from mild to more severe cognitive impairment. Because these variations provide individually different needs and problems, it is hard to treat people with ID as a single group. IQ is used to divide ID into four different degrees for diagnostics in health care:

- Mild ID: IQ 50-69
- Moderate ID: IQ 35-49
- Severe ID: IQ 20-34
- Profound ID: IQ under 20

There are many causes of ID, before, during, and after birth. They include chromosome abnormalities, metabolic diseases, infections, and diseases during pregnancy, congenital disabilities, and injuries or illnesses after birth. People with IDs often have additional disorders like ASD, epilepsy, and physical disabilities. A more severe degree if ID increases the likelyhood of having other disorders or chronic sufferings. Because of this, individuals with ID have more trouble functioning in everyday life.

The World Health Organization recommends children between 5-17 years to have at least 60 minutes of PA daily, and that adults have 150 minutes of moderate-intensity PA or 75 minutes of vigorous-intensity PA per week. [37] In the general population, one out of Four adults is not active enough. PA has positive effects on cardiovascular and psychosocial health factors, as well as brain health. The identification of effective interventions for use in everyday settings is thus essential.

Compared to the general population, individuals with ID have lower levels of PA and have more difficulty finding and obtaining healthcare, thus resulting in lower life expectancy and higher morbidity [1]. The healthcare these individuals need is difficult to find, getting to, and paying for. Evidence shows that inactivity is a significant factor for healthcare problems among these individuals [39]. It is resulting in poorer health than people without ID, implying that a considerable proportion of people with ID are not meeting the recommended PA standards from the World Health Organization.

Motivating individuals with ID to be physically active is a critical concern. There are several barriers to and facilitators of participation in PA. Motivational factors that facilitate participation in PA of individuals with ID are perceived self-efficacy, social support, and peer modeling. Some of the barriers include lack of financial, political, and psycho-social support, as well as a lack of personal interest in PA and a lack of self-efficacy. The lack of PA amongst individuals with ID is identified from family and health care workers as a lack of initiation to PA rather than a lack of motivation [13].

2.2 Exergaming

Exergaming can help individuals reaching their PA requirements by using the engaging experience of playing video games. An exergame requires that the video game has to make the user be active and exercise when using the game [27]. Exergames are made to make playing video games a more healthy activity. To make an exergame a success, there are two critical factors: how attractive the video game is as a motivator, and the effectiveness of the exercise. An exergaming system needs to motivate players to play and to continue to play the game. The top reason for using an exergame is that players are having fun while playing it [9]. To achieve health benefits for an individual is the most critical outcome of an exergame. There are several factors to take into account when making an exergame [27]. Some of these factors are:

- Exergames should require concentration.
- Exergames should be challenging.
- Exergames should support skill development.
- Exergames should have clear goals.

- Exergames should provide appropriate feedback.

2.2.1 State-of-the-art

This section presents the current state-of-the-art on indoor bicycle cycling exergames. I also conducted a systematic literature review on interventions between ID and exergaming in general.

Systematic review

PRISMA [32] (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) was used to collect secondary data and qualitatively combine these findings.

The following databases were queried in the literature review:

- Scopus
- PubMed
- IEEE Xplore
- PsycNet
- PsycInfo American Psychological Association
- ACM Digital Library
- Web of Science

The query for the review was created using logical operators and was build up in three parts, where one term from each category is required from the literature papers.

- Disease aspect.
  ”intellectual disability”, ”developmental disabilities”, ”mental handicap”, “autism”, ”downs syndrome”
- Gaming aspect
  ”exergame”, ”video game”, ”video-game”, “gamification”, ”application”, ”app”
- Activity aspect
  ”physical activity”, “fitness”, “exercise”, “workout”, ”bicycle”, “ergometer bike”

The following query was gathered from this:
(”intellectual disability” OR ”developmental disabilities” OR ”mental handicap” OR ”autism” OR ”downs syndrome”) AND (”exergame” OR ”video game” OR ”video-game” OR ”gamification” OR ”application” OR ”app”) AND (”physical activity” OR ”fitness” OR ”exercise” OR ”workout” OR ”bicycle” OR ”ergometer bike”)
Studies that met the following inclusion criteria were included in the review process: (1) written in English, (2) contain physical exercise, (3) contain an exergame element, (4) the full text of the paper had to be available. The screening processes were divided into three parts; title, abstract, and content. A criterion for not explicitly using a bicycle was

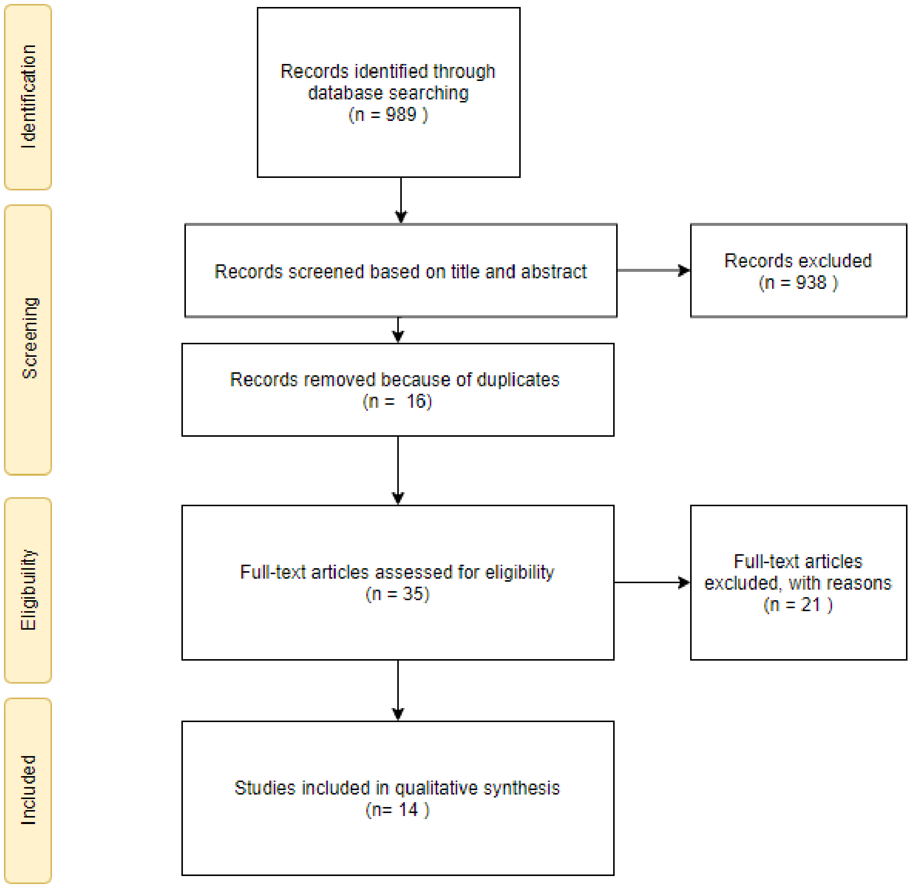


Figure 2.1: Prisma flow Diagram showing the exclusion process.

not included because it provided few results. Because there are few studies on the specific intervention between ID and exergaming, the screening included papers with no user study.

The records were first assessed by reading the title and abstract. Then the duplicates from the accepted records were removed. The full text of the remaining records was screened with the criteria included. Figure 2.1 illustrates the results of the systematic literature review.

Findings

The systematic review is presented in table 2.1. The column ”Author” presents who wrote the paper. The column ”Target group” presents the user group the paper was intended for. The column "Game type / Topic" presents what topic or what the exergame was about. Finally, the column "Findings" presents how the paper was tested and a summary of results.

Table 2.1: Systematic review

Author	**Target Group**	**Game type / Topic**	**Findings**
(Finkelstein et al., 2014 [12])	Children with Autism Spectrum Disorder (ASD)	Motivating exercise using Virtual Reality (VR)) Game	Ten children with ASD played Astrojumper, an exergame that involved fast-paced full-body movement. The results showed that the children achieved vigours activity levels.
(Strahan et al., 2015 [28])	Adolescent with ASD	Looking on video game playing effects on obesity	One participant played six weeks inactive and six weeks active video games on the Wii. Weight and stress results had minor changes. However, the mother reported improved behavior. They concluded that the results provided preliminary evidence for the effectiveness of an active video game.
(Caro et al., 2020 [6])	Individuals with ASD	Comparing exergames designed for individuals with ASD with commercially-available exergames	Fourteen individuals with high-functioning ASD between 4 and 15 years old tested both types of exergames. The results showed that both exergame types are good tools to support visual-motor coordination. And that the exergame made for ASD was a better game and more fun experience. The results also showed that there was no difference between children and adolescents.
(Macias et al., 2018 [20])	Individuals with down syndrome	Comparing exergames between children and adolescents	Ten individuals with down syndrome played a commercial exergame. The results showed a significant difference between the two groups. In task-efficacy, selective attention, and prompts. The older participants were more focused on the task, while the younger needed more prompting.

(Berg et al., 2020 [3])	People with ID	Motivating physical activities with game-based eHealth solutions.	Used participatory design and agile development to create three solutions that promote, motivate, and maintains PA. Will be used in a randomized control trial to assessed the effect of eHealth in direct PA indicators.
(Chang et al., 2014 [7])	Obese students with ID	Encouraging pedaling an exercise bicycle by using an air mouse combined with preferred environmental stimulation.	Two participants had their favorite videos as environmental stimulation. By using the air mouse as a pedal detector, the video playback stopped when the participants stopped pedaling. The results show that the students had more willingness to perform when combining with the preferred environmental stimulation.
(Evensen et al., 2019 [10])	People with ID	Increase daily PA by using game-inspired applications.	The results are from a literature review and lessons learned during the development of a prototype. The design for an application should focus on conveying clear, unambiguous information with limited quantities per view.
(Bittner et al., 2017 [4])	Children with ASD	Facilitate physical activity with the use of technology (an ExerciseBuddy application)	Six children between the ages of 5 to 10 diagnosed with ASD are tested once a week for four weeks. The results showed that the app shows similar cardiovascular and metabolic responses compared to practice-style teaching methods using live models. And therefore, this app is a great tool for facilitating PA.

(Lee et al., 2018 [17])	Adults with ASD	Increase physical activity using a gamified mobile app(Puzzle walk)	A needs analysis was conducted when designing a prototype. A key finding was that walking was the most common form of PA for this group. They developed an app where walking using your device was the PA. Visualized AR feedback is used for entertainment.
(Caro et al., 2018 [5])	Adults with developmental disabilities	Motivate motor coordination exercises using exergames.	Ten adults with developmental disabilities played an exergame on three sessions over one week. The results showed that the participants did decrease the assistance needed and that this kind of game has the potential to help and motivate adults with DD.
(Lotan et al., 2009 [19])	Adults with an intellectual and developmental disability	Gather lessons learn toward a best practices model for the application of VR for adults with IDD.	Participants were in a 12-week program where they did 2-3 30-minute sessions with VR game-like exercises. The results showed that VR systems improved physical fitness and that it is an engaging PA tool.
(Lin & Chang., 2014 [18])	Children with developmental disabilities	Improve physical activities by using interactive augmented reality (Scratch 2.0)	Three children with developmental disabilities tested how a webcam and an interactive computer game can help with PA. And the results showed that the interface interaction increased PA for people with different disabilities.
(Pérez-Cruzado & Cuesta-Vargas., 2020 [23])	People with ID	Improve physical activity by using a smartphone reminder.	Eight people with mild ID participated, half of whom had the intervention and a half without intervention. Results showed that the group with the smartphone application shoes a higher level of maintenance of PA.
(Fang et al,. 2019 [11])	Individuals with ASD	Look at the effects exergaming have on physical and cognitive functions	A systematic review was done to find the effects. They discovered that exergaming significantly helps to engage physical activity, but they did not find the impact on motor skill and emotional control to be significant.

Comments of findings

We included 14 studies in the systematic review. Six of these were about individuals with ASD, one about individuals with down syndrome, and seven about individuals with intellectual or developmental disabilities. ASD is a developmental disorder where individuals are not necessarily included under the term ID. Individuals with ASD, like individuals with ID, have problems with healthful lifestyles, and there are similar methods to getting them to do PA.

The focus of these studies were different. Nine of the studies attempted to motivate or improve PA. One study included a stationary bicycle, which is very similar to this thesis. Two of the studies compared exergames in different ways. Two of the studies looked at the effects of exergames. The last study gather lessons learned when designing a VR application.

All except one study were published between 2014-2020, where the latter was published in 2009. This was the study of lessons learned when designing an application for individuals with ID, which is a well-cited paper.

Only four of the studies included in the systematic review did not have a test phase. They focused looking on how to design application and motivate to PA for users with ID. The studies with a test phase tested on both children and adults. The mean number of individuals included in these studies was ten. A questionnaire was used in most of the studies to gather data on how they liked the game or about their medical history. The data collected and reviewed varied in each of the studies. Some studies looked at medical data like weight, Body Mass Index (BMI), triceps skin-fold, stress, anxiety, loco-motor skills, and heart rate response. Most of them looked at other aspects like motivational factors, game experience, efficacy, attention, and prompts.

One of the studies uses an exercise bicycle in a similar way to this master's thesis. They used a stationary exercise bicycle and used a sensor (air pad) to look at the pedaling. The favorite music video for the individuals in the study was showed while pedaling. The control system would continue playing the participants' favorite video when it consistently detected activity, whereas the video playback would be interrupted by the control system if the participants stopped pedaling [7]. This study tested the willingness to perform pedaling movement when using the system, which was done using a baseline(just bicycling) and then experimenting with it. The results showed that the intervention was sufficient to increase the willingness to perform the pedaling activity.

Almost all of the studies, regardless of the objective, had a positive experience doing the intervention. The systematic review indicated that several aspects that merit careful consideration when working with this user group. This review has also proven that it is hard to find studies that involve ID and exergaming.

2.3 Connection

Most current devices for PA related data collection use either Ant+ or BLE to transfer data to connected devices. Both of the sensors can transfer data with Ant+ and BLE. Ant+ is a wireless technology that is commonly used in small sports devices. Ant+ allows monitoring devices to talk to each other [30]. Ant+ can enable multiple brands to work together. However, not all new devices support Ant+ connectivity; iPad's and the latest android tablets do not support Ant+. BLE is a wireless personal area network that is aimed at healthcare, fitness, security, and home entertainment. It consumes considerably less power and has a similar communication range compared to standard Bluetooth. [34]

2.4 Equipment

Both the hardware and software used in this project are described in this section.

2.5 Development platforms

Unity (Unity Technologies, CA, US) and Visual Studio (Microsoft Corporation, WA, US) are the development platforms for two reasons. Firstly, the previous design of this project is built on these platforms. Secondly, Unity has a good and documented game development kit that can be used. Visual Studio was chosen because it is the recommended development environment when using Unity.

2.5.1 Unity

For this project, the Unity 2019 editor was used to develop the application. It includes a play mode for quick previews of the work in real-time. This can be paused, and you can change values, assets, and other properties to see results immediately. Unity is an All-in-one-editor that is available on Windows, Mac, and Linux. It supports both 2D and 3D development with features and functionality to support specific needs. To develop and create the UI for the app, Unity has a built-in system that allows users to create UI fast and intuitively. For efficient workflow, Unity presents prefabs that are preconfigured Game Objects [31].

2.5.2 Visual Studio

Visual Studio is an integrated development environment produced by Microsoft. It includes a code editor that supports IntelliSense (e.g., automatic code completion, parameter info, quick info, and member lists). It includes debugger and source control systems like Git. Visual Studio also supports 36 different programming languages [22]. In this project, this was used as a code editor for the code written in C#.

2.5.3 Control unit

This project has both an Android tablet and an iPad available for running and testing the application in real-life settings. Unity supports development for both platforms, and the app can be downloaded on each of them. The Android tablet was the main focus, but some minor testing on the iPad was also added. Both types of control unit support BLE which is used for connection with the sensors. For this project, three Samsung Galaxy Tab A were bought.

