



NESTORE

D5.5 Serious games for engagement and well-being

2019.08.31

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 769643

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Deliverable ID:	WP5/D5.5/T5.5
Deliverable Title:	Serious games for engagement and well-being
Responsible partner:	TUD
Contributors:	TUD
Nature	Demonstrator
Dissemination Level:	PU
File:	D5.5 Demonstrator_ V1.0
Revision:	V1.0
Due date of deliverable:	2019.08.31
Actual Submission date:	2019.08.31
call topic	European Union's Horizon 2020 Grant agreement: No 769643 SC1-PM-15-2017 Personalised coaching for well-being and care of people as they age

Document History

Revision	Date	modification	Author
0.1	2019.08.01	Document Creation, initial TOC	Isabelle Kniestedt
1.0	2019.08.14	First draft	Isabelle Kniestedt
1.1	2019.08.20	Revision	Stephan Lukosch
1.2	2019.08.21	Second draft	Isabelle Kniestedt
1.3	2019.08.27	Implement feedback HES-SO	Isabelle Kniestedt
1.4	2019.08.30	Updating screenshots	Isabelle Kniestedt
1.5	2019.09.16	Implementing reviewer feedback	Isabelle Kniestedt

Approvals

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Short Abstract

D5.5 describes the serious games for continuous engagement, including the used game mechanics to train cognition and physical health and their integration with the social platform and the virtual coach. The deliverable is a demonstrator – this accompanying documentation highlights its technical features. The developed games, unified in a single application to increase user-friendliness, are called NESTORE Pocket Odyssey. The resulting application is made available for Android phones. Within the NESTORE project, Pocket Odyssey functions as an accompanying application to the overall NESTORE system and is intended to be an optional way for users to train their physical health and cognition.

This document describes each aspect of the deliverable and its design. It covers its integration with other parts of the NESTORE system, its user experience, and its individual features. The login process, daily interaction, and the physical and cognitive aspects of the games are described in detail. Based on this document, it should be possible to recreate the basic functionality of the game for any future research or commercial efforts or for the existing game to be expanded upon.

Key Words

Game, engagement, applied gaming, serious gaming, motivation, cognition, physical



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1 Introduction

The aim of this document is to describe the demonstrator deliverable for T5.5. The games developed for this task, unified under a single game titled Pocket Odyssey, have the main goal of providing additional engagement for users to interact with the NESTORE system and ways of training their cognitive and physical well-being. It furthermore allows for light social interaction as is common in commercial mobile games. The games are developed using the Unity3D engine as a standalone Android application.

The following sections highlight the connections to other work packages, the games' functions within the NESTORE project, and a high-level description of the games themselves. For a detailed explanation and visual references, see Section 2.

1.1 Interlinks with other Work Packages

The games have been developed to offer the possibility of training a user's physical health and cognition. For this purpose, the design of the game is based on the guidelines set out in WP2, in particular the outcomes of T2.1 (Modelling of physiological status and physical activity behaviour), T2.3 (Modelling of cognitive and mental status and social behaviour), and T2.4 (Integration of Knowledge Areas and Definition of Requirements).

The games send data to the NESTORE cloud, where it is accessed by the virtual coach and the DSS (WP4). While there is no direct interaction between the game and the decision support system (DSS), the data from the games can thereby be used to gain further insight in the user's current capabilities.

T5.5 furthermore links with other tasks from WP5. Data from the games are shared with the coaching application. Additionally, friends of the user are pulled from the social platform, allowing users to see their friends' progress within the game.

T5.5 was developed in accordance with developments within WP6, following the shared architecture, communication interfaces (APIs), and security precautions as set out in the relevant tasks of this work package.

The outcome of T7.1 (Identification of needs, values and suggestions for co-design) and T7.2 (Transferability of participants' perspectives to technologists) was used in shaping the early design of the games. During T7.3 (Co-design user-end participation in order to improve prototypes (iterative co-design)) the games were tested with the intended audience to gather feedback on usability and confirm user interest.

