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# 1 Introduction

Physical exercise provides health benefits including muscular strength, improving cardiorespiratory fitness and weight maintenance. These health benefits can reduce and combat diseases. Despite of all these health benefits, around 31% of adults aged 15 and over do not get sufficient physical exercise [2]. It is also identified that physical inactivity is now the fourth leading risk factor for global mortality. According to WHO (World Health Organization) [1]there are clear health benefits associated with physical exercise; "there is conclusive scientific evidence, based on a wide range of well-conducted studies, showing that physically active people have higher levels of health related fitness, a lower risk profile for developing a number of disabling medical conditions, and lower rates of various chronic noncommunicable diseases than do people who are inactive".

## 1.1 Idea

There are many different fitness apps available today. These apps have different features. Some are helping people setting up plans, logging and collecting workout data or accounting for calorie consumption/burn. Many also include coaching features to motivate the user. Other apps offer workout music playlists, competition, or reward features. While there are currently many fitness apps, there are not many fitness game apps available. However, we think fitness games will be more motivating for some people than the regular fitness apps, and we think such apps will be common in the future.

## 1.2 Goal

Based on this information, the group will be developing an exercise game app prototype to encourage people to start and maintain physical exercise. It works by combining workout with games as well as giving the possibility of interacting and competing with other players. It will be implemented as a mobile application using the Global Positioning System (GPS) for positioning information which will be used for calculation of other statistics.

## 1.3 Research question

Our research question is to examine how gamification can foster motivation in exercise context. This will be done by examining different aspects of motivation through gamification.

# 2 Literature Review

In this section we will look at some of the previously done work related to gamification and motivation connected to physical exercise.

**The article Psychological Perspectives on Motivation through Gamification** by Michael Sailer et al. is a theoretical article that describes general definition of gamification and analyze about motivational pull of gamification from a psychological perspective[8]. The main purpose of this article is to adopt different perspective of view on the topic of gamification in order to investigate the motivational mechanisms. Further, there are description about typical game elements used in gamification and each game elements is matched with suitable motivational mechanisms.

According to Deterding, S et al. the gamification conceptually can be defined as “the use of game design elements in non game contexts”. Since the definition of gamification covers very wide area, the gamification has been used in different contexts and some applications seem to have positive effects regarding motivation and learning. The main components of the gamification are game elements, which describe the specific and characteristic components of games that can be applied in gamification. There have been different approaches to create the lists of game elements. In this article, they provide a list of nine typical game elements that contains points, badges, leaderboards, progress bars, performance graphs, quests, meaningful stories, avatars and profile development. These game elements are discussed and used to investigate different motivational mechanisms from different perspectives.

The article describes six principal perspectives, which can become relevant within gamification, the trait perspective, the behaviourist learning perspective, the cognitive perspective, the perspective of self-determination, the perspective of interest and the perspective of emotion. Each perspective concentrates on different components, which become relevant in different degrees depending on the focus of the perspective. The article analyzes these perspectives and investigates different motivational mechanisms that describe which component gives motivation to different users in different situations, and how.

Since we are going to make a fitness game application, which has a social-competitive aspect, these motivational mechanisms give us useful information about which game elements do we need to give more motivations to different users. As simple examples, the motivational mechanism “Players are likely to be motivated if gamification offers rewards” from behaviourist learning perspective, and the motivational mechanism “Players are likely to be motivated if they experience the feeling of social relatedness” from perspective of self-determination, tell us respectively the game elements “Points” and the game element “Leaderboards” have potential to give users more motivations. Further, these game elements will be used to make questions of our research survey.