2.5.4 Bicycle equipment

The control unit needs to get PA information from the bicycle. There are two different solutions in place to get that information. A sensor can be mounted on the crank arm of an ergometer bicycle, or a standard outdoor bicycle can be mounted on a bicycle roller. Both of these solutions will send some cadence data to the control unit with BLE. For this project, the UNO Fitness ET1000 was bought (Figure 2.2).

Figure 2.2: Ergometer bicycle: U.N.O Fitness ET1000

Sensor

The Wahoo RPM cadence sensor is a small sensor connected to the crank arm of the ergometer bicycle. For people that already have an ergometer bicycle, this is a cheap option. The sensor can measure cycling cadence data and uses BLE and Ant+ technology for connection. The battery lasts up to 12 mounts and it is waterproof up to 1.5 m. Since the sensor is small, it fits most bicycles.

Bike trainer

The bike trainer used for this project is a Tacx Smart Flow trainer (Figure 2.4). This trainer supports both BLE and Ant+ connection. It can measure speed, power, and cadence.

Figure 2.3: Wahoo RPM cadence sensor

External sensors can also be used and connected to the trainer easily [29]. It is possible to adjust the resistance for the power wheel attached to this trainer. The Tacx Smart Flow trainer support wheels with a size between 26" and 30". With easy setup, the bicycle is securely locked in the trainer frame. Some apps can be used specifically for the trainer, but it is possible to connect to it and use it without the included apps.

Figure 2.4: Tacx Smart Flow trainer

For testing the solution, a three-wheel bicycle was borrowed from NAV (Labor and Welfare Administration), an institution in Norway that provides welfare for those who need it. The three-wheel bicycle is used to provide extra stability when testing the solution for people with ID. Figure 2.5 shows the bicycle setup for testing on the daycare center. The trainer is mounted on the power wheel of the bicycle, and the wheel needs to be adjusted to the trainer with enough fraction to do the measuring. The trainer needs to be connected to a power supply for sending Bluetooth data.

Figure 2.5: Tacx Smart Flow trainer with three-wheel bicycle and tablet

Table 2.2: Cost of equipment

Product	Price
Wahoo Cadence Sensor	399NOK (fjellsport.no)
Tacx Smart Flow trainer	2499NOK (xxl.no)
Apple iPad pro 10.5	6797NOK (elkjop.no)
Samsung Galaxy Tab A 2019	2490NOK (elkjop.no)
U.N.O Fitness ET 1000	4583NOK (fitshop.no)
Three wheel bike	Borrowed from Hjelpemiddelsentralen (NAV)

2.5.5 Cost of equipment

The cost of the equipment required to replicate this thesis is presented in the table 2.2.

Chapter 3

Research Methods

3.1 Research paradigm

The report, Computing as a discipline [8], introduces three significant paradigms that provides a context for the definition of the discipline of computing: theory, abstraction (modeling), and design. Each of the paradigms consists of four steps to follow. The steps of the theory paradigm are:

1. characterize objects of study (definition)
2. hypothesize possible relationships among them (theorem)
3. determine whether the relationships are true (proof)
4. interpret results

The steps for the abstraction paradigm are:

1. form a hypothesis
2. construct a model and make a prediction
3. design an experiment and collect data
4. test the system

The steps for the design paradigm are:

1. state requirements
2. state specifications
3. design and implement the system
4. test the system

This project uses a combination of all of these steps, but with a weight on the design paradigm. The development process is iterative, meaning the steps will be iterated, and requirements can be removed, added, or edited in later phases of the development.

3.2 Data collection

3.2.1 Literature review

The literature review carried out in this project was a light version of a Systematic Review. The systematic review provided literature with information about how individuals with ID use exergames and the effects it had on their PA. The main points from the literature review were: that exergaming has a positive effect on the motivation to engage in PA for people with ID, and there is a need for more study and solutions for this user group. The results from the literature review also provided information on how to execute these types of interventions, which this project will use and take into consideration.

3.2.2 Experts, seminars, and workshops

The people in charge of the project ”Effects of Physical Activity with e-health support in Individuals with Intellectual Disability” have been valuable experts to gain information about individuals with ID. The requirements needed to design a system for this user group was gathered through supervision seminars and other meetings with experts. There was also gathered valuable information in the workshop: ”Workshop on technology and e-support for people with mental disabilities”.

3.3 Evaluation method

The interview after testing the application is inspired by a usability evaluation procedure

3.3.1 System Usability Scale

The same questionnaire used for V. Berg master's thesis ([2], p 112) was reused for this assignment (Appendix B). The results from the System Usability Scale (SUS) is calculated by summing the points for each statement, where each statement gives a score from 0 to 4. For the odd number statements, the score is calculated by subtracting 1 from the scale point position. From the even number of statements, the statement score is calculated by subtracting the scale point position from 5. Then the sum of all scores is multiplied by 2.5 to give the SUS-score for each form of statements.

3.3.2 Testing procedure

During the development of the application, there were continuous testing to verify that the application was working. Weekly meetings where held to discuss the previous and the next stage of developing.

3.4 Critique of methods Used

The systematic literature review did not include Google Scholar because it provided too many results for a small size literature review. Because of this, the literature review may not include all the relevant articles.

Chapter 4

System and Software Development

4.1 Requirements Specification

In this sub-chapter, the functional and non-functional requirement specifications for the project are described. The Volere Requirements Specification is used to present the requirements listed [24]. The requirements are partly a result of previous research and theses, combined with feedback from experts and institution staff.

The functional requirements describe the essential parts of a product, and describes what the product must do or what actions it must make to provide the functionality to the user [24].

The non-functional requirements are properties the product must have [24]. These properties do not bring functionality to the product but are attached to the product package.

4.1.1 Source of requirements

The source for composing these requirements come from meetings and discussions with experts, previous results, and testing in this project, and searching studies.

4.1.2 Scenarios

Scenario 1

Jon is a 17-year old adolescent with Down syndrome who lives with his parents and his sister. He likes watching YouTube videos and play games on his tablet. Jon is not very fond of being outside when it is cold. Furthermore, over the last year, Jon has increasingly become less active due to wanting to use his tablet. In his home, they have an ergometer bicycle, which is not much used. His parents want to motivate Jon to try the ergometer bicycle. They have obtained the MoviCycle application on the tablet and bought a sensor to use alongside it. Since Jon have vision impairment, the big symbols in the application helps when using the system. In the beginning, his parents had to convince him to use the system, but now he is using the bicycle 10 minutes a day. Jon thinks it is fun that his sister also uses the bicycle. They both try to accomplish their goals for each week.

Scenario 2

A daycare center for people with disabilities wants to motivate their users to be more active. They found the MoviCycle system to motivate the individuals at the daycare center. The system could track all the different individuals' usage of the app, so a small competition between them started. This was good for their motivation to be more physically active while being at the daycare center.

4.1.3 Functional Requirements

Functional requirements are described in table 4.1. The description-column describes the requirement's intention, while the rationale-column is a justification for the requirement. The fit criterion-column is a benchmark that has to be tested to determine if the implementation has met the requirement. Customer satisfaction is a degree of user happiness if this requirement is implemented successfully. The scale goes from 1 (uninterested) to 5 (extremely pleased). Customer dissatisfaction is a measure of stakeholder unhappiness if the requirement is not part of the final product. The scale goes from 1 (hardly matters) to 5 (extremely displeased). [24] Functional requirements 1-20 are continued from previous master's thesis done on this project [2], while requirements 21-28 are added mostly from the goals set for the continuation of this project.

Table 4.1: Functional requirements

Req. #	Description	Rationale	Source	Fit Criterion	Cust. Satisf.	Cust. Dissatisf
1	The system should show progression in activity visually.	Make things simple, put in a system, help to visualize activity. People with ID enjoys getting attention and praise for achievements done.	V. Berg([2], page; 37)	Show that cycling is an activity, be able to show others activity achieved.	5	4
2	The system shall excessively use symbols to describe navigation and actions.	Only a few with ID know how to read. They are used to point at symbols or things for expressing themselves.	V. Berg([2], page; 37)	A user should not be required to read to be able to use the system.	4	4
3	The system shall show visually when a session begins and when it will end.	When activities are predictable, it is easier for the user to enjoy them.	V. Berg([2], page; 37)	A user should be able to predict how long a cycling session will last.	5	4

4	Using the system will motivate individuals with ID to continue cycling with the use of fun, surprising animation throughout the session.	To be active is rarely motivating itself; it must be something more that brings amusement to the activity.	V. Berg([2], page; 37)	A user should be entertained by the visual effects in the application.	3	2
5	The system shall be runnable on a tablet or an iPad.	Individuals with ID are used to using a tablet or an iPad.	V. Berg([2], page; 37)	A user should be able to run the application on a tablet or an iPad.	5	5
6	Any text displayed shall be either Norwegian or English	The group that is in contact with the project and that are potential users are all Norwegian. To be able to spread the idea further, support for English will extend the potential for users.	V. Berg([2], page; 37)	A user that understands Norwegian or English should be able to read and understand any text in the application.	5	5
7	The system shall support the use of a Tacx Smart Flow trainer or a similar one that can be mounted with a regular bicycle.	Many of the individuals with ID enjoy biking outside when the weather allows so.	V. Berg([2], page; 38)	A user should be able to use the same bicycle that she or he uses outside.	4	3
8	The system shall be able to use any ergometer bicycle that can be mounted with a cadence sensor.	Some households own an ergometer bicycle and would save space by not having to install another type.	V. Berg([2], page; 38)	A user should be able to use the system on an ergometer bicycle.	4	3
9	The system shall play videos of tracks through a landscape or familiar paths/streets when pedaling.	To be active is rarely motivating by itself. It must be something more that brings amusement to the activity.	V. Berg([2], page; 38)	A user should be able to play a video of a track/ride by pedaling on the bicycle.	4	3
10	The resistance on the paddling shall be adjusted after the current steepness of landscape in a video.	Making the system more like biking outside it can be used to learn how to use a bicycle.	V. Berg([2], page; 38)	A user should feel that it is heavier to cycle up a hill than down.	3	3

11	The system shall play music when pedaling.	Many of the individuals with ID enjoys listening to music.	V. Berg([2], page; 38)	A user should be able to play the music that he or she likes while pedaling.	4	3
12	The system shall play videos that are entertaining when pedaling.	The individuals with ID often like to watch a specific movie or tv-show repeatedly.	V. Berg([2], page; 38)	A user should be able to play an entertainment video by pedaling.	5	4
13	The system shall provide different lengths of exercise sessions.	The experience with cycling varies; some may be able to cycle for 20 minutes while others have had enough after 10 minutes of cycling.	V. Berg([2], page; 38)	A user should be able to choose the length of the exercise session.	4	3
14	The system shall have a game where stars and medals are collected in a virtual world by pedaling.	To be active is rarely motivating by itself. It must be something more that brings amusement to the activity.	V. Berg([2], page; 38)	A user should be able to control a unit in a virtual world collecting stars and medals by pedaling.	4	1
15	The system shall have a game where garbage is collected of the ground in a virtual world by pedaling.	The game could beneficially be educational to learn that garbage should not lay around.	V. Berg([2], page; 38)	A user should be able to pick up garbage in a virtual world with pedaling.	4	1
16	The system shall have a game where letters are collected to spell a specific word in a virtual world by pedaling.	They would like a game that can educate how to spell words.	V. Berg([2], page; 38)	A user should be able to collect letters that make up a word by pedaling.	3	1
17	The system shall have a way of setting the goal activity time and show the progression of achieving this time.	Make things simple, put in a system, help to visualize	V. Berg([2], page; 38)	A user should be able to set a goal time to achieve and see how far he or she has come on this goal.	4	2
18	The system shall have a game where a unit is controlled in a virtual world, and a friend can control a unit with another instance of the system in the same virtual world.	Some of the individuals with ID likes to be social while doing activities.	V. Berg([2], page; 39)	A user should be able to control a unit in a virtual world and to see another user represented by a unit in the same virtual world.	4	1

19	The system shall store activity that has been performed and has a way to display the history.	Parents and caretakers would like an overview of the activity that has been done.	V. Berg([2], page; 39)	A user should be able to look at an overview of earlier conducted activity sessions.	4	3
20	The system shall allow the user to choose the entertainment video.	There is a high diversity among individuals with ID in what type of entertainment they like.	V. Berg([2], page; 39)	A user should be able to choose a video he or she likes for a training session.	5	4
21	The system should be able to include multiple users	Multiple users should be used on the same device for usage at daycare centers / big families.	Author	Multiple users should be able to customize their user and have individual tracking of PA data	4	3
22	The system should include a secure, easy and safe way for individuals to log in	To keep the data private from other users, there should be a way for the users to log in	Author	A smart log-in function should be used included to identify the user.	4	3
23	The system shall have different content of entertainment	The content of entertainment should be different so that users with different interests can be entertained by the system.	Author	A user should be able to choose from different forms of entertainment, including YouTube, movies, or landscape track videos.	5	4
24	The system shall include a gamification aspect	If the user can see progress in a different way than just numbers, it can be more motivating.	Author	A user should be able to choose if he wants to watch videos or use the gamification mode for the system.	5	2
25	The system shall send data to the cloud	It is easier to get information from the users to progress if the data can be sent to the cloud.	Author	When the system is used in for a clinical study, it is much easier to retrieve data from the cloud instead of retrieving data from the device.	1	1
26	The system should have a high-score list	To motivate users to do well a high-score list is set up for the individuals that want it.	Author	A user should be able to compare himself to his friends if he wants to.	4	2

27	The image from the device should be distributed to an external monitor	An external monitor would help if the user wants to see a bigger picture of the screen.	Author	A user should be able to distribute the image to an external monitor easily.	5	2
28	Include an integration with the project application(Actiplan app)	If the system can be included in the application of the principal project, it will be easier for the individuals in the study to use it.	Author	A user in the study should be able to access the application easily.	3	2

4.1.4 Non-functional requirements

All the non-functional requirements are taken from the previous master's thesis done on this project, and are presented in table 4.2.

Table 4.2: Non functional requirements

Req. #	Description	Rationale	Source	Fit Criterion	Cust. Satisf.	Cust. Dissatisf
1	The system shall not require special competence in the the technology used to set up the system	If the system needs to be easy to use for this user group, it will not be used. Parents and caretakers that help the individuals with using the system are rarely experts in technology	V. Berg ([2], page; 39)	A user should be able to set up the system without having special abilities in technology	5	5
2	The system shall not require extensive knowledge about exercising for using it.	Activities should be easy and simple to do, individuals with ID are often in bad shape.	V. Berg ([2], page; 39)	A user should be able to use the system without being in good shape.	5	5
3	The system shall not make it to sophisticated and advanced to do a session, but also not too childish.	All welfare technology support must be simple and require little resources. Some of the individuals with ID have learned to look up videos on YouTube by using it for an extended period. They should be viewed as regular and often cool persons.	V. Berg ([2], page; 39)	A user should be able to use the system after 20 times using it and should not be embarrassed by a simple UI.	5	5

4.2 Design

This section presents the design of the application with some preliminary plans before going through the final prototype design. The purpose of the design is to fulfill the requirements set in the previous sub-chapter. The control system is connected to the sensor installed on the bicycle crank or the trainer wheel. The system uses BLE to connect to the application. On the device, the users can play their favorite YouTube videos or videos installed on the device. By detecting the continuous pedaling activity, the videos are playing. However, if the users are pedaling to slow according to the applied settings, the video will be interrupted.

4.2.1 Final design

The final design is shown in Figure 4.1, which displays the general UI design of the system. Figure 4.2 highlights the contribution done by me to the design.