1.2 Function within the NESTORE system

T5.5 is a collection of serious games for continuous engagement and cognitive and physical well-being. The designed serious games play a role in motivating users to achieve the requirements in the different pathways of wellbeing. Efforts in other work packages have been used with the aim to create games that are meaningful and valid. The serious games support sporadic and short-term interaction and can be played individually or with other players from the player's personal network to foster social wellbeing. The games offer physical exercises and cognitive training with adaptive difficulty. The games have been developed for mobile devices in accordance with certain limitations discovered over the course of the project. However, using mobile technology – which is already owned and used by a large percent of the population – ensures that the games can be played frequently and with a low entry barrier. Data on the interaction with the games is collected to elicit user provided data in a playful manner.



Studies have shown that games can be effective in engaging users in certain types of behaviour. However, as was confirmed in WP7 participatory design sessions, games are not enjoyed by everyone. *Pocket Odyssey*, like other games, is unlikely to appeal in the same amount to each and every user. It has therefore been designed as an optional addition to the NESTORE system, with both the integrated physical and cognitive game able to be used independently from one another. Its design is furthermore based on successful commercial games in the mobile market to aim for a wide appeal through proven mechanics.

1.3 Overview of Components

The game offers users with three integrated sub-games:

1. The Ship game, which functions as the main interface for the rest of *Pocket Odyssey*. The ship rewards interaction with the other two games listed below, based on the recommended amount of usage as set by the NESTORE domain experts. Rewards take the shape of in-game currency, which a user can use to expand and decorate a virtual ship, a reward mechanic based on existing mobile games and discussions with users.
2. The Gym game, in which users are guided through routines of strength exercises to improve or maintain their physical health. In addition to the predetermined strength routines, the game also offers a number of flexibility and balance exercises.
3. The Submarine game, which aims to help users train or maintain their cognitive functions.

2 Demonstrator

The following sub-sections describe the various aspects of the game. For each aspect, technical functionality and interaction flow are described. Specific connections to other components of the NESTORE system are also highlighted.

2.1 Login

Players enter the game on the login screen. Here, they will fill in their email and password. The password is obscured from view (i.e. 12pass becomes *****). The game will remember the last used settings and fill them into the fields automatically when the user has logged in previously. The game will check with the cloud and, assuming it has an internet connection and can reach the NESTORE server, check whether data from a previous session still needs to be synchronised. If such data exists, the game will synchronise the data and clear the cache afterwards.

In case the user does not have access to the internet or the server cannot be reached, the game informs the user of this. The game can still be played and progress is saved locally, but data of that session is not synced to the cloud. The game is able to store one session for both the cognitive game and the physical activity game to sync later when a connection has been established. The decision to make the game playable offline was made to increase accessibility and potential engagement for players.





Figure 1 - Login Screen (L) and failed login attempt (R)

2.2 Daily reward

Once the player has logged in (or continued to play the game offline), a check is performed to see when the player last logged in. If the player last logged in the day before, this counts towards their login streak. A player receives a small reward every day that they log in consecutively (coins). When a player reaches a streak of 1 week, the reward is bigger than usual (star). See the section below for details on rewards. At this point the streak resets. This feature is common in commercial mobile games to encourage players to log in frequently.

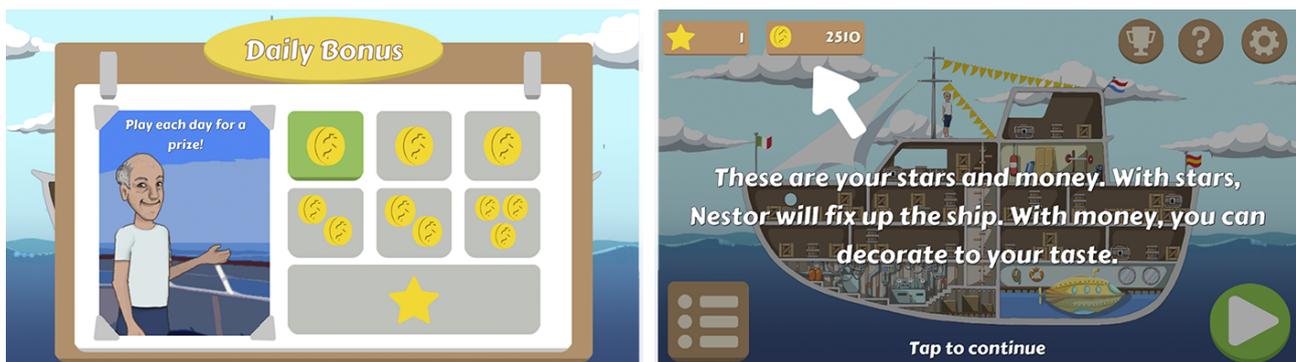


Figure 2 - Daily reward (L) and tutorial (R)