**In Social Motivations To Use Gamification** Juho Hamari and Jonna Koivisto looks at how social factors can be used to predict attitude towards gamification[6]. They refer to social influence as “an individual’s perception of how important others regard the target behaviors and whether they expect one to perform that behavior”. Where the behaviour is the use of gamification to motivate oneself to exercise. They hypothesise that the more strongly a

person believes that others expect and support certain behaviour, the better it feels to conform to those expectations. And when such a behaviour can be met, the social influence will have a positive effect on the attitude toward the service. They tested this thesis with 107 people who were using a training service called “Fitocracy” the exercise: “activities earn you points. Points lead to level ups. Earn badges for significant achievements. The community will reward your hard work with props” where the users were given the option to give each other “likes” or comments on good work. Their results confirmed this theory that social influence positively influences a user’s attitude directly, with social factors accounting for 56.5% of the variance of attitudes towards using a gamified service. There is a place for discussion concerning if giving a “like” might not improve the service if the user does not feel the need to giving/receiving a like themselves. Understandably this would be able to change with the use of a larger network or people closer to the user being the ones giving the comments or “likes”.

### **Negotiating Privacy Boundaries in Social Applications for Accessibility Mapping**

As we mentioned above, we are going to make an application that provides a kind of social networking service. Since this kind of application usually deals with personal information of users, we could get useful advices from the article “Negotiating Privacy Boundaries in Social Applications for Accessibility Mapping” by Harald Holone and Jo Herstad[5]. This article discusses about privacy issues that arises in process accessibility mapping, by describing existing practice for sharing information about physical accessibility among wheelchair users, and compare that with new practices that using ICT, the mobile, collaborative route planning concept OurWay, which is described in detail in another article of Harald Holone, “Aspects of Personal Navigation with Collaborative User Feedback”[10]. In this context, the notion of privacy is not about law, but experienced privacy.

The article introduces three boundaries central to the negotiation of information disclosure, which is proposed by Palen and Dourish. The first boundary is the disclosure boundary, about what information to share and what to keep from others. The second boundary is the identity boundary, which is defined by the role taken on by the user. Finally, the temporal boundary discusses the effects of persisted information. Through this article, these boundaries are used to discuss about negotiation of privacy in different situations, by presenting anecdotes of different users as examples.

In summary, the article proposes three suggestions or recommendations of negotiation of information disclosure. 1) The negotiation of what information to disclose must be left to the user, and traces of the user’s activities must be negotiable by the user at any time. 2) The system must be open to the result of the negotiation. 3) The issues about who owns the service and associated contributed data, and who can change, must be publicly addressed to users prior to joining such a social service. These suggestions will be taken into account in our app design, in particular registering service and handling user information.

**Role Playing in Concept Design of Mobile Services and Devices** In the article: On the Move with a Magic Thing: Role Playing in Concept Design of Mobile Services and Devices, they take a look challenges faced by creating new concepts for new mobile services at the design level[7]. The article looks at PD(Participatory design) and develop two participatory techniques. “The two techniques are organized around situations either staged or real where users and designers can envision and enact future scenarios: a role-playing game with toys, and SPES (Situating and Participative Enactment of Scenarios).”

In the roleplaying game with toys, the designers organized groups with users, to enact out different games with specific rules. Each game were set in a specific environment where the “players” enacted out different situations through role-playing with toys. Dices were used to create some unpredictability with different in-game game setups. Situation cards were used to create different happenings during the gameplay. The designers took minor side roles while also explaining how to play the game. By using this technique the designers were able to look at different situations that may occur in scenarios often hard to replicate in the “real world”.

During the SPES technique a user is given a simple mock up device and are set to interact with the device during their regular day. A designer shadows ,takes notes and asks the user of the different situations the experience. The mock up helps the designer witness different situations that may occur with the application during a normal day for the user. The situations may be created either by the designer deliberately or by the user. This technique lets the designer visualise different ideas rather than just storyboarding.

The articles gives us new light on how to conduct different tests and scenarios with users to gain information in creative ways. For our project the use of role playing is not convenient due to the fact that we have limited time and resources. However some of the techniques used in the SPES testing may be used. We may not be able to follow a user around for 2 days at the time, but we can create a mockup of our future applications and see how the user interacts by themselves and by us creating scenarios. By letting the user use a mockup of our application we can analyze what of our design works and what improvements should be done for further improvements.