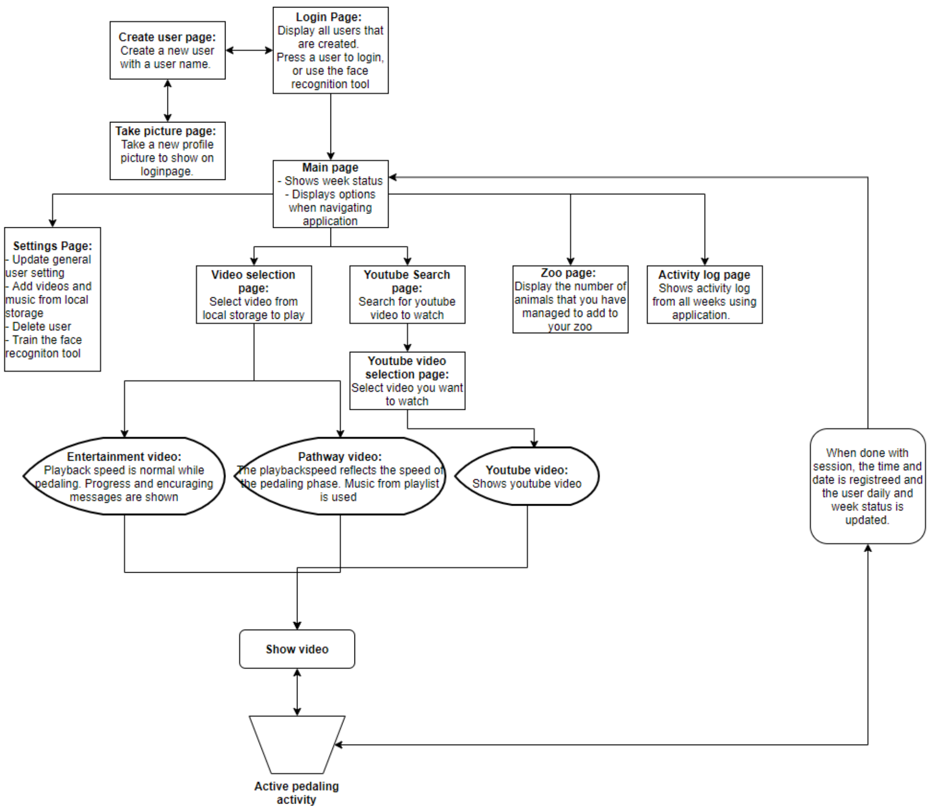


Figure 4.1: UI design for application

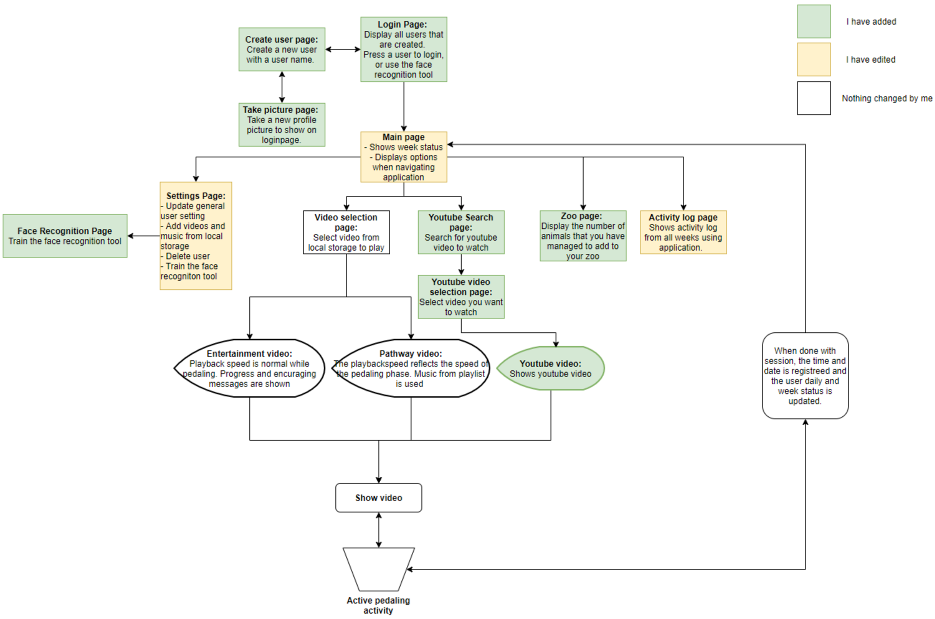


Figure 4.2: Shows the additions and changes to UI done by author

4.2.2 User Interface (UI)

General design

Non-essential app features, such as entering settings, navigating backward, and logging out, is placed at the top bar. Text is short, presenting the information in a direct and straightforward style. The buttons are generally large for easy navigation in the application. The requirements demand usability towards individuals with ID, and therefore the design choices are applied for this user group.

Login page

The login page displays all users created for the application. The users are presented in a scrollable grid view with default with three users. Each user is pretested with their profile picture and their name, as shown in figure 4.3. From the login page, you can navigate to the main page by tapping one of the users. You can also scroll to the create user page by pressing the "Legg til ny bruker" button.

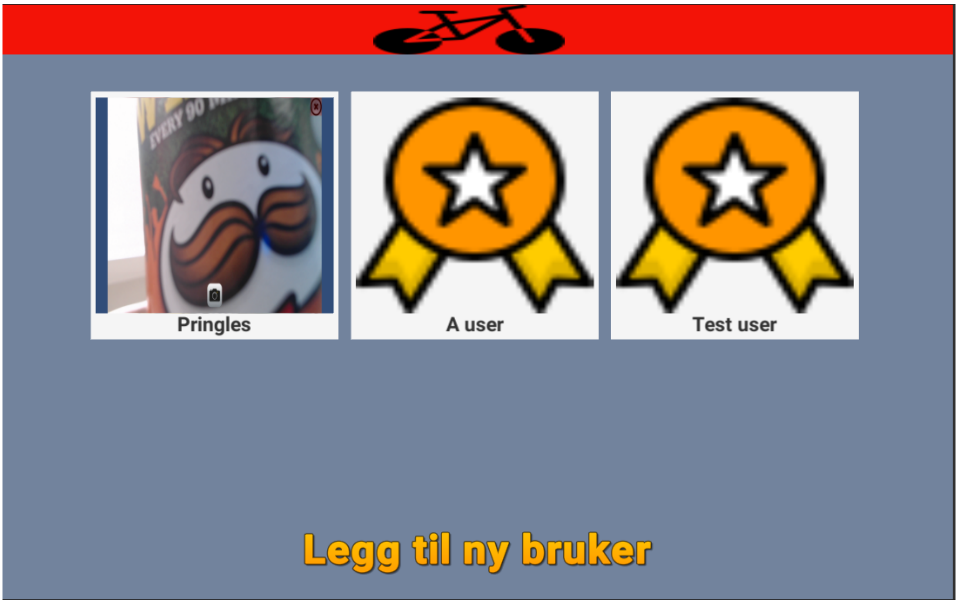


Figure 4.3: A login screen with three users added

Create user page

On the create user page (figure 4.4) there is a possibility to create a new user by pressing the "Legg til ny bruker" button. A user can be created after adding a profile picture or/and a user name. If a user wants to add a profile picture, he can press the "Ta nytt profilbilde" button to navigate to the take picture page(figure 4.5)

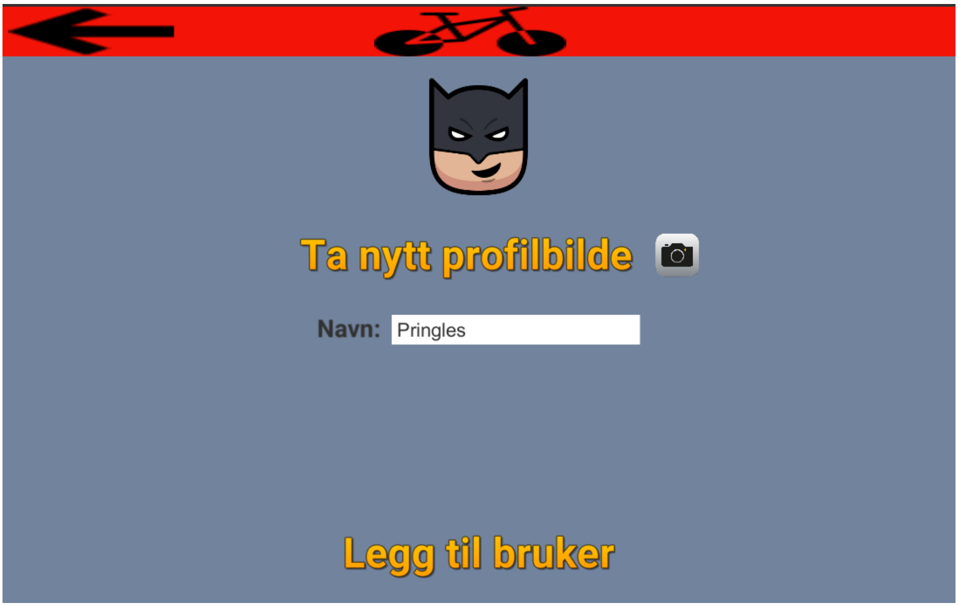


Figure 4.4: The design of the new user page

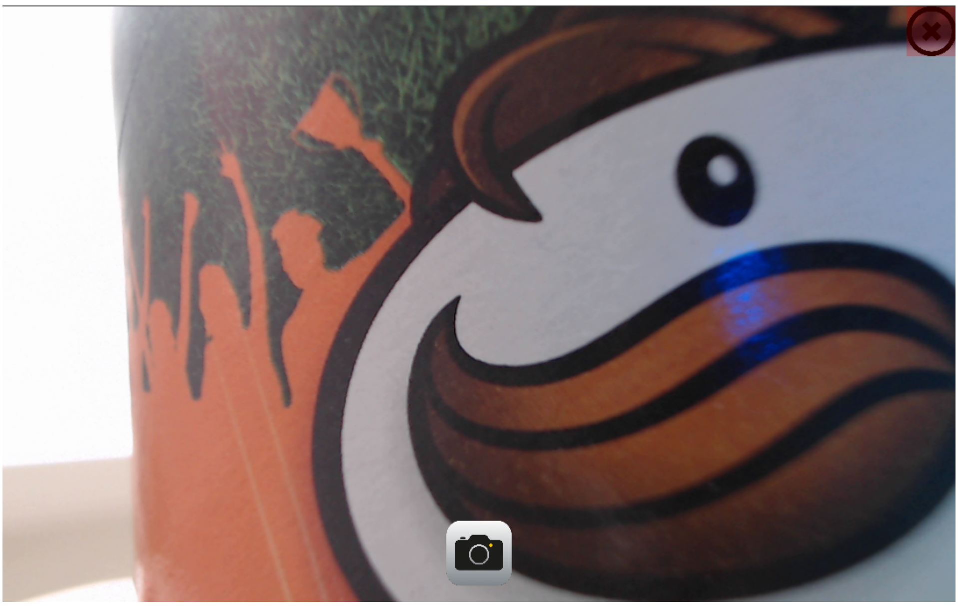


Figure 4.5: Take picture by pressing the camera button

Main page

On the main page, the user is presented with several options displayed with big icons (figure 4.6). There are three main options to play this game. By pressing the "Videoer" button, you will navigate to the videos stored on the application, by pressing the "YouTube" button you will navigate to the YouTube search page, and by pressing the "Dyrehage" button, you will navigate to the zoo page. The activity time archived the current week is also presented. The activity time is compared to the week's target activity time and shown in a progress bar. The number of days partitions the weekly goal in a week. And when these partitioned goals are achieved, the number of medals and a message displayed will change for each goal met.

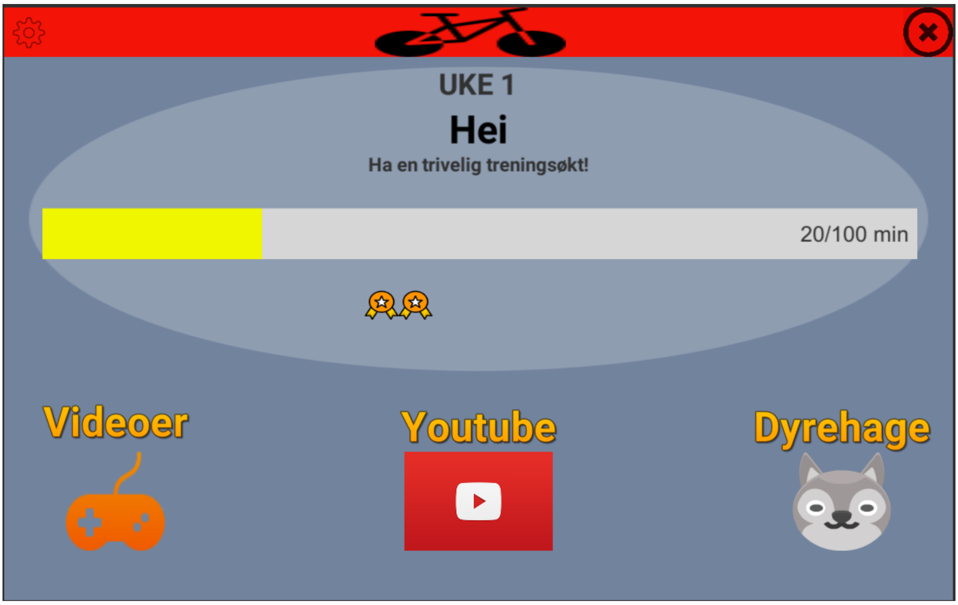


Figure 4.6: The main page for each individual user

Settings

The settings page (figure 4.7) is not a page that the user is required to access several times. Often this user group would need some help when first trying out the app. The settings page can therefore be hard for the user to configure alone. On the settings page, the user can configure their user settings. This includes choosing a target time for cycling performed in a week and the speed required to play a video. The user can also delete their user and navigate to the train face recognition page on the settings page. The user can also add or remove videos and music. These videos will be used during activity sessions on the video game mode.

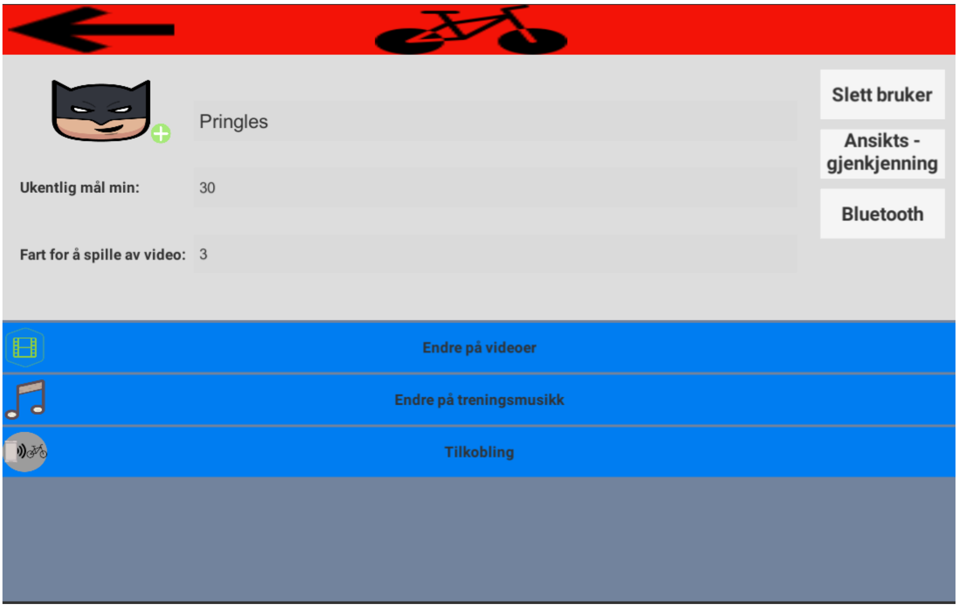


Figure 4.7: The settings page

Video modes

There are two choices to enter video game mode: either press the ”Videoer” or the ”YouTube” button. On the YouTube option (figure 4.8), the user can search for a video it would like to see. The search results are presented with the ten most relevant videos from the search query. And on the other option, the videos included from settings are displayed. Both of these videos are offered as a scrollable list. The YouTube results are presented with a thumbnail and with the name of the video. While the videos from the device are presented with a thumbnail, title, and length of the video (figure 4.9), to select a video, one must click on the list item. When clicked, the user is navigated to the video player.