2.3 The Ship Game

The first main component of *Pocket Odyssey* is the Ship game. The player is brought to the ship after logging in. This part of the game functions as the main 'hub' for the player and allows access to all other parts of the game. Both the Gym and the Submarine game can be accessed from here and are visually represented inside the ship. The player can pinch the screen to zoom in and out of the ship, pan the view, and tap on items to interact. The camera focuses automatically on the selected item.

2.3.1 Introduction and Tutorial

The first time a player starts the game, the user is welcomed by the character Nestor. Nestor's design is meant to be reminiscent of the NESTORE project logo, though with less classical facial hair. He is the player's guide to the game. In the introduction, he informs the player that he requires their help in fixing up the boat that he has bought so that he may take it around the world. Once Nestor has established the premise of the game, he will guide the player through a short tutorial that explains the basic functionality.



The tutorial screens may be viewed at any point through the respective button on the ship screen.



Figure 3 - Starting ship (L) and possible final ship (R)

2.3.2 Rewards and Currency

Pocket Odyssey incorporates two types of currency, a feature adapted from existing mobile games. The benefit of having two types of currency is the ability to pace the reward received by the player. The game aims to encourage players not just to play the game, but to play it the right amount (i.e. complete a physical exercise routine or train their cognition for a certain amount of time). A less valuable currency is used to reward basic interaction, while a rarer currency is used to reward commitment to achieving daily or weekly goals.

The less valuable currency takes the shape of coins. These are used to customize the ship (see below). The more valuable currency takes the shape of stars, which are tied to the progression of unlocking the ship. Players receive 50 coins whenever they finish a set in a physical exercise routine, and a star when they complete the entire routine. Players receive 20 coins whenever they finish a level in the cognition game and advance in difficulty and they receive 10 coins when they finish a level and stay on the same level. They receive a star every time they reach a 5th level (i.e. 5, 10, 15, etc.) for the first time. This is further explained in the respective sections below.

The amount of stars and coins the player currently possesses can be viewed in the top-left corner of the ship screen.

2.3.3 Progress and Customization

The ship is functional at the start of the game, but not much more. Nestor asks the player to help him fix it up. In order to do so, the player can unlock rooms and items in the ship in a predefined order. In this way, the player gets a sense of progression as they interact with the game. Progression is unlocked with stars, which can be earned through physical exercise, cognitive training, or maintaining a daily streak for the duration of a week. The player can unlock a new part of the ship by pressing the to-do list button in the bottom-left corner of the screen and spending the necessary stars. The cost of progressing increases gradually over the course of the game.



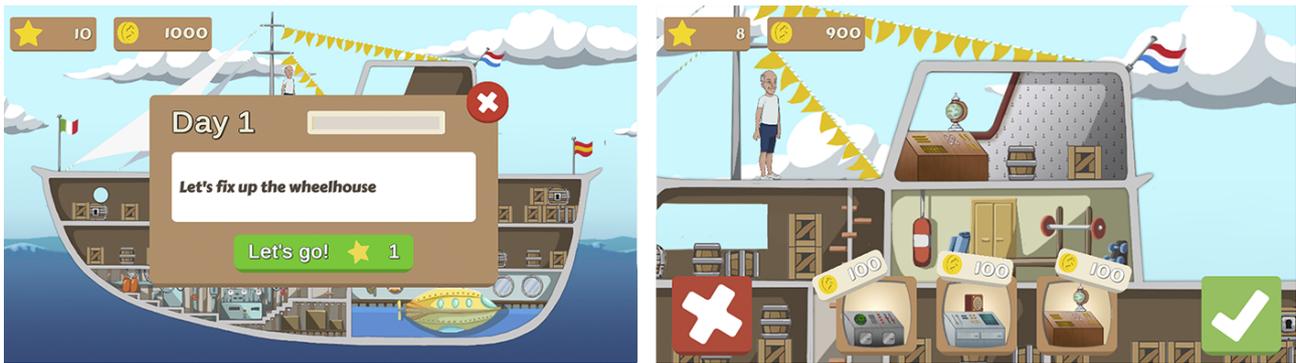


Figure 4 - Unlocking new option (L) and choosing customisation (R)