**Gamification dynamics in app development** In article gamification dynamics in app development[4]. Kate Abrosimova propose how integration of technology effects on human behaviour by using some mobile app. The focus of the theory was on the behaviour of people in accordance with their socially influenced affinities. Through gamification people like to share their achievements and to feel as if they have a mission when using an app. Related to this study gamification dynamics in app development are the intentions of a population in adopting a new advance mobile application. Also within the framework of behavioural control, potential access related difficulties could play a major role. Gamification features are one way to increase engage with mobile app. Reward systems are widely used in games, but there are certain game dynamics that be

integrated into the overall mobile app user experience.

## 3 Research and Method

In this section we will look at how to best continue the development of our application. We are following the classic design lifecycle where we start by determining needs and establishing requirements. We have gathered data by creating an online survey as well as looking over different personas.

### 3.1 Personas

We created a few personas to assist in deciding and understanding the user group:

Pierre: A married 33-year old gym teacher, from Nice, France. Loves to go cycling in the mountains. He likes to set for himself real long term goals while training. He would love to motivate his wife to join him to go training with him. To have a common goal they could work together towards.

Per: 24 year old student. Per lives in a shared accommodation with 3 of his friends. Per is a very competitive man and loves to compete with his friends in everything. He would like to start exercising more outdoors in form of running but need some form of challenge to do so.

Silje: 35 year old programmer from Trondheim. She is always on the lookout for new ways to exercise but struggles to find motivation to stay on the different programs. She has tried some different training apps before but struggle to find the inner motivation to stick with these.

Hank: 52 year old man from California, USA. Hank works as a car salesman and have been doing that for 20 years. His work doesn't offer him much exercise in his everyday life. He is interested in starting to exercise so he could take more care of his health. He isn't a very practical person when it comes to new technologies so a training app might be more of a challenge than assistance.

Frank: 35 year old man from Bergen, Norway. Frank works as a personal trainer. His day job requires that he stays fit. He has used and uses a lot of different training apps but is on the lookout for a good motivation app for cardio training mostly for his clients. He has no issues himself with motivation, but rather looks for a good way to set goals and store information about his cardio exercises. Also finding a way to set goals for his clients they can follow when the train on their own.

### 3.2 Persona analysis

Pierre who is trying to motivate his wife to go training with him would like to have features that would allow him to have a common goal with others. And



also have features that would allow him to bring include his class on. Pierre would also like the app to be in his native language.

Per would like to have some challenge features into the app. Since Per is a very competitive guy he would like to have some ways to challenge his roommates to reach certain goals first.

Hank who is not well known in the use of smartphone applications would like it to be very user friendly with some introduction tutorial for explaining how to use the it. Since he is knew to doing regularly exercise he would like it to be easy to set partial goals to see some progress towards a greater goal. A possibility of setting up a training schedule with a notification system to remind him of when he should exercise.

Frank is looking for a feature so he can organize his clients training. A way that he can monitor clients progress and set up plans for them. The app needs to be easy to use for the clients so that they can be able to start using it without much hassle.

Silje needs an app that can keep her motivated. By giving her partial goals and achievements for them. Also a social aspect would be nice to keep an extra motivational pull.

The personas gives us an idea of what different features/design choices that are important for different users. By analysing the different needs of the personas we can make design choices that matches some of the requirments/needs they have.

## 4 Findings

We surveyed 88 people about their training habits and their relation to training applications to give us a better insight to how we should develop our application. The majority of the people who answered the survey (91%) were in the age group 20-35 years.

## How old are you?

	19 or younger	20-25	26-35	36 or above	Standard Deviation	Responses
All Data	2 (2%)	52 (59%)	28 (32%)	6 (7%)	19.95	88