The video player will start with a spinning animation to indicate that the user should pedal to start the video. To start the video, the user must pedal faster than the playback speed set in the settings menu (default is 3m/s). If the user stops pedaling, or does not pedal fast enough while pedaling, the spinning animation will appear and the video will pause.

At the bottom of the screen is a progress bar that shows how far the user has left of the video. While in the top bar, the length and the current speed of the user bicycle data are shown. Seven different messages will show during the session, where the messages will tell the user how well it is doing and how far the session has lasted.

For the videos added from the device, there are two options. The video can be added as a pathway or an entertainment video. The pathway videos will be played at a speed relative to the pedaling activity, while the entertainment videos will play at the same playback speed. The pathway videos will also play the music from the music list in the background of the video. When the video is finished playing, both confetti effects and a trophy will be

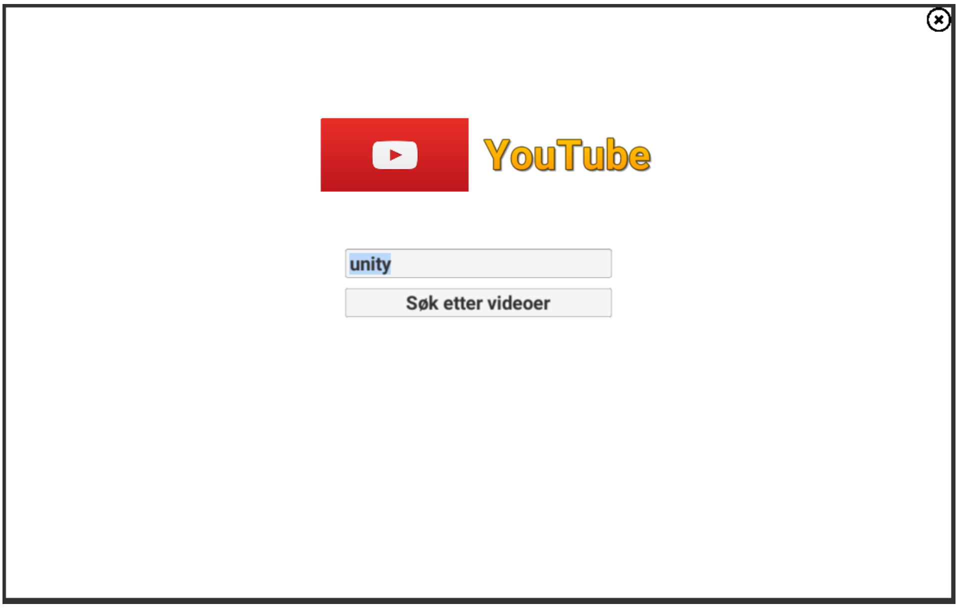


Figure 4.8: YouTube search

shown, while a cheering sound is played (Figure 4.10).

Zoo

The zoo is a way to reward the user for consistency. Animals can be added to the zoo by reaching a daily goal. This daily goal is a seventh of the weekly goal set in the settings page. If a user achieves the daily goal, it will collect an animal for the zoo. But if the user does not bicycle for the entire day, it will lose an animal. If the user has used the bicycle but has not reached the daily goal, nothing will change about the zoo's number of animals. By bicycling in the video modes, the user will start the daily challenge to collect an animal.

4.2.3 Hardware design

Connection with sensors

The sensors and the Tacx Smart Flow trainer will connect to the application through BLE. Pedaling activity will be registered and transmitted to the application. When the application starts, it will connect to an available sensor that has the required services. If several sensors can connect to the application, it will connect to the last used sensor. When the user starts pedaling, the data will be transmitted to the application, where an estimated bicycling speed will be calculated. This speed is used during the sessions.

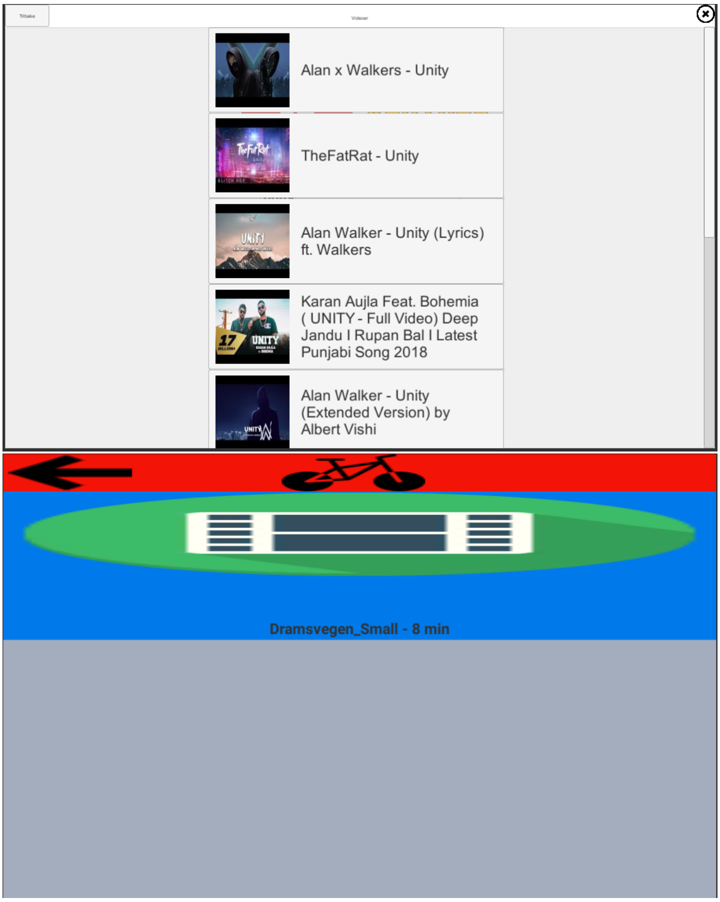


Figure 4.9: Pick a video to start game

Equipment

Depending of the equipment bought for the system, the equipment needs to be applied differently. The Cadence sensor should be mounted to the ergometer bicycle crank, while the trainer is mounted on the power wheel of a regular bicycle. The trainer also needs to be in reach of a power supply socket.

The tablet placement for both an ergometer and a regular bicycle is shown in figure 4.12. The ordinary bicycle needs an external handlebar to hold the tablet, while the ergometer bicycle already has a spot to place the tablet. If a bigger monitor is wanted, the tablet can transmit its screen to a compatible monitor by using screen mirroring. The display can be shared both with cable and through google chrome cast. This option can also be used if there is nowhere to place the tablet during an activity session.

Figure 4.10: A finished session on video mode

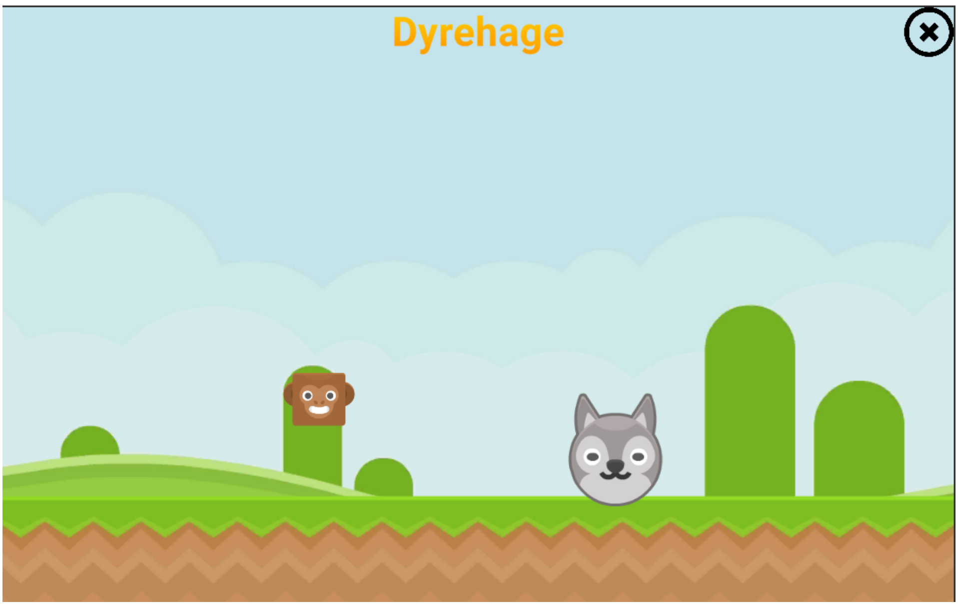


Figure 4.11: In the zoo you can collect animals

Figure 4.12: The picture shows how to place the tablet during sessions

4.3 Implementation

4.3.1 Development process

The application is developed in Unity because there is an easy way to create visual effects and game elements in Unity. Unity also supports building to both iOS and Android. The application was compiled to both operating systems. However, it has not been tested on iOS because of a time shortage. Unity supports both 3D and 2D game mode design, which can be intertwined in the application. For this project, only 2D development is used.

Unity allows for continually testing the application during development. By using Unity's design and test windows during development, you can change the UI in the design window and simulate how the application work in the test window. Figure 4.13 shows how the unity Engine is. Since the application is designed for touchscreens, all navigating and user input must be accessible through the display. Navigation and other aspects of the application are tested on the unity engine before being deployed on a tablet to check how it works. Unity executes its functions in cycles. If no functions are running, Unity renders the current frame again.

The Unity editor revolves around game objects. Where each object that adds content to the game can be looked upon as a game object, each game object contains components that give them a specialized field of usage. The inspector column in figure 4.13 shows the game object that contains the list of users shown at the login-page. Unity organized its application into scenes that include environments and game objects. A scene file can be seen as a unique level in a game with several levels. Unity also offers an asset store that sells user-created game assets. These assets can be useful in game development as they can simplify your code. Assets can help with AR, deep learning, functionality enabling, and other essential game environments.

Some of the objects are not contained in the scene before it is compiled. Figure 4.13 shows the login screen. However, the login buttons with pictures of the users are not displayed on the figure. This is because they are initialized at run time. The application needs to find the users stored before being able to display them. This is done through scripts. The game object ”userScrollList” displayed in the inspector have a script attached to it. This script is made in C#, and all of the individual game objects like the ”Button template” and ”Scroll view” are publicly available in the script and can be accessed through the Unity editor.

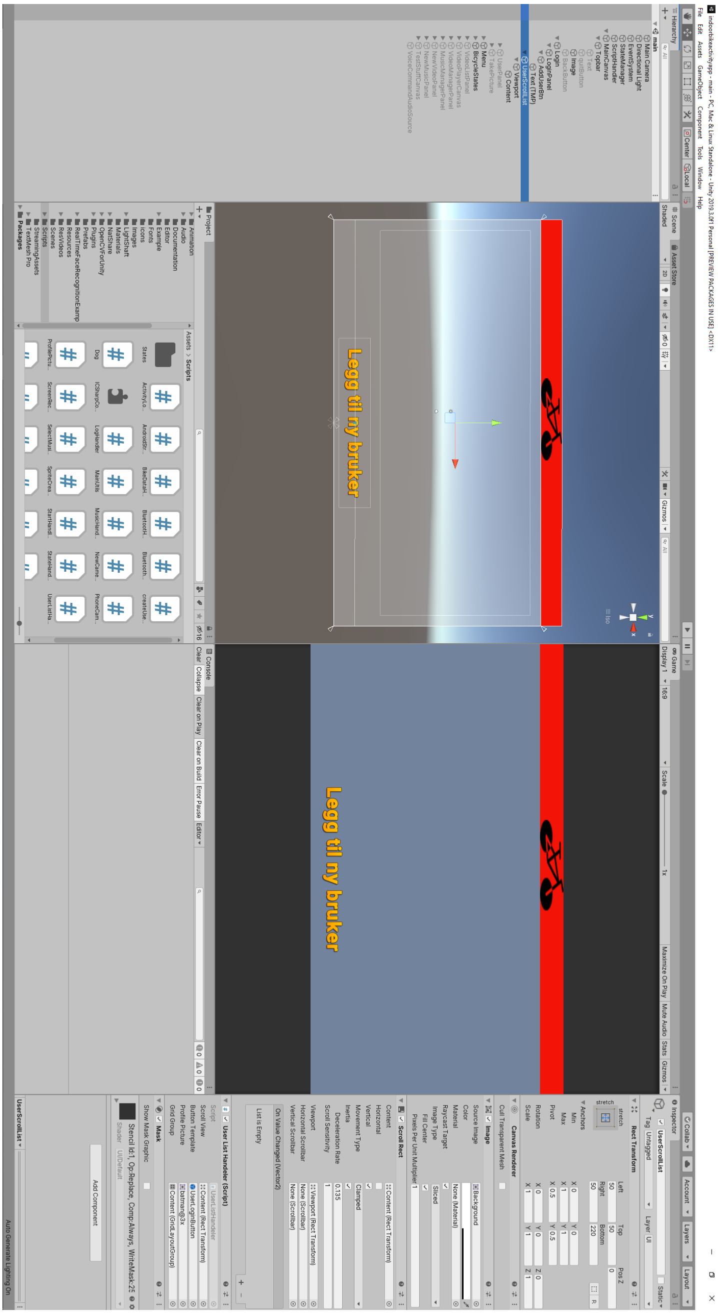


Figure 4.13: Unity engine: Hierarchy shows all game objects in scene ”main”, while scene shows the design window. Game shows the test window, while the inspector show the highlighted game object in the hierarchy

4.3.2 Project structure

This project is separated into four scenes, where one scene contains most of the content of the application, and the three other scenes contain some other aspects of the application. Some of the states are preserved between the scenes to provide the state throughout the app.

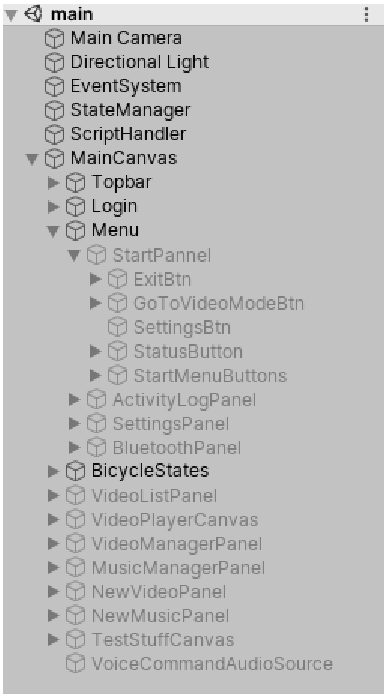


Figure 4.14: All game object in the ”main” scene

Figure 4.14 shows how the project is structured in Unity. All of the game objects are divided into a hierarchy where the game objects contain smaller game objects until we get the smallest game objects (buttons, text).

4.3.3 Code structure

Figure 4.15 illustrates how the different parts of the system interact with each other. Script handlers control the pages displayed in the scenes; they also control functionalities such as navigation, storage, web search, etc. State handlers maintain the game state that needs to be shared between script handlers. The display pages display all game objects the user can see and interact with. The last part of the system is the data files that are stored in the application. Necessary user data is stored in these files.