Once unlocked, the player has various options available to them. Each room consists of three items that can be placed and customised, as well as a choice of wallpaper/wall decoration. Customisation options are unlocked using coins. Each option costs the same. This is to encourage players to choose their favourite option rather than go for the cheapest. However, options get slightly more expensive as the game progresses to encourage increased play. Once an option has been 'bought', the player never has to spend coins on it again and the option can be restored without additional costs. The player can interact with an option once it has been unlocked by tapping on it. This brings up the customization menu.

2.3.4 High-Score and Visiting Friends

Players can access a menu from the top-right corner of the ship screen that lists the friends they have on the NESTORE social platform. Friends are shown with their name and their high-score, i.e. an aggregated score based on their progress in the game and frequency with which they play. When selecting a friend from the list, the player is brought to see that player's ship. These features encourage a sense of competition between players and potential discussion between the players in real life as they compare the décor of their ships.

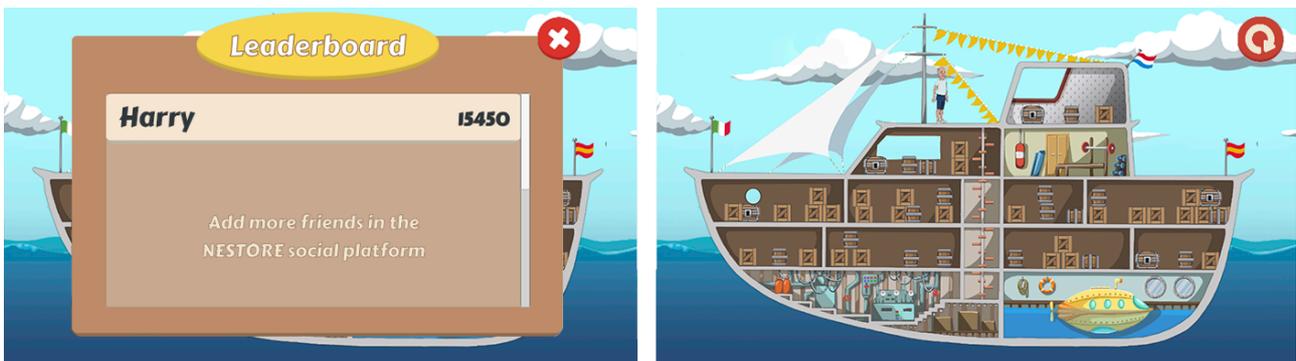


Figure 5 - Friend list (L) and other player's ship (R)

2.3.5 Settings and Play Button

The settings menu can be accessed from the ship screen by pressing the gear button in the top-right corner. Here, users can change the language of the game (options English, Dutch, Spanish, Italian). They may also reset their game progress (which needs to be confirmed before it is enacted), although this function is disabled for the NESTORE pilot studies to prevent accidental loss of data. Finally, players can change the amount of weight used in physical exercise.





Figure 6 - Settings screen (L) and game selection screen (R)

Players can access the tutorial from the question mark button in the top-right of the screen in case a reminder is needed.

Finally, the player can choose one of the two sub-games, Gym, or Submarine, by pressing the green play button at the bottom right of the screen. This brings up a screen where they can select either option. This functionality is restricted in the NESTORE pilot study until the time that a player chooses a pathway in the coaching app.

2.4 The Gym Game

The Gym game aids users in performing a variety of physical exercises to help improve or maintain their physical well-being. A total of 27 exercises is included in the game, which are performed by the Nestor character through unique animations. Players are rewarded for completing sets and routines of exercises.