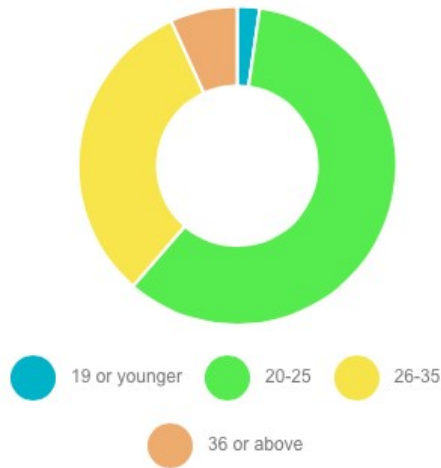


Figure 1: Age groups of survey participants

WHO describes recommended physical activity of adults (18-64 years old) to be 150 minutes per week, which comes out to an estimate of 8 training session in a month. And 300minutes (16 times in a month) to achieve all health benefits given from training. (this is training with moderate intensity, with high intensity training time needed would be the half)[1]. Looking at the results we can see that 45% of the participants does not meet the minimum requirement. And only 11% achieves all of the benefits from training. (for simplicity we look at moderate intensity training as the average training form, this could vary from user to user.)

## Average how many time do you exercise in a month?

↶	0-2 times	3-5	6-9	10-15	15+	Standard Deviation	Responses
All Data	16 (19%)	22 (26%)	20 (24%)	16 (19%)	11 (13%)	3.79	85

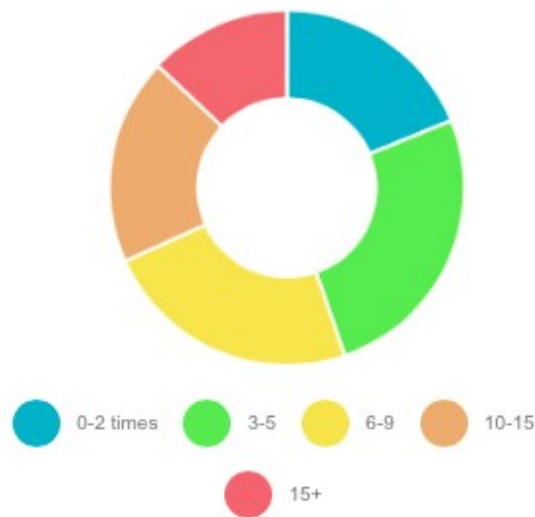


Figure 2: Average training done in a month

In the next questing we looked at what the user would estimate as their own ideal exercise amount. Comparing this graph with the previous one, we see a shift where almost everyone would want to train more. And the moving average leaning towards WHO's optimal health benefit goal. These two graphs alone gives us a good indication that there is a need for a change when it comes to a person's training habits.

## How often would you ideally want to exercise in a month?

↶	0-2 times	3-5	6-9	10-15	15+	Standard Deviation	Responses
All Data	4 (5%)	8 (9%)	16 (18%)	31 (36%)	28 (32%)	10.65	87

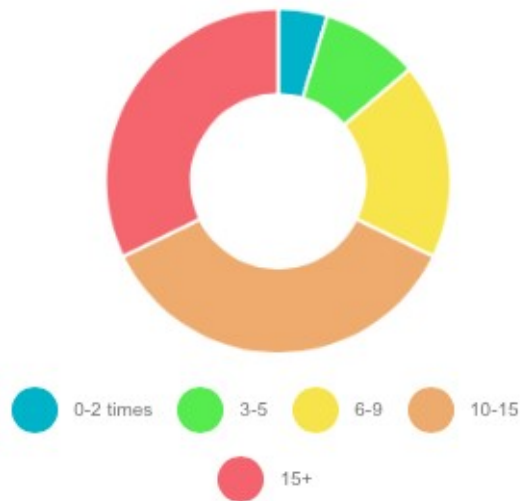


Figure 3: ideal amount of training

Our initial idea was to focus our application on outdoor exercise with GPS tracking. So with this survey we find out how many of active people like to train outside compared to inside. This gives us a decent view on how the distribution of where people like to exercise, showing that our application would reach 59% of the users.

### If you exercise regularly, where do you usually train?

	Outdoor	Indoor	Both	Standard Deviation	Responses
All Data	13 (17%)	32 (42%)	32 (42%)	8.96	77

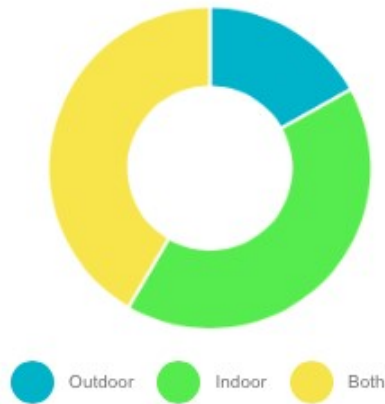


Figure 4: location of training

We wanted to find out what motivated a user into training. Where seeing progress, it being fun and social were the biggest factors.