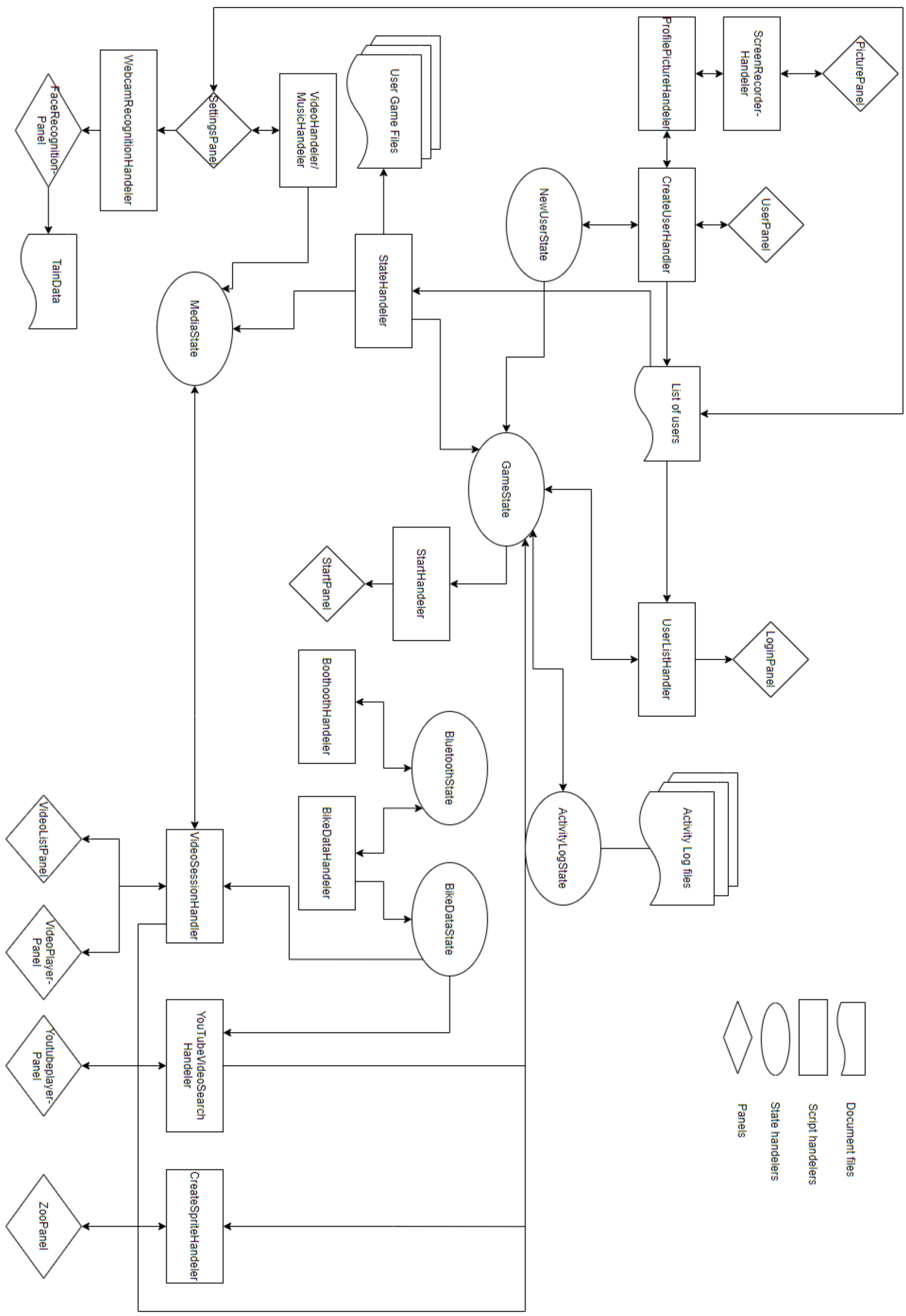


Figure 4.15: Flowchart over implementation with script and state handlers, data management and display panels

In figure 4.15, all of the scenes are combined in one flowchart. As mentioned earlier, there are four scenes in this implementation. When the Unity app starts, the first scene (main) is loaded, and the script handlers' initialization functions are started. When the application starts, bluetoothHandler uses BLE to connect to a sensor and updates the bluetoothState. The userListHandler fetches all user profiles stored in the application. When a login happens, the stateHandler brings the user data for this user and updates the gameState. The bluetoothState and the gameState are continued into the other scenes when the scene is changing. Some other scenes are YouTubeSearch, the ZooPage, and face recognition page.

4.3.4 Game scenario

For the standard videos stored on the device, the bikeDataHandler has a coroutine(Coroutines allows functions to pause and return control (yield) to the Unity cycle and then resume in the next cycle) that reads and calculates it into a speed that is then written to bikeDataState. When a selected video is loaded into the video player, the videosessionHandler shows this data in the top bar. To start the video, the users pedaling speed has to be higher than the lower speed limit set in the user settings. The user can stop the session when he wants, and the activity data will be stored on the device.

The YouTube pages use the asset ”Youtube Video Player + Youtube API” found in the asset store. This asset has several functions relating to YouTube. It can search, show, and get info about videos. This asset is used to make searching for videos easy to include in the application. The Youtube pages are on a different scene. However, the gameState, bikeDataState, and bluetoothState are included in this scene as well.

4.3.5 Rewards

There are several types of rewards in this exergame; they can be found during sessions, on the start page, and in the zoo page. During sessions, motivating messages are shown to the user to let the user know how well he is doing. The start page has a weekly progress bar and medals that can motivate the user to do sessions.

The zoo is a little mini-game where the user is rewarded for consistency. This mini-game finds out how much the user needs to bicycle each day according to his settings. The number of current animals is stored in the gameState, and it increases or decreases depending on if the user reaches his daily goal.

4.3.6 Face recognition

The face recognition uses two different assets. The ”OpenCVForUnity” is necessary to have the deep learning used in the asset ”RealTimeFaceRecognition.” The face recognition is only included in the settings part of the system and is not yet connected to the gameState. However, it can store the face recognition data in a file in the application. This can be used for further development of the application.

4.3.7 Storage

The application store several types of data. The list of users used for the Login page is stored in the player preferences. In contrast, profile pictures, face recognition, user data, and activity data are stored in the persistent data path to the operating system. The structure of the activity data is stored as a JSON-file, so it will be easier to include cloud storing in further development.

Chapter 5

Test and Results

The testing of the functionality of the system was done throughout the development process to establish that features behave as expected. Because of the Covid-19 pandemic [38], the planned execution of the testing of the application could not be done. There were plans for testing the system on a daycare institution and on a High School that have a class for people with ID. An user manual(Appendix C) was created to present how the system should be used. Because of not being able to achieve realistic testing, a more thorough examination was done by letting one of the experts test the system to get some qualified feedback.

5.1 Testing procedure

Previous testing of this application showed promise, and the results showed that the application motivates to PA.

5.1.1 Testing done before thesis

Before the thesis started, I tested the system on Tindfoten day center during Christmas. There are 22 users at the day care center. The bicycle solution was available for three weeks. Four of the users used the solution during this time. After this, the contact person (an employee at the center) who was responsible for the application was asked questions about how the application was working and what should be improved for the next time.

5.1.2 Planned testing

Planes were set for two types of testing for this thesis. On the daycare center, we planned for the application to remain a week to test the new multi-user functionality. The other testing was planned to be at a high school, where a similar test to what Chang et al. tests in their study [7]. Then results from two testing situations could be fetched. The results from the high school could be compared to the study by Chang et al. [7]. This type of testing would be suitable for measuring how much better the application is to prompt the user. The questionnaire for individuals with ID and staff members was prepared to collect some answers on what could be done better, on what can be improved. The prepared questionnaire was the SUS-questionnaire along side some general questions about the application.

Testing the multi-user features

The bicycle and the application were supposed to stay at Tindfoten Dagsenter for a week. Where each of the participants could try out the system 3-4 times during that week. Plans were made with the caretakers to uphold the testing of the system. Because of the previous and successful tests at this daycare center, the participants and the caretakers are positive to try out the solution. At the end of the week, a questionnaire was given to both the caretakers and the participants of the study. The results from this testing is compared with the tests used in the previous work of this project.

A-B test design [35]

Similar to Chang et al. [7], the testing at the high school has an A-B design. Where A represents the baseline and B represents the intervention phase. Plans were to have the experiment at the activity room at the school, where the participants took part in the experiments for one 3-minute session each day during the study period (divided into five baseline sessions and ten intervention sessions). This testing is totally controlled while the session lasted.

The baseline phases watch the participant's original performance without the application running on the bicycle. But the participants would get some vocal prompts to start pedaling if they stopped for over 30 seconds.

The intervention phases have the same setting as the first phase, but with the application running to evaluate the effectiveness. The system stops the video playing on the app if they stop pedaling, and prompts the participant itself.

The results from this experiment are to look at the pedaling activity (how much % of the time used to pedal) in the sessions and compare this to what they discovered in a similar project [7].

5.1.3 Testing with expert

The testing with the expert was set up in a room at the university. The Tacx Smart Flow trainer system was used for the testing. Samsung Galaxy Tab A 10.1 was the tablet used during the testing. The testing was done in a 15-minute session with a 30-minute interview about how the testing had been. The expert was asked to give an opinion on how the system was and how it can be improved for individuals with ID.

5.2 System Usability Scale

The questionnaire used in this project is equal to the one used in the previous work done in this project (Appendix B). The odd-numbered questions are all in a positive voice, while the even-numbered questions have a negative tone. The results from the SUS scale is calculated by summing the points for each statement, where each statement gives a score from 0 to 5 (strongly disagree - strongly agree). To calculate the SUS-score, the sum of all the odd-numbered questions minus 5, and 25 minus the sum of all the even-numbered questions, are added together before being multiplied by 2.5 to give the SUS-score.

The figure 5.1 shows how the SUS scores should be interpreted. A score below 50 is not acceptable, a score between 50-70 are marginal, while a score over 70 is acceptable. The mean SUS score is 68 [25], which will give a SUS score of 65 a below-average result.

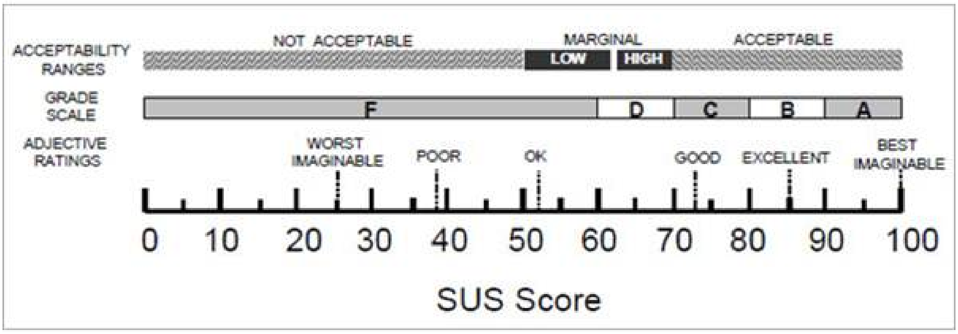


Figure 5.1: Grade rankings of SUS scores from "Determining What Individual SUS Scores Mean: Adding an Adjective Rating Scale," by A. Bangor, P.T. Kortum, and J.T. Miller, 2009, Journal of Usability Studies, 4(3), 114-123

Figure 5.2 illustrates the accumulated scores from two experts, with score possibilities from 0 to 8. The results from the SUS score from the testing with the expert is 57.5, while the testing at the daycare center for the capstone project showed a SUS score of 75, which gives an average of 66.25. However, the result from the daycare center does not include the new features, so the expert's conclusion can be said to weigh a little more.

5.3 General feedback

Some general questions about the application were also answered.

- What is good about the application?
- What is bad about the application?
- What can be improved or changed on the application?

The feedback from the expert showed promise, while also suggesting changes and improvements.

What is good?
Firstly this is a relatively cheap system that is good for people with ID since many of them like to bicycle. The system does not require much space, and it is easy to add/remove from the bicycle. Having the opportunity to have several users on one tablet is very good

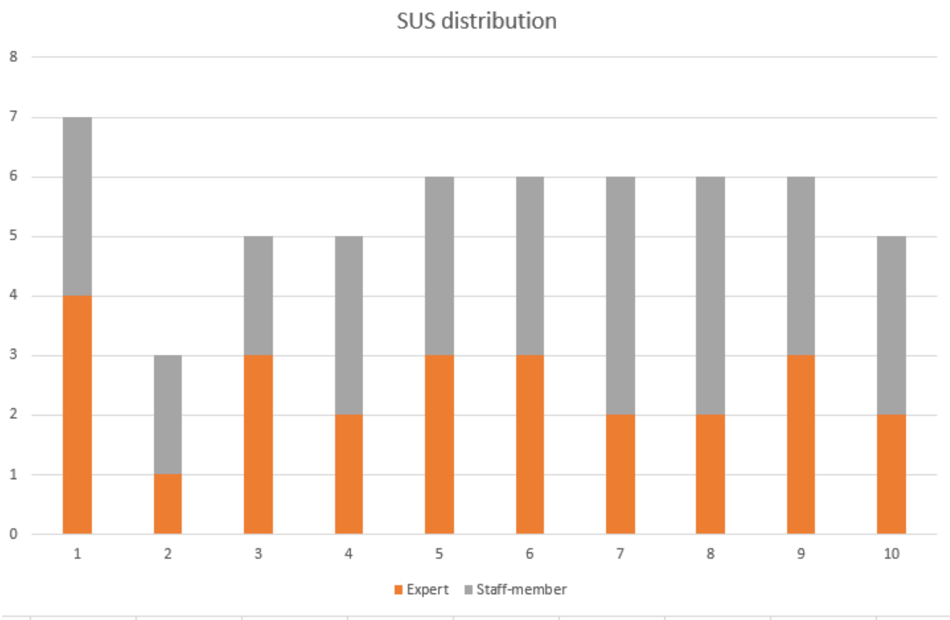


Figure 5.2: The accumulated scores for each of the questions. Maximum score for each item is 8, and minimum score for each item is 0.

for families and institutions for people with ID. Getting several options for the user is a definite improvement over the last design. It works for individuals with ID. The design has a relatively small amount of information for each page, which is suitable for people with ID. The YouTube page is very simple and easy to understand.
What is bad?
Some bugs and some not fully implemented features need to be fixed before this is a finished product. Individuals with ID will loose interest or give up if the technology not works.
What can be improved or changed?
Text and symbols are not used consistently. More clearly visible icons are always suitable in these types of applications. The zoo rewarding system should have a user setting to remove the opportunity to lose animals. Often individuals with intellectual disability need support to use the bike, and non-use may be due to lack of support. If the user cannot understand why their animals are disappearing, it should be possible to turn this option off. More contrasts are good in these types of applications, and it is better with recognizable icons than a pretty design.

Chapter 6

Discussion

6.1 Requirements

The requirements added to the project on this master's thesis are:

1. The system should be able to include multiple users
2. The system should include a secure, easy, and safe way for individuals to log in
3. The system must have different content of entertainment
4. The system shall include a gamification aspect
5. The system shall send data to the cloud
6. The system should have a high-score list
7. The image from the device should be distributed to an external monitor
8. The system must include an integration with the project application (Actiplan app)

There was never an expectation of implementing all of these requirements during this thesis, but to include as much as possible. The first of these requirements is done; the system can include multiple users. Where the users can store their data, add their videos, and customize their user.

The second requirement is not completely done; the users can log in to their user by tapping the user profile picture on the login page. For the secure and safe way for the users to log in to their profile, there were many discussions made on how I could do this. Password protection was excluded early from the process because it showed it to be to complex for this user group. Both face and voice recognition was considered optimal solutions during the implementation phase. The voice recognition extensions on the Unity hub were only for word recognition because recognizing voice is hard to distinguish on a tablet microphone. Therefore face recognition was included in the application. There is a possibility to train the face recognition tool on their face on the settings page. Still, it is not connected to the login solution, and therefore not finished implementing.

The third requirement was essential because the feedback of previous test phases done by me and others showed that more content of entertainment was wanted. The content considered early on were: YouTube, Netflix, Viaplay, NRK(Norsk rikskringkasting), alongside other streaming platforms. Contact and approval with NRK were made to include their database of videos into the application. But because of time shortage and the Covid-19 situation, contact with NRK broke down, and it was not included in the application. However, YouTube was highly sought after by the user group, so this was a priority during development of app.

The fourth requirement is, in a way, implemented. The zoo reward system can be looked upon as a gamification aspect. Plans were made to make this more like a game, but the solution ended in a reward system. The plans were to have an animated bicycle in a 2D environment, where it collected animals while bicycling. However, a reward system that adds more animals depending on how much the user bicycle is added to the app.

The fifth requirement is partly done. The system stores the data in a JSON-format, ready to be sent to the cloud, but it is not connected to it. Plans were made for the application to be connected to a prototype currently in development for the Tromsø Study. Because of time constraints, this was not implemented.