2.4.1 Game Structure

Players are initially brought to a screen where they can select the type of exercise they want to do – strength, flexibility, or balance. Depending on the choice, players then either start exercising (balance or flexibility), or they select which routine they would like to perform (strength).

When starting a routine, the player is shown a screen with explanation for the upcoming exercise. The structure of these screens is always the same – they show the two key positions of the exercise, as well as a textual description of the movement to be performed.

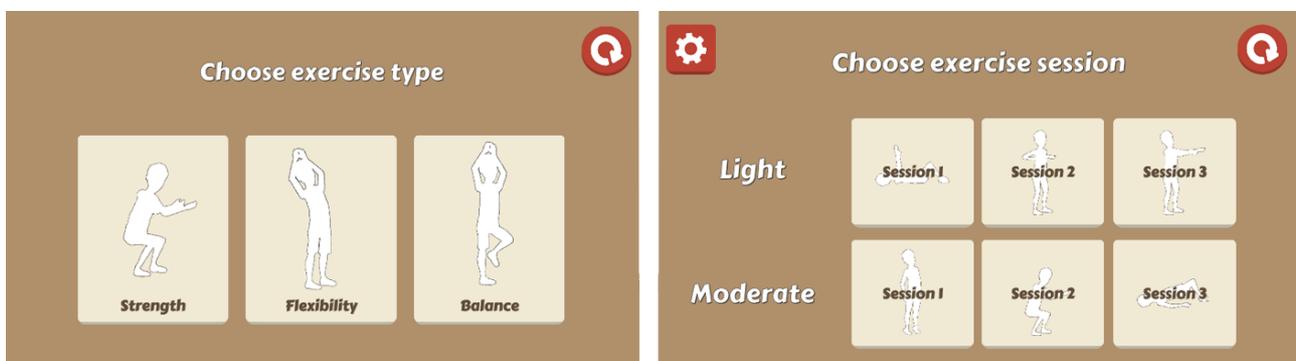


Figure 7 - Exercise selection (L) and strength routine selection (R)

The player presses the button to continue and the exercise starts. The Nestor character performs the exercise on screen with the correct timing. Repetitions are counted in the top-right corner of the screen. Motivational text is provided at the bottom of the screen to guide the player through the motions. If the player needs to perform the exercise on two sides (e.g. an exercise using a single arm), the game prompts the player to switch sides halfway through the repetitions. When the target amount of repetitions has been completed, the next exercise is explained through a similar screen as the previous.

This process continues until the player has performed all exercises in the routine. At this point the game checks whether the player has performed enough total sets (complete routine finished) for their daily reward. If not, the player is rewarded stars and prompted to continue with the next set. If yes, then the game removes the option to continue with more sets and the player is rewarded a star instead. It is possible to finish a set, leave the game, and finish the required amount of sets later on.

For flexibility and balance there is no target to be reached. Each routine only lasts for 1 set.

The game sends the session data to the cloud whenever the player returns to the ship screen, which can either be at the end of a set or at the end of the total exercise. The last session is stored in local memory in case synchronisation is not possible. However, this session is overwritten if players do more exercise until the data is synced with the cloud.

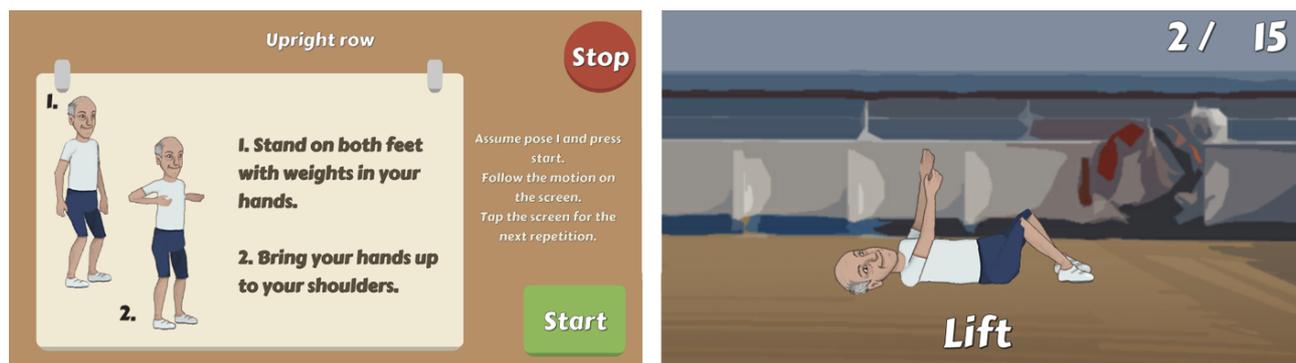


Figure 8 - Explanation screen (L) and Nestor performing exercise (R)

