Design4Health

IN4302TU – Building Serious Games

Game Design

Ralf Nieuwenhuizen	(4080408)
David Prihoda	(4405951)
Ismini Psychoula	(4411285)
Arnold Schutter	(4260724)
Shuheng Shen	(4298225)

Chapter 1

Game Design

1.1 Introduction

We propose a game which encourages the user to regularly perform different types of physiotherapy exercises in order to stay healthy by representing his progress in the storyline. The user's intrinsic motivation to stay healthy is supported by educating him about the impact different exercises have on his body and by an engaging interaction using smartphone sensors. The user is provided with feedback on the number and type of exercises he has performed and their impact on his different body regions.

1.2 Game design

1.2.1 Real-life implications

From the real-life point of view, the user is encouraged to perform isolated exercises that are carefully selected to cover all body regions. He is also able to set his own personal goals by choosing to perform sets of exercises focused on a specific body region. During the execution of the exercise, a smartphone is used to measure the movements and to provide acoustic feedback. Moreover, the game reflects the user's long-term progress, encouraging him to continue exercising regularly throughout the day and also to focus on all different body regions equally. All the real-life implications of performing the exercises are explicitly mentioned in the game, while being seamlessly incorporated in the storyline.

1.2.2 Game Story

The game starts with a story.

Figure 1.1: The farm

2542 AD. Your uncle was one of the first people to buy land in an unknown planet and decided to turn it into a farm to facilitate the earth's growing needs of foods. As years went by the farm became very profitable and produced the most sought out products. You were very surprised when you received a mail saying that your uncle had left you the farm years ago but you only heard of it now. After so many years, the fields on planet Yeo are unused and empty. Will you be able to salvage the farm? Spend your money wisely to grow the company and unlock new possibilities by doing the exercises.

1.2.3 Gameplay

The user, a novice farmer, is instructed by a virtual physiotherapist, an old farmer, to learn and perform regularly different types of exercises that help him stay healthy in real life and progress in the game. By growing crops and breeding livestock the hero can become a more skilled farmer and revive the company.

The game mechanics are shown in Figure 1.2. The central point is the exercise, which powers all the progress in the game.