The sixth requirement required the fifth requirement to be completed. So this was not included in the application. Plans were to have the users add on to a high score list to show on an external monitor on the daycare institution to motivate them to compete.

The seventh requirement can be done, but it requires the tablet to screen-share either through a cable or through chrome-cast to work. The eight requirements are not implemented either.

6.2 Discussion of results

The results from the testing were provided through an interview with the expert and with the staff member. Both of these have long experience with individuals with ID, and because of this, the results can be considered to be of significant relevance as test results. However, testing with a user group would provide effects with more considerable significance. Because of the Covid-19 situation, testing with this user group was not possible. Many individuals with ID are more at risk of being seriously ill if infected with the virus. In addition, rules for avoiding risk situations are more difficult to effectuate. Therefore the daycare center was completely look down for a long period and thereafter had stringent rules.

The achieved SUS-score from the expert is on the low side of the marginal grade between "Acceptable" and "Not Acceptable" and gives F on the Grade Scale. While the average SUS-score of 66.25 is right between the low and high end of the marginal grade and provides an D on the Grade scale. The average score gives an D on the SUS-score and is almost an acceptable score. Both of these results are a below-average score, something expected from a system that is not quite ready for deployment. However, research shows that individuals with ID often requires assistance from institution staff or family members when performing activities. Because of this, the usability justifies saying that the system is user-friendly for individuals with ID, despite the low SUS-scores.

We did know from the research that individuals with ID often receive assistance from institution staff or family members when performing different activities. Taking this fact into the usability assessment justifies saying that the system is user-friendly for individuals with ID, despite receiving low SUS-scores in some of the forms.

The distribution of the SUS-scores (Figure 5.2) shows that there where four statements that did stick out negatively. These statements were:

- Statement 2: ”I think an individual with an ID will think the system is unnecessarily complex.”
- Statement 3: ”I think an individual with ID found the application to be was easy to use”
- Statement 4: ”think that an individual with an ID would need the support of a technical person to be able to use this system.”
- ”Statement 10: ”I think an individual with ID needed to learn a lot of things before they use the application.”

Statements 2 and 3 are about the complexity of the system. All compartments of the settings part of the application are complex. Face recognition, adding videos, etc. can be hard and complex, which will make the system hard to use. Statement 4 requires the user to have a technical person beside them when they use the application. To start up the app and chose video can be difficult, but when first started, it is easy to use. Usually, this user group demands specialized learning in many aspects of self-care, so no matter how secure an application is, it will require some level of learning.

The addition of a multi-user system that can separate users and make them track their bicycle activity is useful for families that have an individual with ID and for daycare institutions. The previous testing at the daycare center showed that multi-user functionality was much appreciated. The users could compete with each other by tracking individual data, and they could customize videos for their users.

The general feedback showed promise for the application, as it is a cheap option because most people either have a normal or an ergometer bicycle at home. Then all that is required for the system is the sensor and the tablet. Many individuals with ID like to ride a bicycle, which adds to the motivating aspect of the application. By already enjoying bicycling, there is a lower chance for the individual to be reluctant to try out the system. By being an application designed for individuals with ID, the design needs to be user-friendly. A password-protected account cannot be included because it would be demotivating for an individual to go through a long sign-in process before starting to do the PA. Therefore an easy option to click their picture to log in is used. Short text and big symbols are essential when designing an application for individuals with ID. However, the design could have room for improvement as the contrasts between the game choices can have higher variations. Adding different content of entertainment is also an addition that is good for the user. Users like to have opportunities, and by using something familiar to the user(YouTube), they will have a higher chance of using the system. Having the zoo animals is good because it will be a rewarding system that will motivate the user to be active every day. However, by not having the opportunity to turn of losing an animal when not being active, it can have the opposite effect on the user. There might be other aspects of life, for example, family deciding to go to their grandparents for a day, which makes the user lose an animal in the zoo. This can be devastating for the user's motivation, and that's why the option to shut this functionality off is essential.

6.3 Research Problems

6.3.1 Main research problem

How to motivate individuals with intellectual disabilities to do PA with exergaming and indoor bike cycling?

The project's main goal was to create an exergame that motivates individuals with ID to do PA. The system should make the "cost" of using the game lower than that of doing passive activities. It should be fun and more engaging to do than other idle activities. The game aspect of this is to watch videos, something everyone loves. Bicycling is also something many individuals with ID already enjoy, making it easier for the user group to engage and try out the system.

It is essential to understand the design choices needed to motivate individuals with ID. These design choices that were made throughout the game development is archived through seminars, discussions with experts in the field, and institution staff. A simplistic design, with symbols and short text, is essential. This user group also enjoys getting rewards for their achievements. The main problem is divided into two subproblems to emphasize different parts of the problem.

6.3.2 Sub problem 1

What type of exergame elements would motivate individuals with intellectual disabilities to use a stationary bike?

Through research on individuals with ID and technology and through previous testing on this project. I learned that individuals with ID enjoyed watching videos, movies, and music videos. YouTube is an application that is used much by this user group. The content of entertainment with videos is vital to motivate individuals with ID. The content should be dynamical to suit all different users.

Rewarding users during and after the activity session is essential for this user group. Constant approval and reminders can help to do the activity more efficiently.

6.3.3 Sub problem 2

How can you design an exergame to make it suitable for multiple individuals with intellectual disabilities on a single device?

Designing an exergame to make it suitable for multiple users can be hard if you want to separate the users safely. The design needs to be easy to understand and not make the complexity of the application unmotivate the user.

By hiding a login function so that the users can log in with face, recognition is the preferred solution; however, this was not wholly included in the implementation.

6.4 About the research method

I choose the research method Computing as a discipline as introduced in chapter 3. The iterative process while designing the system were both requirements and design choices were edited during the development. This was a right choice of model for this thesis.

6.5 Literature Review

The literature review included 14 articles. There were not many articles that were relevant when searching for individuals with ID and exergaming. This indicates that this user group needs more studies on improving their PA with mHealth applications. Several of the included studies were about individuals with Autism Spectrum Disorder (ASD), which necessarily does not mean that they have ID.

6.6 Designing an application for individuals with ID

The main challenge with this project is the process of designing a product for a user group that might have a very different perspective than me on technology. There are tremendous diversities within the user group, where one individual might be able to read and not need much help with tablets, but another might have more skills. Individuals with ID also have higher chances of struggling with other health conditions like epilepsy. They have higher chances of diabetes, and many have problems with reduced vision. All of these factors have to be taken into consideration when designing an exergame for this user group. To reach the end product, the information gathered in the literature review and discussion with professionals was essential for finding solutions.

Designing a user-friendly application is very important. Having essential aspects of the application to be automatic increases users' chances to continue using the app. As mentioned earlier, big icons and short text are imperative. It is crucial to convey precise information to the user. Each page should not contain loads of information, but rather be limited. Contrasts and familiarity are also significant when designing applications for this user group. It is also important to motivate individuals with ID with rewards during and after activity.

6.7 Testing

I did not complete the planned testing because of the Covid-19 situation. Therefore I did not ask for written consent to participate in test phases. There was no opportunity to test the system with the user base because of strict restrictions with physical contact.

The results gathered from the daycare center are from a previous iteration of my capstone project and did not include several new features. This is unfortunate as these functions previously were suggested as improvements to the system by the daycare institution. Both of the SUS-score results were gathered through interviews. Using interviews can add risks of bias opinions, which is not wanted.

The plan was to test and compare the results with another study similar to this project [7]. The other project [7] tested a bicycle application where they showed a video to adolescents with ID, and got a significant increase in willingness to perform pedaling activity while watching a preferred video during the pedaling activity. If I had tested this this during development, there would be a reason to think that a similar result would also apply to this application.

Despite limitations to system testing, the results conducted from the expert and the daycare institution still have credibility. This is because the opinions gathered are from people with broad experience with individuals with ID. They know what works and what does not work for this user group.

Chapter 7

Conclusions and Further Work

This chapter includes both the conclusion and some suggestions for further work.

7.1 Conclusions

With this thesis, I have shown that developing an application for individuals with ID is challenging, but not impossible. Several requirements are devised through research, previous feedback, and expert knowledge. Several of these requirements are included in the final product. I have made it possible for several users to use the system with only one tablet. A multi-user system is implemented so that families and daycare centers can motivate individuals with ID through engaging in the same application. I have worked with the design and made simplified solutions with simplified text and large icons. I have extended the user capabilities and included separate user storage. I have added the face recognition tool so that face recognition can be added to further development. The system also gives the users several options. I have included YouTube videos and reward systems that can motivate individuals with different interests.

This project lays the foundations for further work towards exergame solutions for individuals with ID. The research from this project provides valuable information on individuals with ID and some mHealth solutions that encourage PA.

7.1.1 Motivation to Physical Activity

Research shows that individuals with ID are struggling with sedentary lifestyles, and they have higher chances of diabetes and obesity than the rest of the population. To support motivation to perform PA for people with ID is essential. This is something that parents or institution staff can struggle with, and making a system where the enjoyment of the system support motivation to perform PA is essential. By promoting this system, individuals with IDs might succeed to increase the level of PA. If the system can motivate individuals with ID to engage in more PA, it can help against sedentary lifestyles.

7.2 Further work

7.2.1 Face recognition

The face recognition tool included in the project needs to be included and stored in the game state. An automatic login would benefit this user group as it would simplify the system's usage, making it more available for individuals with different levels of ID. It would be beneficial and more adaptable among the differences this user group has.

7.2.2 Possibility to pause and resume the video in the next session

All of the media content in the application should have a possibility to save state between activity sessions. Requests from previous iterations have been to include the possibility to pause long movies or videos, and continue them on later sessions. This might increase motivation because they can look forward to continuing a movie they are watching, and come back to the next meeting quicker than planned. It is probably not enjoyable to restart the same video repeatedly and never finish it because the activity session does not last long.

7.2.3 Cloud

With cloud integration, several opportunities present itself. This thesis is a sub-project, and in the principal project, a study where the activity data of several users is stored. It would be easier to gather this data from the cloud instead of retrieving this from the tablet.

By integrating with the cloud, there could be an administration web page where parents or institution staff could change the user configurations. Configurations like user videos, YouTube preferences or playlists, and activity goals can be changed.

Both the cloud integration and the high score list were requirements that were not included in the final solutions. A high score list would allow users to compete with each other. This might increase motivation and make the exergame more desirable to play. Either this high score list can be everyone registered on the device, or users could be added to a high score list set up by either a family member or an institution staff member.

7.2.4 Game mode

Increasing opportunities in the application are always wanted, and adding a game mode where there are possibilities to collect animals or words when riding a bicycle through a landscape would be good. A learning element could be added to the application by having a game where the user collects letters in a word that would be good.

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Appendix

Appendix A

Source	**Search term**	**Found**	**Hits**
Scopus	((TITLE-ABS-KEY (intellectual AND disability) OR TITLE-ABS-KEY (developmental AND disabilities) OR TITLE-ABS-KEY (mental AND handicap) OR TITLE-ABS-KEY (autism) OR TITLE-ABS-KEY (downs AND syndrome)) AND (TITLE-ABS-KEY (exergame) OR TITLE-ABS-KEY (video AND game) OR TITLE-ABS-KEY (video-game) OR TITLE-ABS-KEY (gamification) OR TITLE-ABS-KEY (application) OR TITLE-ABS-KEY (app)) AND (TITLE-ABS-KEY (physical AND activity) OR TITLE-ABS-KEY (fitness) OR TITLE-ABS-KEY (exercise) OR TITLE-ABS-KEY (bicycle) OR TITLE-ABS-KEY (workout) OR TITLE-ABS-KEY (ergometer AND bike)))	300	13
IEEE Xplore	(("intellectual disability" OR "developmental disabilities" OR "mental handicap" OR “autism” OR "downs syndrome") AND("exergame" OR "video game" OR "video-game" OR “gamification” OR "application" OR “app”) AND ("physical activity" OR “fitness” OR “exercise” OR “workout” OR "bicycle” OR “ergometer bike”))	19	5
PsycINFO American Psychological Association	((intellectual disability or developmental disabilities or mental handicap or autism or downs syndrome).ab. and (exergame or video game or video-game or gamification or application or app).ab. and (physical activity or fitness or exercise or workout or bicycle or ergometer bike).ab.)	19	5
APA PyscNet	(Any Field: intellectual disability OR Any Field: developmental disabilities OR Any Field: autism OR Any Field: mental handicap OR Any Field: downs syndrome) AND (Any Field: exergame OR Any Field: app OR Any Field: application OR Any Field: video game OR Any Field: video-game OR Any Field: gamification) AND (Any Field: physical activity OR Any Field: bicycle OR Any Field: ergometer bike OR Any Field: exercise OR Any Field: workout OR Any Field: fitness)	4	0
PubMed	((intellectual disability[Title/Abstract]) OR (developmental disabilities[Title/Abstract]) OR (mental handicap[Title/Abstract]) OR (autism[Title/Abstract]) OR (downs syndrome[Title/Abstract])) AND ((exergame[Title/Abstract]) OR (video game[Title/Abstract]) OR (application[Title/Abstract]) OR (video-game[Title/Abstract]) OR (gamification[Title/Abstract]) OR (app[Title/Abstract])) AND ((physical activity[Title/Abstract]) OR (fitness[Title/Abstract]) OR (exercise[Title/Abstract]) OR (workout[Title/Abstract]) OR (bicycle[Title/Abstract]) OR (ergometer bike[Title/Abstract]))	23	5
ACM Digital Library	[[All: "intellectual disability"] OR [All: "developmental disabilities"] OR [All: "mental handicap"] OR [All: "autism"] OR [All: "downs syndrome"]] AND [[All: "exergame"] OR [All: "video game"] OR [All: "video-game"] OR [All: "gamification"] OR [All: "application"] OR [All: "app"]] AND [[All: "physical activity"] OR [All: "fitness"] OR [All: "exercise"] OR [All: "workout"] OR [All: "bicycle"] OR [All: "ergometer bike"]]	359	6
Web of Science	(TS=(((intellectual AND disability) OR (developmental AND disabilities) OR (mental AND handicap) OR autism OR (downs AND syndrome)) AND (exergame OR (video AND game) OR video-game OR gamification OR application OR app) AND ((physical AND activity) OR fitness OR exercise OR workout OR bicycle OR (ergometer AND bike)))) AND LANGUAGE: (English)	165	17
Sum		**989**	**51**

Appendix B

Spørsmål om sykkelappen.

Tilfredshet.

Disse spørsmålene er for å høre hva du tror om hvordan sykkelappen er å bruke for personer med psykisk utviklingshemming.