2.4.2 Strength

A total of 17 strength exercises are included in the game. These exercises are based on efforts from WP2 and cover all important muscle groups. The exercises are used within 6 possible routines that are of either light or moderate intensity. Which routine a player chooses is left up to them to allow for variety and adaption to their own skill level, but suggestions are made by the virtual coach.

The amount of sets needed to perform is based on the chosen routine. Moderate routines (used either to maintain or improve physical activity) are generally required to be repeated 3 times with approximately 10 repetitions per exercise, while light routines are meant to be repeated 5 times with approximately 15 repetitions. The game keeps track of the amount of sets performed that day and adds them together to guide players to perform the right amount and not overexert themselves or underperform.

The information panel informs the player of the ideal training schedule and the suggested amount of weight to use for the two types of routines. The actual level of weight used can be entered to ensure



proper calculation of the intensity of the training. The game remembers the last value put into the system so that users only have to change it when they change the weights they use.



Figure 9 – End of set screen (L) and BORG rating (R)

When finishing a set or routine and going back to the main ship screen, the player is asked to rate their level of exertion on the BORG scale. The player is presented with textual descriptions of the scale values, as the rating from 6 to 20 was considered unintuitive for players. The player's input is translated to the corresponding numerical value and, together with the amount of exercise performed and the weight used, is then sent to the NESTORE cloud to be processed by the DSS.

2.4.3 Balance and Flexibility

When balance or flexibility is chosen as an option, the user starts a pre-defined routine of exercises. The general structure of this routine is described above. Players are guided through a set of exercises, which are explained through explanation screens. The routine only lasts for 1 set but can be repeated as often as the player wants to. The data for these routines is sent to the cloud to inform the coach that it has taken place. The player is not asked to fill in the BORG scale and the data is not further processed by the DSS.

2.5 The Submarine Game

Pocket Odyssey aims to help players train their cognition through the Submarine game. In this game, players are asked to memorize a route on a map with a grid. Depending on the level of difficulty, the route has a certain length and therefore requires the memorization of a number of directions to turn on each juncture. At the same time, players need to steer the submarine by tilting the mobile device so that they can collect treasure in the water, all the while avoiding bombs. The game is designed with input from WP2 to offer multi-modal 'brain-training'.

2.5.1 Game Structure

The player accesses the Submarine game through the play button on the ship screen. They are brought to the main interface, where they can choose to play any of the training levels. Each of these levels introduces the player to a different aspect of the game. Playing these levels is optional and does not net the player a reward.

The player starts playing the real game by pressing the main play button. This loads the last level that the player reached, which is stored as local data on the mobile device. First, the player is shown a route on a map. The difficulty of the route increases with level tiers. For example, between levels 1 and 5 the player needs to complete a route with 3 junctures, while levels 45 to 50 consist of routes with 12 junctures. There are multiple possible layouts for the player to receive for each level. This is to improve variability and replayability of the game, as well as to retain a sense of challenge.