### What motivates you to do exercise?

	Not motivated at all	Little discouraged	Neutral	Motivated	Highly Motivated	Standard Deviation	Responses	Weighted Average
● Competition	27 (33%)	3 (4%)	24 (29%)	15 (18%)	14 (17%)	8.45	83	2.39 / 4
● Rewards	19 (23%)	4 (5%)	27 (32%)	27 (32%)	7 (8%)	9.72	84	2.81 / 4
● Social	13 (15%)	2 (2%)	21 (25%)	34 (40%)	15 (18%)	10.49	85	3.09 / 4
● Fun	6 (7%)	2 (2%)	15 (18%)	31 (36%)	31 (36%)	12.18	85	3.31 / 4
● See progress	4 (5%)	1 (1%)	9 (11%)	28 (33%)	42 (50%)	15.71	84	3.45 / 4
								3.01 / 4

Figure 5: What motivates a user to train

The last questions look at the user's relationship to training applications. Where 64% of the people asked had already taken use of some sort of a training application, and 77% believed there could be one able to help motivate them to start training.

Do you believe an application could be able to help motivate you when it comes to training?

↶	Yes	No	Standard Deviation	Responses
All Data	67 (77%)	20 (23%)	23.5	87



Figure 6: Users relation to training applications

## 5 Mocup Interview

### 5.1 Mockup testing

We created a basic mock-up application which we installed on a phone. The mock-up was a basic representation of how the application could look and function when completed.

We gave the intervju subjects a brief explanation of the idea behind the application and how the different features was supposed to work on the finished product. Then we asked them 5 different questions after they tested out the application.

We interviewed three different people after they used our mock-up application.

Table 1: Questions for interviews

Questions
What is your first impression of the application?
What improvements would you like to see?
What improvements would you like to see?
If you could add some functionality to the application what would it be?
Would you use an application like this in your daily life?

Table 2: Hans 25 years old.

Answers
Very good. I liked that I can compete against friends and have part goals. I like the tracking of calories and the pictures.
The startup screen was simple to understand. It was a bit difficult to navigate between the different parts of the app and a bit buggy at times.
Higher quality. Higher definition on the icons and the implementation of the other features.
The ability to add different types of exercises when logging data. Add a sharable weightlifting statistic function. Add goals system to more than just distance/calories spent, like first one to lift a certain amount of weights. Add smaller challenges between friends.
Yes I would.

Table 3: Jadir 23 years old

Answers
Low resolution. A bit difficult to navigate without explanation from before. Looks decent.
Should have more text to explain the different features.
Add more competition aspects in the app. To be able to compete in different exercises and create small and big challenges.
Get a in game currency system which you can increase with doing different exercises. This could then be linked up with supermarkets or newsstands to get discounts on certain goods. Now and then in the functionality worked as explained.

Table 4: Mathias 21 years old

Answers
The loading screen was pretty. A bit low definition. The startup screen should have less options. Like putting the two training options into one training category.
No
Shouldn't be necessary to click more than one button to start the training tracking in the outdoor training section.
Add push notifications for example if friend is overtaking you in a challenge. Add some handicap element so that people in different shapes can compete which each other.
I don't know.





Figure 7: Interview with Hans



Figure 8: Interview with Hans

## 6 Discussion

### 6.1 Usergroup

This application is created solely to help motivate people to start or continue training, and since everyone should be doing so, there are no limitations to the user base. Still our main focus will be built around students. We concluded with this because older people might have other needs when it comes to the understanding of the application, and eventual legal issues concerning younger people and training. It is also a benefit that the user group is easily accessible

when it comes to the time pressure of this assignment.