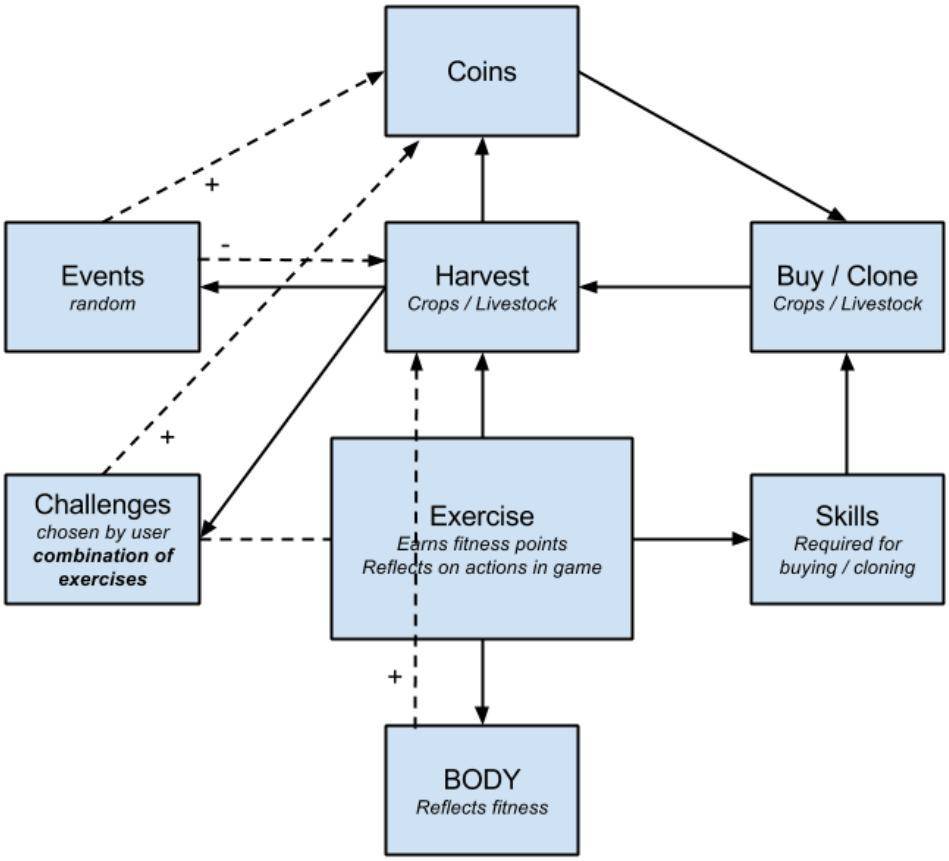

Figure 1.2: Game mechanics

To grow crops or breed animals on the farm, the farmer has to learn skills and earn coins. Skills are learned by performing specific exercises in real-life. After learning a skill, the farmer can pay coins to buy the corresponding crops or livestock and place them on tiles in the map. In a certain time interval the crops are ripe and can be harvested and livestock products can be gathered, this requires specific exercises to be executed in real-life.

The user starts with a small amount of coins that allows him to buy the first crops. Coins can be earned by selling the products on the market, extra coins are earned by using specific batches of products to complete challenges and events. Challenges consist of a story and requires the execution of a set of exercises focused on a specific body region. Events are random challenges that bring the surprise element into the game.

The farmer is equipped with a Bionic Outer Dimension Yeosuit, or BODY, in short, which re-

flects all the exercises the user has performed in the game. For example, after performing ten exercises that focus on shoulder muscles, the BODY will automatically get a visible upgrade. This way, the user is informed which body regions he has improved and which need to be focused on in the future.

1.2.4 Example game scenario

This section provides an example of the game play. In this example, the user learns the skill of growing apple trees by performing the exercise to pick them (stretching his middle back and shoulders by alternating arms, reaching one as high as he can and as low as he can, while standing upright with his back to the wall). After a satisfactory execution of the exercise, he is able to buy apple trees with his money and plant them on any available tile on the map. After a few hours, the user will get a notification that the apples can be harvested. To harvest them, the user has to perform an exercise of picking apples . After the apples are harvested, the user can either sell them for coins directly, or store different crops to complete a challenge for extra money. The completion of a challenge requires a certain amount of crops, but also new exercises specific for a certain body part.

1.3 Game features

In the sections below there is an extended description of all the game features and their specifications. The sections with a star are planned for the final version of the game, however they will not be included in the first playable.

1.3.1 The overview

At the start of the game, the introducing story will be presented to the player before the farm is shown. A short explanation of the game will be given, and then the player is ready to start his adventure.
By clicking on the farm, the user can see his current inventory of items. (see figure 1.3)

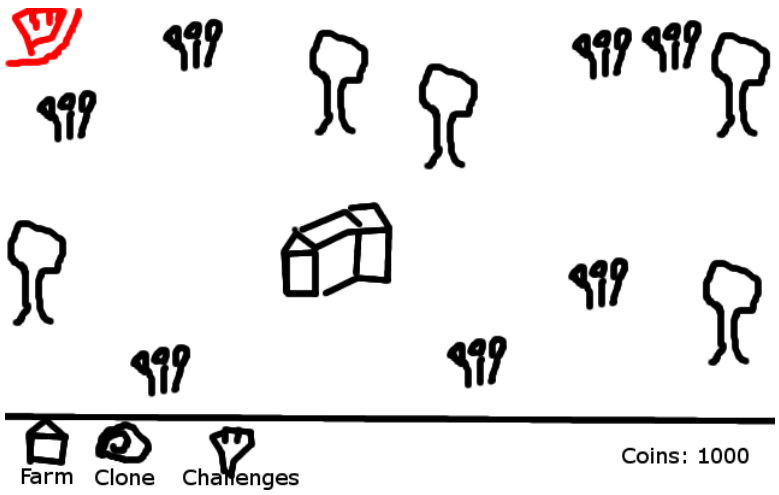

Figure 1.3: Sketch of the overview of the game, with menu items

1.3.2 Mentor Phil

Once you get to the farm, you discover there is a very old friend of your uncle's, Phil, who is around 60 years old, but still very much in shape. He will serve as your mentor and "physiotherapist" in the game. Phil explains the purpose and correct execution of each exercise to you. During the game, the mentor and the player will become friends.