1. Jeg tror personer med psykisk utviklingshemming vil bruke systemet jevnlig.

Veldig uenig — Veldig enig

1 2 3 4 5

2. Jeg tror en person med psykisk utviklingshemming vil synes systemet er unødvendig komplisert.

Veldig uenig — Veldig enig

1 2 3 4 5

3. Jeg tror en person med psykisk utviklingshemming vil synes systemet er lett å bruke.

Veldig uenig — Veldig enig

1 2 3 4 5

4. Jeg tror en person med psykisk utviklingshemming vil trenge støtte fra personell for å bruke appen.

Veldig uenig — Veldig enig

1 2 3 4 5

5. Jeg tror en person med psykisk utviklingshemming vil synes de forskjellige delene av systemet henger godt sammen.

Veldig uenig — Veldig enig

1 2 3 4 5

6. Jeg tror en person med psykisk utviklingshemming vil synes det var for mye inkonsistens i systemet. (Det virket ulogisk)

Veldig uenig				Veldig enig
1	2	3	4	5

7. Jeg tror en person med psykisk utviklingshemming vil lære seg fort å bruke denne appen.

Veldig uenig				Veldig enig
1	2	3	4	5

8. Jeg tror en person med psykisk utviklingshemming vil synes appen er vanskelig å bruke.

Veldig uenig				Veldig enig
1	2	3	4	5

9. Jeg tror en person med psykisk utviklingshemming vil føre seg komfertabel med å bruke appen alene.

Veldig uenig				Veldig enig
1	2	3	4	5

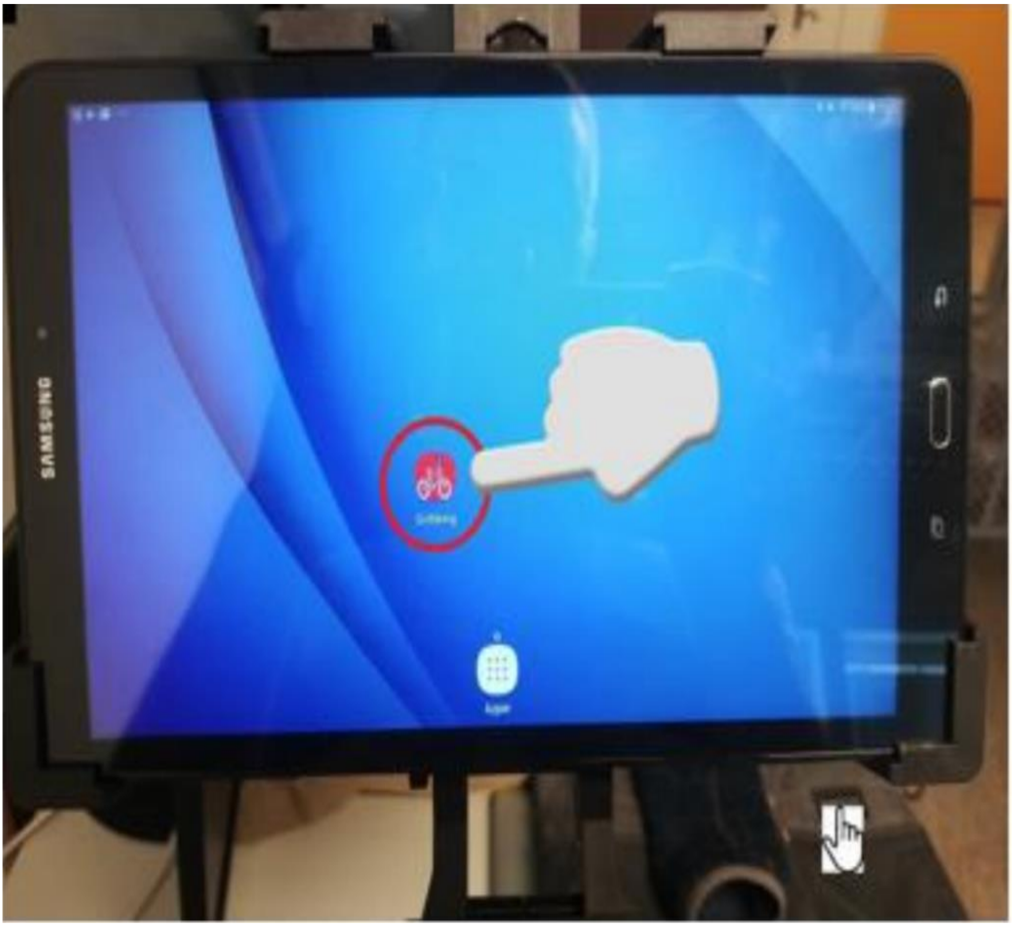
10. Jeg tror en person med psykisk utviklingshemming må ha en omfattende opplæring for å bruke appen.

Veldig uenig				Veldig enig
1	2	3	4	5

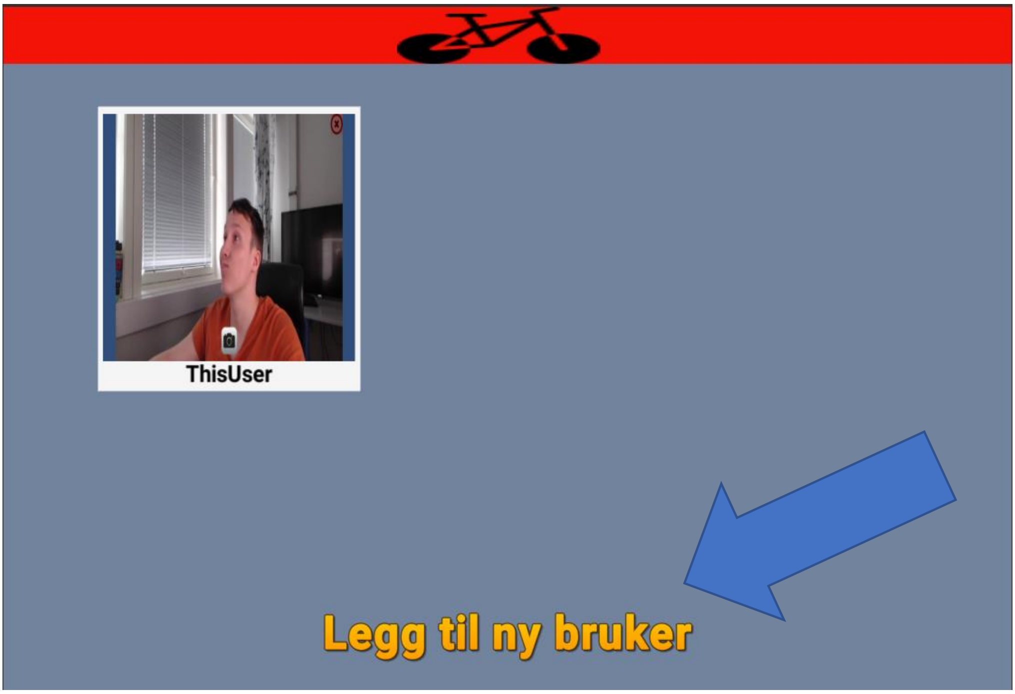
Appendix C

Brukermanual MoviCycle

1: Åpne tablet og trykk på MoviCyle app:



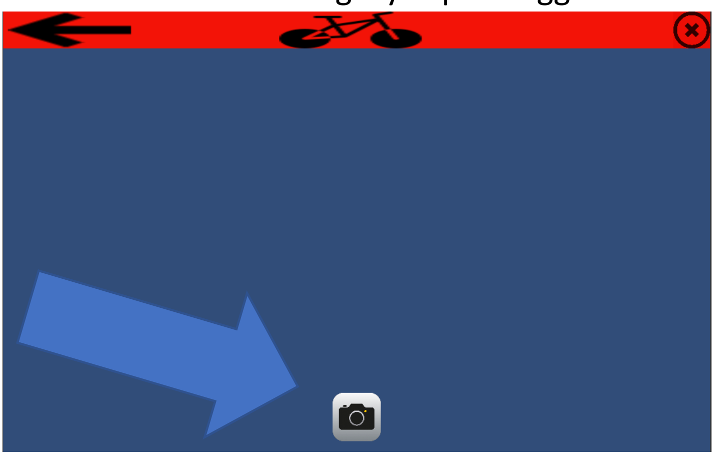
2: Vent til du ser denne siden



Trykk på «Legg til bruker» dersom du ikke har en bruker registrert på deg.

3: Lag en bruker

Skriv inn navn i feltet og trykk på «Legg til bruker».



Trykk på «Ta nytt profilbilde» dersom du vil legge til et bilde til profilen din.

For å ta bilde, trykk på «Kameraet»

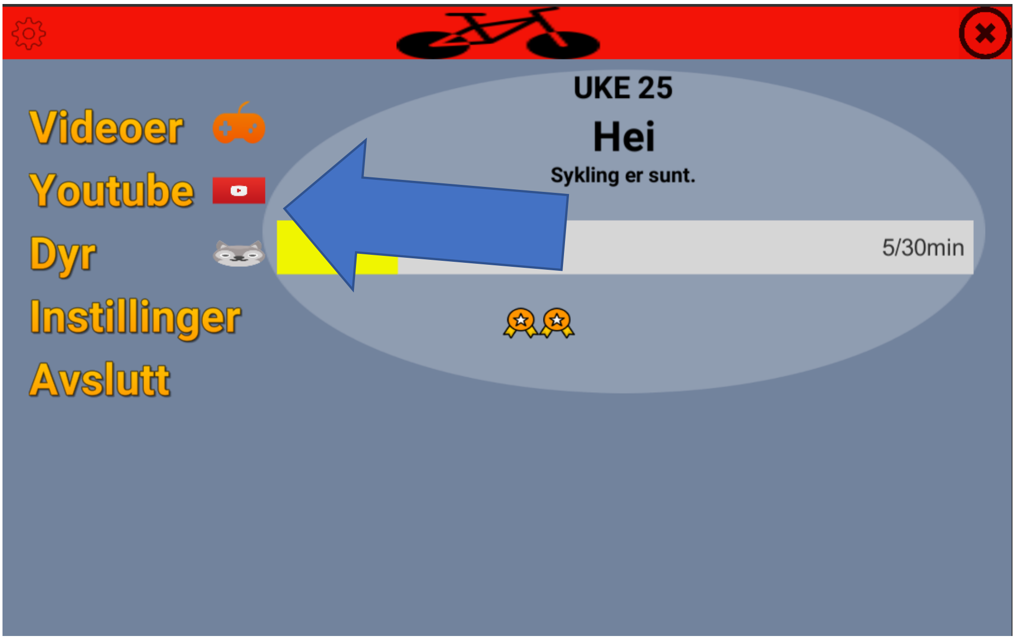
4: Logg inn på din bruker

Trykk på din profil for å logge inn på din bruker.

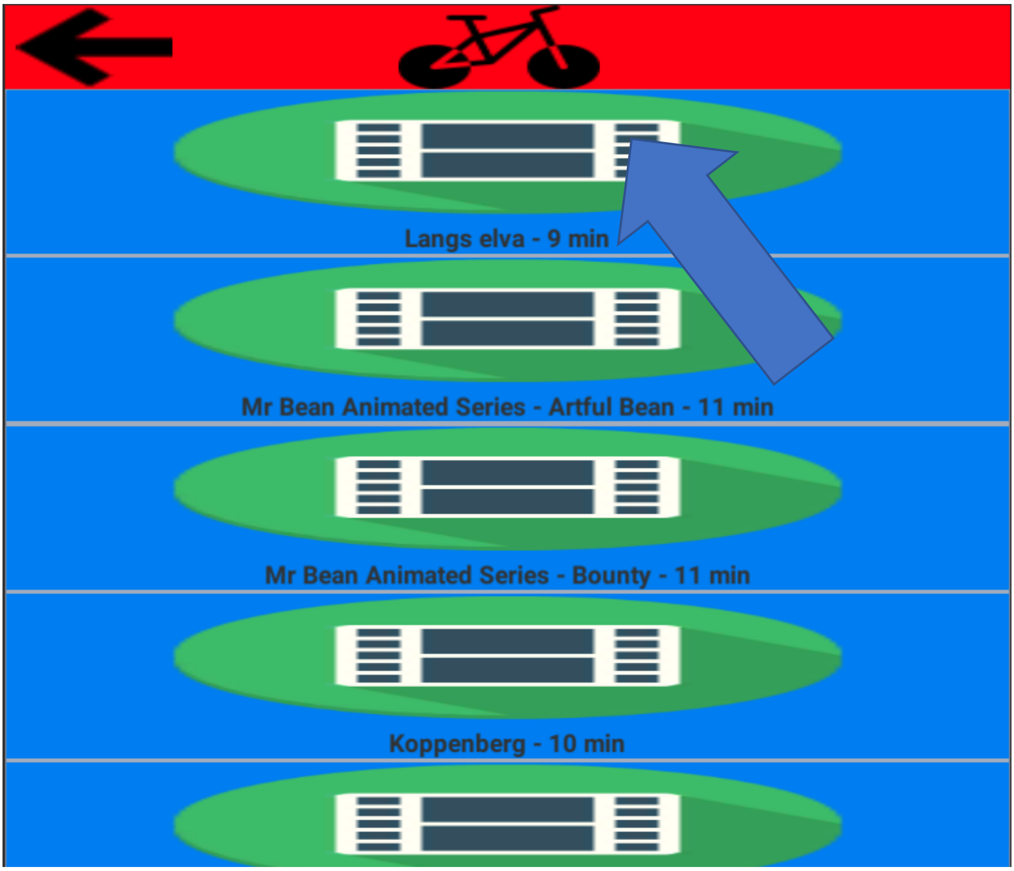
5: På hovedsiden er det flere valg.

Du kan velge mellom:

- Videoer lagret på Tablet,
- Youtube videoer
- DyreHage

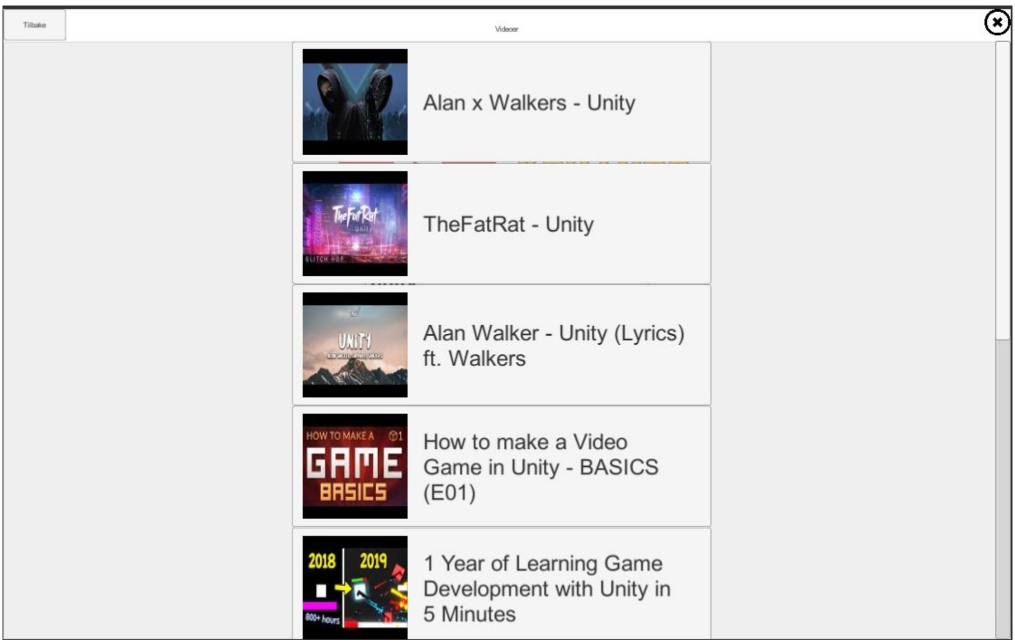


6: Dersom du trykte på Videoer, kan du velge mellom videoene tilgjengelig.