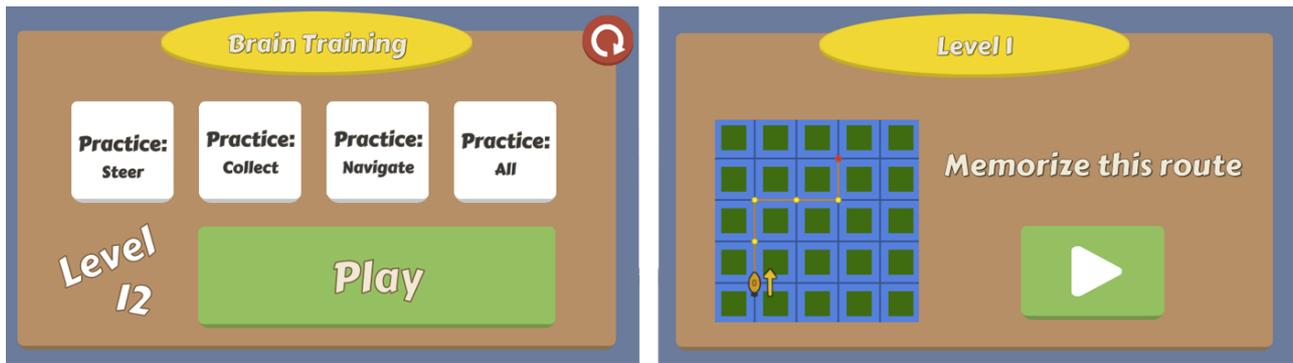


Figure 10 - Main selection screen (L) and map screen (R)

Once the player feels they have memorised the route, they press continue. Now, they are presented with a 3D environment of a submarine moving through seaweed on an ocean floor. Coins and bombs may appear along the path, the frequency and ratio of which depend on the difficulty level. Players tilt their mobile device to steer the submarine left and right. The goal is to steer the submarine close to coins and collect them by tapping the screen to earn points. The player should not tap the screen when they are in range of a bomb, as this deducts points. Whenever the player reaches a junction they need to make a choice of which direction the submarine should go to follow the route that was memorised before. The game pauses until the player has made a decision. Sound effects and a score bar at the top of the screen inform the player of whether their choice was correct, and when they collect coins or bombs.

When the player finishes the route, they are shown a screen with their score. If they score above a certain percentage, the player may advance to the next level. If the player performed averagely, they need to replay the level (possible with a different, randomly selected route). If the player performed poorly, they may drop a level in difficulty. Every fifth level (i.e. 5, 10, 15, etc) earns the player a star, but only the first time that level is reached. Levels in between these points, or levels that have been reached before, earn the player coins. The current version of the game includes 50 difficulty levels.

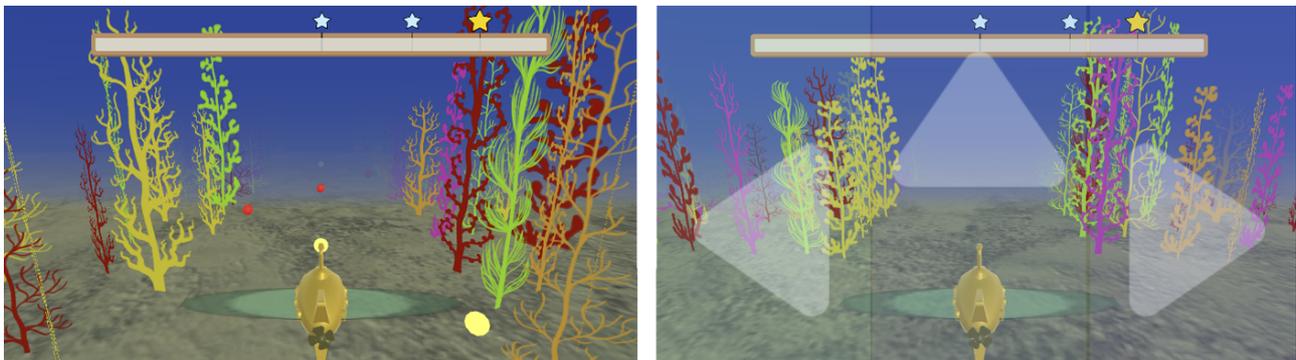


Figure 11 - Submarine collecting coins (L) and submarine at junction (R)

Data is submitted to the cloud after the completion of each level. Based on the date and time, the DSS can then process the data and determine whether enough time has been spent on playing the Submarine game. The game also tracks this internally and encourages users to play for a minimum amount of time on a daily basis.





Figure 12 - End of level with positive result (L) and negative result (R)

3 Links

NESTORE Pocket Odyssey in the Google Play Store:

<https://play.google.com/store/apps/details?id=com.tud.NestorePocketOdyssey>