1.3.3 The farmer

In the game, the player will be impersonated by a farmer. This farmer will perform all the tasks on the screen the player performs in real-life. The farmer wears a BODY which is upgraded according to performed exercises.

1.3.4 BODY

Apart from the advice part that the player gets from the mentor, he also gets reflection of his progress in the game in the form of a "BODY". The player has a list of points, one for each body part (arms, legs, abs, back), and each executed exercise will yield some points for a specific body part. When the points for a certain bodypart have reached a certain amount, the player will be awarded an upgrade to his BODY. This way, the player will be warned if he's focussing too much on one or several body parts, and he will be motivated to also focus on the other parts. The player has a free choice in the exercises he performs, but is motivated to make a balanced scheme.

The level of the player is defined by the progress of the BODY. In this way, the BODY gives an indication of the progress in the game and the physical performance. The level is defined by the lowest level of the body parts (a chain is as strong as its weakest link). A higher level gives the player more skills and unlocks new crops and livestock.

1.3.5 Exercises

During the game, players will be confronted with several exercises, which they will have to perform in real life. These exercises will allow them to either plant or harvest a crop, or to perform a task, like milking the milkatrons. Prior to each exercise a clear explanation is shown about the movement the player has to perform demonstrated by a drawing of the mentor. The phone is used to measure the execution of the exercise and should be held by the player. The accelerometer of the phone measures the movement.

A sketch of what an exercise will look like is shown in Figure 1.4.

List of exercises

1. "Apple picking" - Harvesting apples
    - Start from standing up straight
    - Raise one arm (with the phone in hand) as high as you can, while you raise your opposite knee until you have a 90 degrees angle both between legs and core and between upper and lower leg

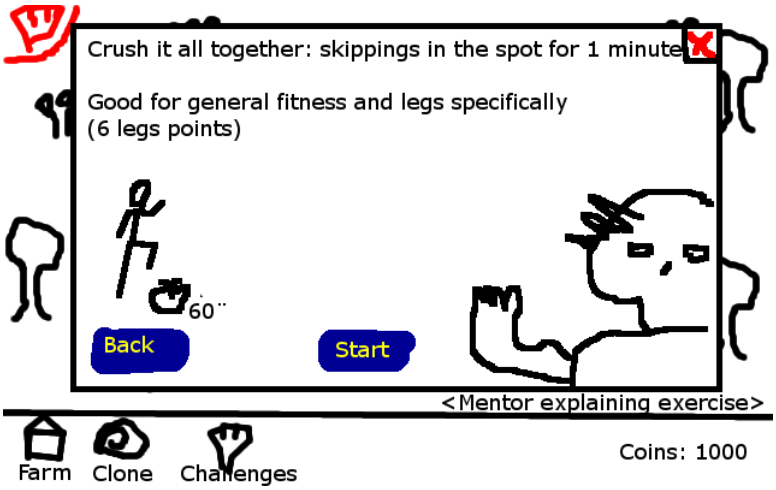

Figure 1.4: Sketch of the exercise view

- Finally, try to keep this stance while standing on your toes
- Repeat on the other side (switch the phone hand!)