## 6.2 Data analysis

Based on the gathered data, we see that from figure 6 there is a marked for our application. As mentioned in the previous section, we originally wanted to focus our application on outdoor activities because of the simplicity connected of using GPS to track distance traced. After seeing the results from figure 4 and feedback given from other groups on the report, we decided to include indoor activities in our application as well. Looking at the figure 5, we found that something being social and fun were the biggest factors that we could take advantage of in our application.

**Further work** Based on the persona Silje we might want to implement an achievement factor to motivate her. Looking at the interview with Jadir and the persona Per who wanted to be able to see that he was better than his friends, we thought about implementing were you can see the highscores of your friends for self comparison.

## 7 Application Design

Through our research and survey we decided to make an app for both indoor and outdoor exercisers. The main concept of the app is to give them little fun by simple game and allow them to see their progress in a more interesting way. This concept will basically be implemented as a combination between the simple game we have designed and two existing technologies. The first technology is 'Calorie calculator' and the second is 'GPS tracking' technology.

As the name 'Calorie calculator', it is used to calculate how many calories the user have burned by exercise[3]. If the user types in their weight, duration of exercise and chooses the type of exercise, the value of burned calories is calculated immediately. The basic function of 'GPS tracking' is to display the map including a route that the user has passed by[9]. When it comes to the fitness app, the app is normally displaying the values of distance, duration and calories the user have burned as well.

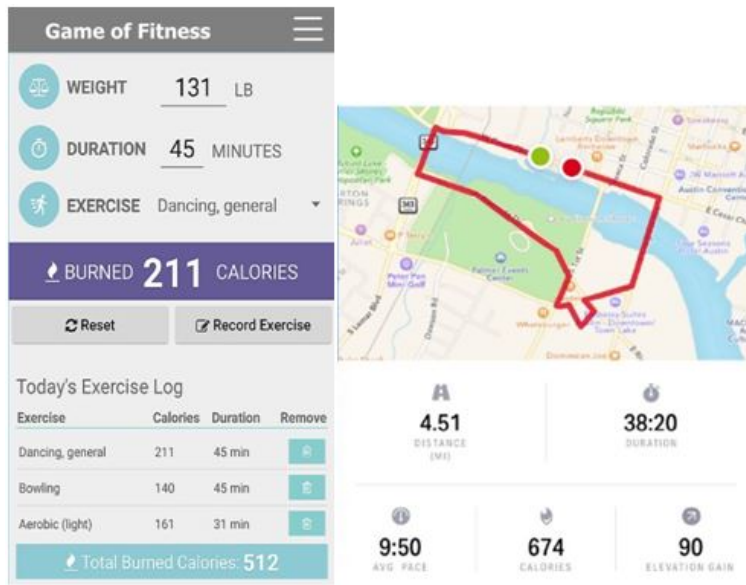


Figure 9: Examples of 'Calorie calculator' and 'GPS tracking' apps

The basic concept of the game is a simple 'Reach the goal' type of game. When the user begins the game, it starts from level 1 that shows start point and goal point with several middle points between them. The user will be represented by a simple character with orange color and will run from the start point. If the user runs or rides a bicycle in the real world, the app will use GPS tracking technology to calculate the distance, duration and the calories the user has burned by running. At the same time, the character in the game screen will be moved forward to the goal the same distance the user has run. The game is basically focused on to show the users their progress in interesting way and give them more motivation during exercise. We have concerned few ideas to give users more motivation effectively by using game elements based on Michael Sailer's article[8]:

1. Each point in the game will represent places that are familiar to users. For instance, the start point will be named Blindern and the goal point, Oslo S.
2. When the user reaches each point in the game, the user will receive some 'reward'. For instance points, badges and a random box, which includes random clothes and accessories that can decorate user avatar in profile. The background picture of the game screen can be also changed to not make the user get bored.
3. If the user wants, the user can see other user's characters in the game screen as well for enjoy the competition with friends.

For those indoor exercisers, who cannot use GPS, the app also provides 'Calorie calculator' service. If they run or ride bicycle using machines, they can easily connect their smart phone with the machine and enjoy the game. If they do other exercises, they can choose which exercise they have done in

the list and calculate how many calories they have burned. This value will be calculated once more to the value of distance – how long they have to run in order to burn this amount calories – and the character will be moved the same distance.