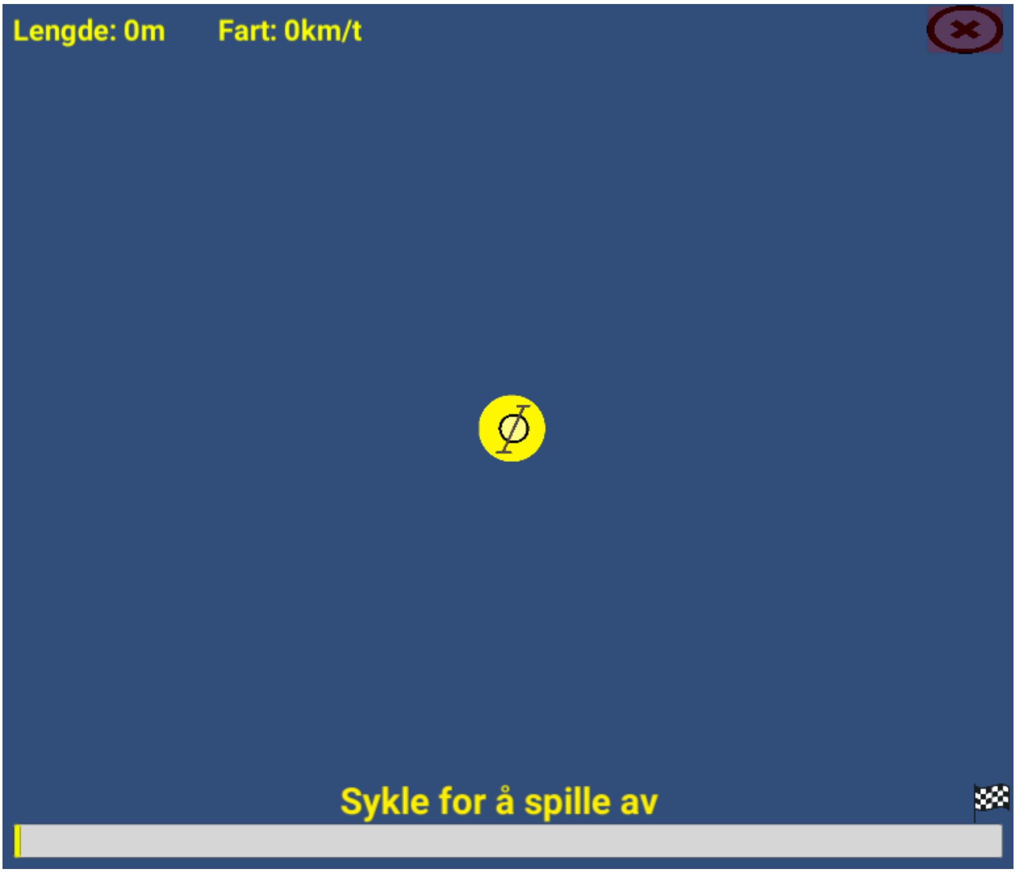


7: Dersom du trykte på Youtube, kan du søke etter den videoen du vil se

Velg deretter video fra listen som kommer opp.

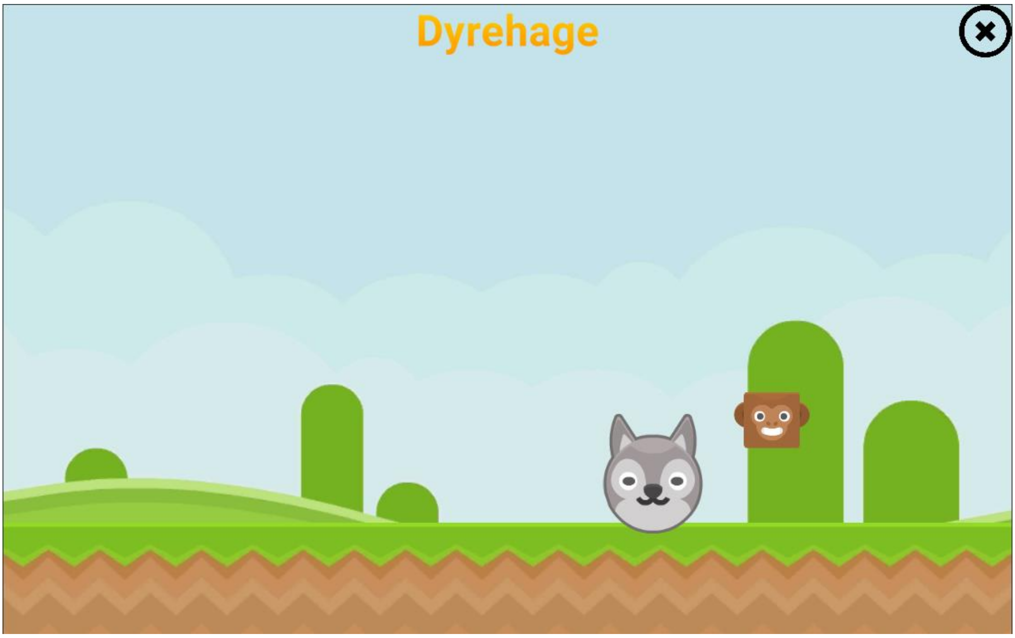


8: Start å sykle når video er valgt

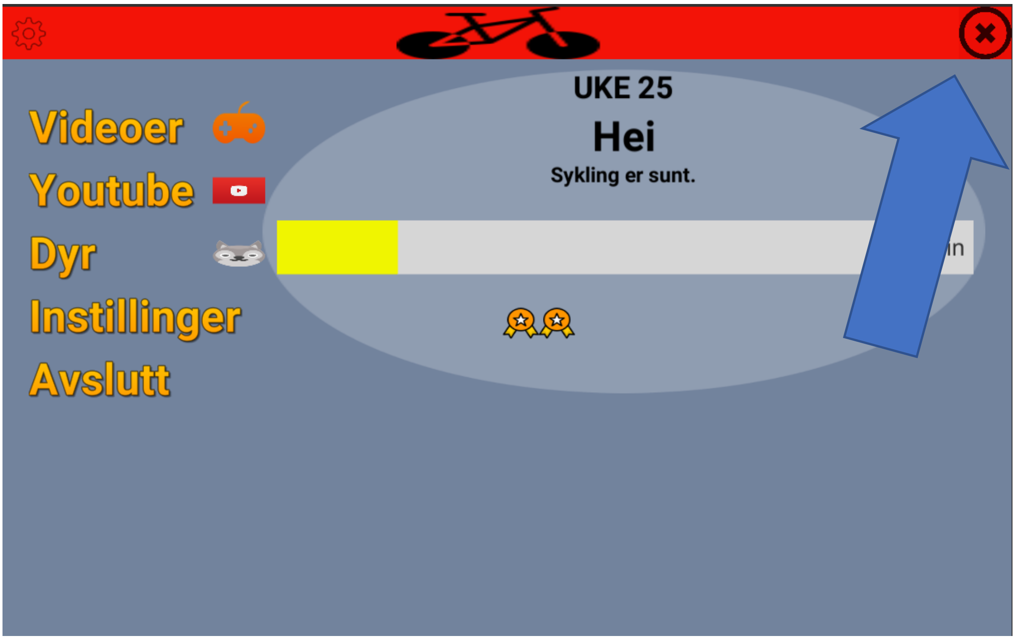


9: Dyrehage:

Du blir belønnet av å sykle hver dag. De som oppnår målet sitt for hver dag, vil få et nytt dyr i dyrehagen. Men dersom du ikke sykler noe, vil noen av dyrene gå til noen andre som sykler mer.

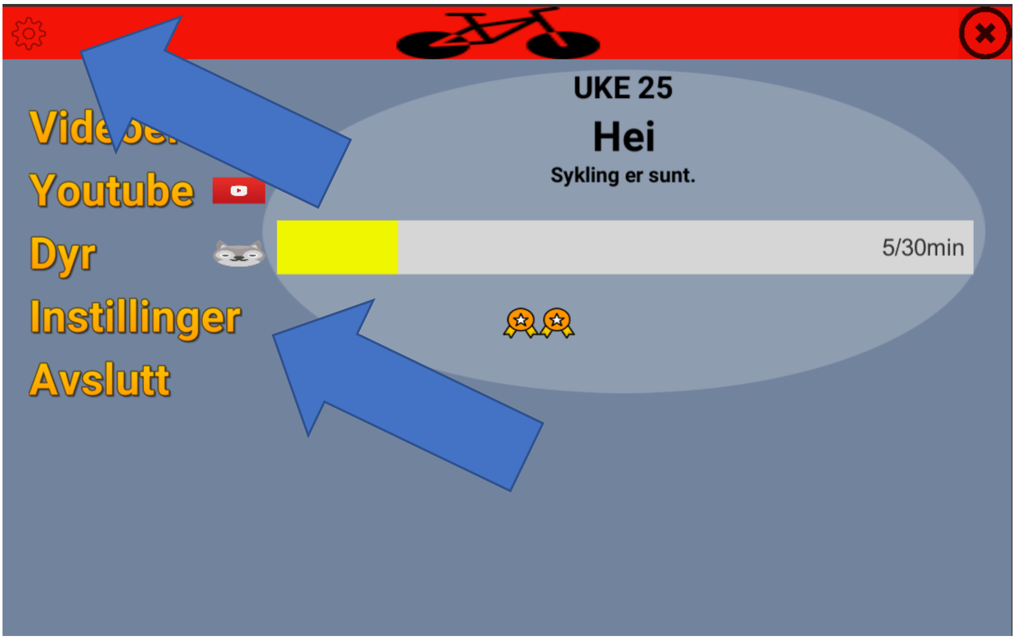


10: Logg ut av app:



Trykk på «X» i høyre hjørne for å logge ut av app.

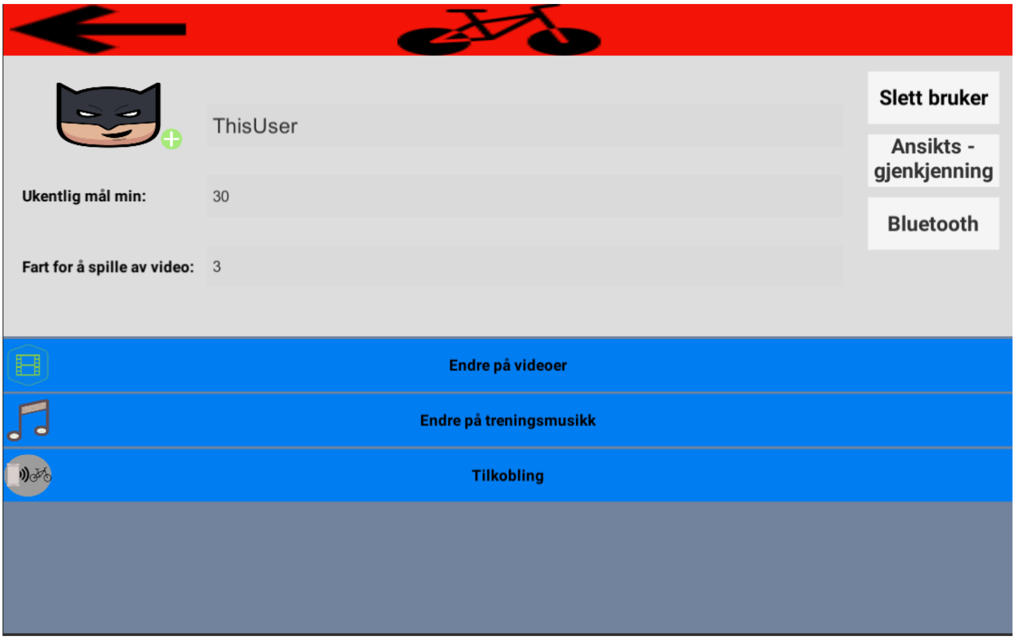
Brukermanual for innstillinger av MoviCycle



Gå til innstillinger ved å trykke på tannhjulet oppe til venstre på startsiden, eller på instillinger knappen på siden.

Endre brukerinstillinger:

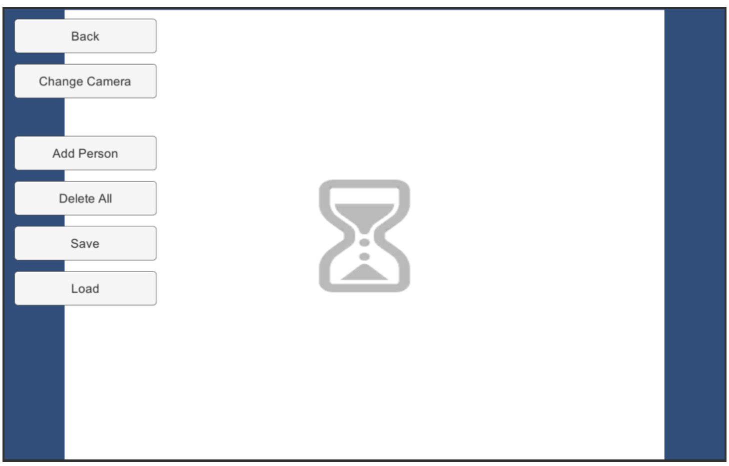
For å endre på dine brukerinstillinger/treningsmål, så kan man skrive inn ønsket innstilling i det feltet som man vil endre.



Trykk på knappen «Slett bruker» for å slette din bruker.

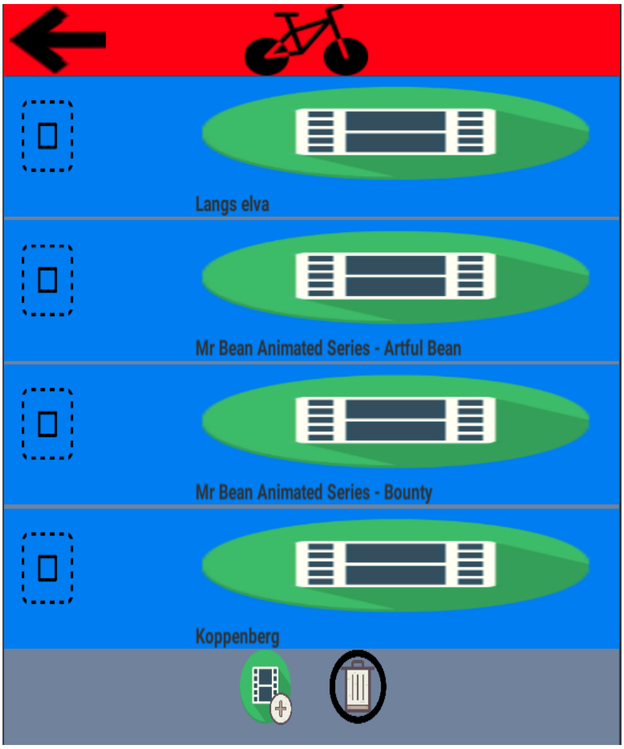
Trykk på knappen «Bluetooth for å sjekke din tilkobling»

Trykk på knappen «Ansikts-gjennkjenning» for å trene appen til å gjennkjenne ditt ansikt.



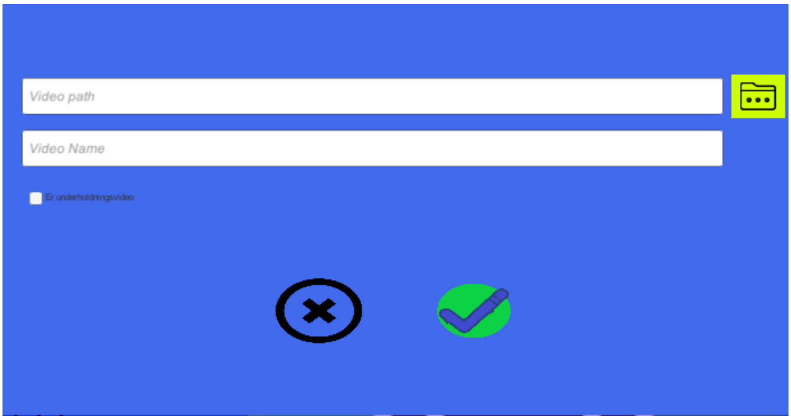
Endre på videoer tilgjengelig

Trykk på knappen «Endre på videoer» for å åpne et vindu som lar deg redigere hvilke videoer som skal være tilgjengelig i appen.



For å slette videoer ifra appen, velg en eller flere videoer med å trykke på de og trykk på «søppelbøtteknappen».

For å legge inn flere videoer, trykk på grønn kanpp med videofilm og et pluss-tegn. Finn en video på enheten ved å trykke på mappe figuren og let frem videofilen i filutforseren som dukker opp. Gi så videoen et passende navn og velg om det er en underholdningsvideo eller en «sti-video» og trykk på grønn sjekk-napp.



*Sti-videoer vil spilles av i en hastighet som gølger målt hanstighet på syklingen. Det vil også spilles musikk under treningsøkten.

Endre på musikk i spillelisten

Trykk på «Endre på treningsmusikk på instillingssiden for å åpne redigering av spillelisten. Trykk og huk av en sang for å legge den til i spillelisten. For å fjerne tilgjengelige sanger fra valglisten kan de velges for så å trykke på søppelbøtten. For å legge til flere sanger, trykk på noteknappen med pluss-tegn. Let så opp sangfiler på enheten med å åpne filutforskeren på samme måte som i redigering av videolisten.