2. "Arm Circles" - Harvesting wheat
   - Stand up and extend your arms straight out by the sides. The arms should be parallel to the floor and perpendicular to your torso.
   - Slowly start to make circles of about 1 foot in diameter with each outstretched arm. Breathe normally as you perform the movement.
   - Continue the circular motion of the outstretched arms for about ten seconds.
   - Then reverse the movement, going the opposite direction.
3. "Rocket jumps" - Crushing things together
   - Keep your phone in two hands
   - Begin in a relaxed stance with your feet shoulder width apart and hold your arms close to the body
   - To initiate the move, squat down halfway and jump back up as high as possible
   - Fully extend your entire body, reaching overhead as far as possible. As you land, absorb your impact through the legs
   - Repeat x times

1.3.6 Challenges

The player will have a list of challenges from which he can at anytime pick one and execute that to receive bonus coins. These challenges have an underlying set of exercises that can either be focused on one body part, or they can be a complete body workout. The mentor will explain about that. Challenges are proposed to the player as an appealing task in the game, for example to make a spaceapple pie for your neighbouring Yeowoman that is ill. The player would have to perform some exercises that would be needed to get the ingredients for the spacepie, and by doing that he would have completed a workout without noticing. The mentor will inform the player of that afterwards,

to raise awareness.

A sketch of what an active challenge will look like is shown in Figure 1.5.

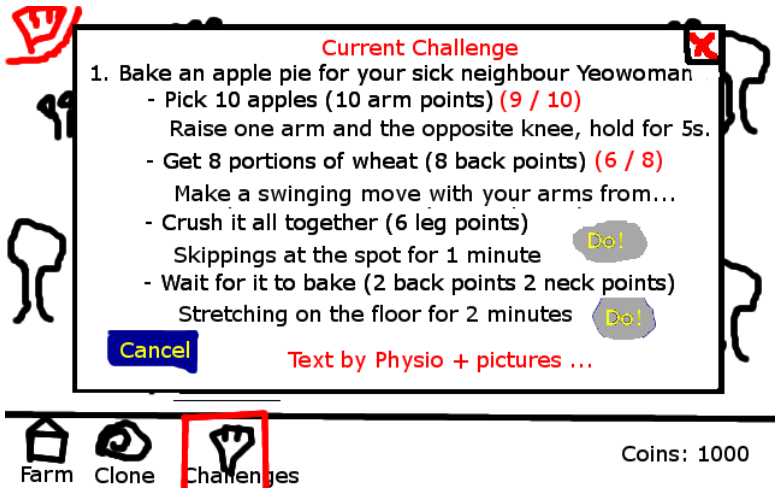

Figure 1.5: Sketch of current challenges view

Example challenges

1. Bake a spaceapple pie for your sick neighbour Yeowoman. (Full-body)
   - Pick 10 apples (arms) - See exercise "Apple picking"
   - Get 8 portions of wheat (back) - See exercise "Arm circles"
   - Crush it all together (legs) - See exercise "Rocket jumps"
2. Make a wool doll for your cousin as a birthday present. (Back) No exercises specified yet

1.3.7 Events

Events will occur randomly in the game and are used to create extra challenges for the player. An example of an event is a raid of Space Cowboy to the farm or a disease that comes to your planet. More severe events will happen once the player has reached a higher level. The chances of getting events will decrease when the player is active.

List of events

- Save the farm from an attack of space cowboys
- Save your crops from the Pest
- Save the farm from an attack of neighbouring Aliens

1.3.8 Money

When the game begins the player is given a 1000 coins to start developing his farm. After that first allowance he can earn more money by selling his products on the market.

1.3.9 Growing crops

Each type of crop has a name, a cost, a revenue that it brings in when harvested, the time it takes for it to grow. Plants will only last one harvest and have to be harvested soon enough (e.g. two times its growth time), or they die. Trees can last multiple harvests.

A sketch of what the clone view will look like is shown in Figure 1.6.