The differences between two choices – ‘Running’ and ‘Biking’, are speed and amount of calories being burned. If we concern about competition between users in our game, those bikers will naturally go much further than runners in the same time. By this gap, runners can take feeling of deprivation, but according to our survey, the ‘competition’ element doesn’t give much motivation to users, but they wanted to ‘see progress’. So we decided not to adjust the values of distance for each exercise in order to show them their progress more clearly.

## 7.1 Low fidelity prototype

The low fidelity prototype of the app contains six main components.

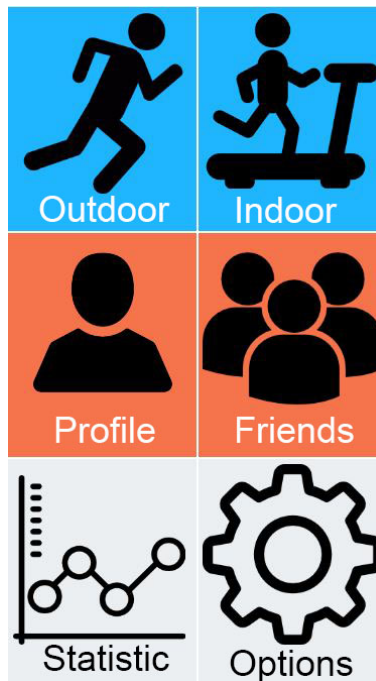


Figure 10: Main menu of the prototype

1. Main service for outdoor exercisers – selects between ‘Running’ and ‘Biking’ and starts game. The app shows both GPS tracking service and game screen at the same time. The user can also display one of them with full screen.



Figure 11: Game screen with GPS tracking

2. Main service for indoor exercisers – selects between ‘Running’, ‘Biking’ and ‘Other exercise’. Those who use running machine and bicycle machine at the gym can connect their smart phone with the machine and play the game. If the user selects ‘Other exercises’, the calorie calculator will be displayed including exercise selection box.

3. User profile – includes user information, for instance user’s ID, name, age, weight. An user avatar with ‘level’ system has been suggested.

4. Social service – can make friend list. An exercise posting service with friends will be concerned.

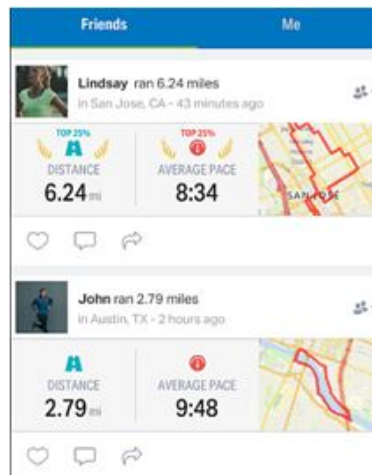


Figure 12: Example of friend list

5. Statistic – shows achievement, graphs, total distance and calories burned. A calendar with user’s exercise history can be included.
6. Option – can change settings of this app. For example, the user can choose to see friends’ characters in the game screen.

## 8 Conclusion

In this project, we have examined how gamification can foster motivation in exercise context. We have reviewed some of the existing research which is available on this topic, and used some of their conclusions to determine which game elements can be efficient when it comes to motivating the users.

In addition, we have conducted a survey to learn more about how gamification can motivate users to exercise. Firstly, we found that almost everyone would want to train more. Secondly, the survey indicated that watching progress, having fun and social interaction are the most important motivational factors. Furthermore, as many as 77% believe that an application can help to motivate them when it comes to exercise.

Based on this we made a prototype of a fitness game app called Game of fitness, which combines workout with games, enables the users to monitor their progress and provides social interaction.

After we had completed the prototype we conducted a mock-up test interviewing three different people. Overall, the prototype seems to give a good first impression, although there is some improvement potential when it comes to navigation and design. The participants also gave several interesting suggestions on how to improve the prototypes functionality further.

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