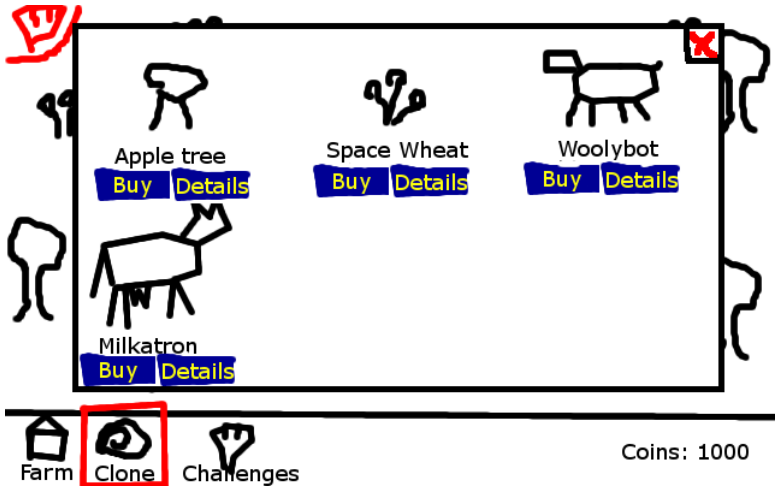

Figure 1.6: Sketch of cloning crops / livestock

List of crops (cost, time to grow [minutes], revenue of single harvest, number of harvests)

- Spacewheat (5, 1, 10, 1)
- Tomatoid plant (30, 3, 50, 1)
- Sprice plant (50, 10, 50, 1)
- Yeotato plant (60, 15, 100, 1)
- Yeogrenade plant (100, 30, 200, 1)
- Zorganic melon plant (300, 240, 750, 1)
- Spaceapple tree (100, 600, 75, 5)

The amount of space around the farm is fixed throughout the duration of the game. While the game progresses, some old crops or livestock might be sold to free space for new options.

1.3.10 Cloning livestock

Each type of livestock has a name, a cost, a revenue it brings when exploited and the time it takes for it to be ready (for example milking a Milkatron every 8 hours will produce 2 buckets of milk that can be sold for 40 coins each).

List of livestock (cost, time to grow [minutes], revenue of single exploitation)

- Polychick (15, 5, 10 (2 eggs))
- Metagoat (30, 30, 10 (1 milk))
- Milkatron (100, 240, 40 (4 milk))
- Woolybot (100, 600, 30 (2 balls of wool))
- Piggium (200, 1440, 50 (1 meat))
- iBeef (300, 2880, 150 (3 meat))
- Unicorn (1000, 4320, 1000 (1 magical hair))

1.3.11 Market

From the farm you are able to see your inventory. Here you will have an overview of all the items you currently possess. These items can be sold on the market, giving you the revenue they are worth.

A sketch of what the inventory will look like is shown in Figure 1.7.

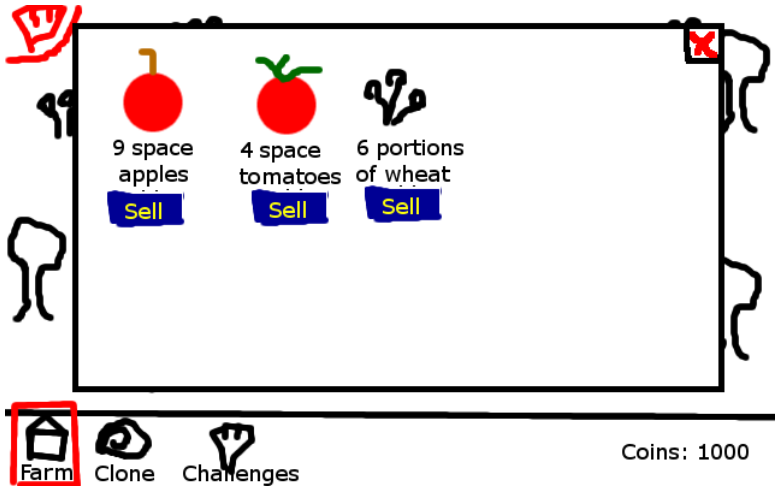

Figure 1.7: Sketch of the inventory

1.4 Phases

This section shows the planning for the project. An overview is given for each phase about what part of the game should be completed.

1.4.1 Designing the game

Before starting on developing the actual software, there will be sketches for all screens of the game, to create a clickable static prototype. This will be presented to the group, a final decisions about the design is made after this session in week 2.

1.4.2 First playable

The first playable will be a small version of the final game. It will not be complete, but the vital functionalities will be completed. In this phase a basic version of the game is available to be played and some exercises can be performed. Some user tests will be done and the progress will be reported to the commissioners.

Week 3

- Map view (farm and fields) is functional
  - Farm and fields are showed on the screen with right dimensions
  - Fields are clickable for harvest and planting
- Panning is possible through screen
- Rotation of the screen to landscape
- Currency is implemented
- Three screens are completed and functional
  - Clone: Crops can be cloned and the action is connected with currency
  - Map: Crops can be planted, harvested and show progress
  - Exercise: Screen shows and explains the exercise to be done to complete a task
- Accelerometer is connected to the software and is able to distinguish if movement was performed

Week 4

- Two crops are fully functional in-game
- Three exercises are fully functional in-game
  - Accelerometer measures correct execution of exercise
- Test
  - Game play: The game works fluently and correct
  - Intuitiveness: Navigation through screens and action buttons are intuitive

1.4.3 Beta version

The beta version will already have all of the main features of the final game. Most of the crops and livestock will be buildable and the game works fluently. The beta version will be tested on the target audience.

Week 5

- Livestock is implemented in the game
- Two extra screens are functional
  - Challenge screen: Challenges can be selected and executed
  - Farm screen: The amount of harvested crops and completed products are shown
- The view is scalable
- Complete the functionalities of the gameplay
  - Currency
  - Exercises with detailed descriptions and measurements (>10)
  - Challenges (>5)
  - Events (>2)
- Design models for
  - Mentor Phil
  - Crops (>5)
  - Livestock (>5)
- Test
  - Story: Purpose of the game and actions to be taken are clear
  - Intuitiveness: Navigation through screens and action buttons are intuitive
  - Game play: The game works fluently and correct
  - Features: Are there more wishes for features

Week 6

- Sounds are added for the exercises
- Sounds are added to the game
- The BODY with different levels is designed and implemented
- Completed the exercise-related functionalities of the gameplay
  - Exercises with detailed descriptions and measurements (>15)
  - Challenges (>10)
  - Events (>4)
- Implemented comments from previous user tests
- Tested:
  - Game play / Features
  - Exercises: Opinion about exercises and willingness to do them

1.4.4 Final version

In the final version all the features are added from the list above. The game will be tested again on the target audience and the gameplay is improved.

Week 7

- Improve game (according to user tests)
- Test
  - Gameplay: Engagement of the user in the game
  - Features: Are there more wishful features
- Fix bugs

Week 8

- Final user tests
- Final report

1.5 Testing plan

In order to check the usability of our game. We will evaluate it in the form of questionnaires. As for the effectiveness of some specific modules, an A-B test for the final version will also be conducted following the between-subjects design if necessary.

1.5.1 Experiment Setting

Participants

The subjects of the testing will be adults between the ages 18-30. We aim for sufficient people for each phase.

Materials

- Informed consent form
- A room for the experiment
- Questionnaires for the participants
- Smartphones with our game installed

Experiment Procedure

- The participants enter the room.
- We will give a brief introduction of our game to the participants.

- They will be requested to play the game and focus on the aspects we want to test each time. During this section we will ask the test persons to speak out loud and if they agree we will film them. This way we can get the most out of the test session.
- After the gaming session is finished, the participants will have to answer the questionnaire.

Questionnaire

This is the general model of the questionnaire which will be specified accordingly depending on which components of the game we want to test each time.

- Sex? male/female
- Age? 18-25, 25-30, over 30
- Have you ever played a similar game like this? Yes/No
- If so, what is the name of that game?
- Do you think the challenge was hard to finish? Likert Scale: "easy"(1) "hard"(7)
- Is the process of fulfilling the task clear? (i.e., Are you fully aware of what could be the next step?) Likert Scale: "I have no idea"(1) "I have a clear idea"(7)
- Was the drawing demonstrating the exercise clear? Likert Scale: "I couldn't understand what movements the illustrations represented"(1) "The demonstration was clear."(7)
- Does the smartphone sense your movement well? Likert Scale: "The sensors couldn't sense my movement at all."(1) "The sensors work well."(7)
- Did the game react fast enough on your actions? Likert Scale: "It was too slow."(1) "It was too fast."(7)
- Do you think this game can help you relax and prevent you from sitting on the chair the whole day? Likert Scale: "No, I don't think so."(1) "Yes, I totally agree."(7)
- Were the graphics visually appealing? Likert Scale: "I didn't like them at all."(1) "I liked them very much."(7)
- Was the text used in description clear and understandable? yes/no [comments section]
- The pace of the game is Likert Scale: "Too slow."(1) "Too fast."(7)
- The aim of the game is . . . : Likert Scale: "rather confusing"(1) "clear"(7)
- Free comments section

1.6 Requirements

1.6.1 Meeting the requirements from the commissioners

During the first meeting with the commissioners the requirements for the game were discussed. From this session it seemed not to be important to focus specifically on physiotherapists and their

patients. The focus is more on the use of sensors to keep people activate and motivate them to move. After this session we have decided not to focus too much on the physiotherapeutic part of the game, but more towards the activating nature of it.

The main goal of the project is: Explore the ways sensor technology can improve communication/engagement in an e-health environment. Inspire long-term self-management and sticking to self-imposed goals and lifestyle changes through digital means. To support this goal we are using the sensors in mobile phones to measure exercises the player does in the game. By providing feedback to the users about their progress in fitness level (by the BODY) and the feedback per exercise about what body parts are trained by this exercise, and by the addicting nature of the game, it inspires a lasting lifestyle change in a positive way. The game can teach the user to use random previously not-utilised times during the day (e.g. performing squats while waiting for toast) to get their exercises done and reward them appropriately. This all serves the goal to change their habits. Driving lasting change.

Considering sub-goal 1: Raise patient's awareness and sense of responsibility for their own health in an engaging way. The patient should be more focused on the exercises than on the farm itself. Therefore we have decided to think of the game more with the focus on the exercises. We will make a list of exercises categorized by bodyparts. These exercises are mapped to several actions in the game, instead of the other way around. In this way, it will be easy to provide feedback to the user about what exercises he has done and what purpose this serves in real life (the feedback part is really important). Specific exercises for certain bodyparts could eventually be added and provided to users by adding new challenges.

Considering sub-goal 2: Enhance the feeling of being a team with your physiotherapist. To support the second subgoal, we have decided that once you get to the farm, you discover there is a very old friend of your uncle's, who is around 60 years old, but still very much in shape. He will serve as your mentor and "physiotherapist" in the game, so he will explain the purpose and correct execution of each exercise to you.

1.6.2 Target audience

The envisioned design will fulfill the requirement of being an engaging, activating game. This is all meant to activate people while doing an activity they love, gaming. The game will focus on young adults, as these are the people mostly concerned with exercise and activity. These people are also the ones who are most likely to make lifestyle changes. The game will be serious, as there is a clear purpose behind it of activating people and making them change to an active lifestyle, and it will be fun, as is proven by previous games in which you build up your own world, and have to show dedication to keep it up and running.

1.6.3 Resources

To derive a full up and running game from a paper prototype some resources will be needed. Because it will be a smartphone application, no external sensors will be needed at first. Plenty of open source software is available to fulfill our needs. The only cost we have is the Android Developer registration fee which is $25.

Hardware

The only requirement for someone to play our game will be the possession of a smartphone. Several sensors on smartphones to measure the execution of exercises will be investigated. Most likely these will include the accelerometer, GPS, and microphone.

Software

The game will be developed for Android mobile phones, using open source software. We will do this using HTML5 supported by javascript, supported by LimeJS, and maybe more libraries. The HTML5 can be converted to a native app by using PhoneGap (`http://phonegap.com/`). This also gives us the option to convert to other mobile platforms, like iOS and Windows Phone