D 5.5 FINAL BEHAVIORAL GAME CONCEPT

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1.0	26/04/2019	Final version	Sergio Herrera (PMI)

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

The enCOMPASS deliverable 5.5 Final Behavioral Game Concept is a demonstrator, which according to the DoA comprises:

"The final version of the gamification and game concepts (front-end and back-end), integrated with real-time consumption and comforts data sources, user modelling, and sustainable actions recommender, adapted to the use/user contexts."

This report is an accompanying document to the actual demonstrator deliverable and is organized as follows:

- **Section 1** Describes the integrated gamified features and incentives that were implemented in the final version of the enCOMPASS awareness application and that were deployed to the pilots with the platform second release. It provides information to download and access the awareness mobile application, as well as information to access the public code repositories and build the platform.
- **Section 2** Presents Funergy card game, it shows the final version of the packaging design, it includes the final version of the card illustrations and explains in detail the game rules and mechanics, including the interaction with the digital game extension.
- **Section 3** Presents Funergy Digital game extension, it describes the features of the app, it introduces the gameplay modes. It provides instructions to download and play with the mobile application, and it provides information to access the public repositories and build the application.

The relationship of D5.5 (Final behavioral game concept) with the other ones can be summarized as follows:

- *D5.1 Behavioral change models and determinants for energy consumption* and *D5.2 Visualizations, Incentives and Engagement Strategies* have provided an extensive literature review that has yielded possible incentive mechanisms and behavioral antecedents that can be targeted by means of the visualizations designed and evaluated in this deliverable.
- *D5.3 First visualization and feedback interfaces and behavioral game concept* presented an early prototype of the incentive mechanism and the integration with smart-meter and sensor data.
- *D5.4 Final visualization and feedback interfaces* presented the final version of the incentive mechanisms that were implemented and deployed to the pilots with the platform second release.
- *D6.4 Platform second prototype* explained in detail the technical aspects of the platform component and its integration, as well as the technical requirements to build, configure and deploy each component.

1 FINAL GAMIFICATION FUNCTIONALITIES IN THE ENCOMPASS APPLICATION

The final version of the Awareness application integrates the smart-meter consumption data and the sensor readings with the end-user application and the gamification engine services to provide a fully gamified platform that reacts to user energy consumption and behavior.

Integration with all platform component has been fully accomplished, the recommendation engine uses consumption data, user profile information and user feedback to provide tailored recommendations, users receive points for reading and providing feedback of the recommendations. The inference engine uses sensor data to provide inferred information about user comfort with respect to indoor temperature and luminance, the information provided by the sensors is used to create a virtuous cycle in which users are awarded point for providing feedback about their comfort, this information is used to adjust the inference engine and improve its accuracy.

Additional to the platform gamified features and incentives already integrated and described in deliverable D5.3 First visualization and feedback interfaces and behavioral game concept, the following were integrated during the second release:

Goal Progress and Gamified Consumption Overview	A battery metaphor saving goal progress with respect to the energy consumption of the month and to the baseline. It allows to set a saving goal every month, points are awarded if the goal is reached by the end of the month; the amount of points received is proportional to the saving goal, there are 4 levels 10%,15%,20%,25% and 30%.
Monthly Competition	Every pilot runs a monthly competition in which the top 2 player of the monthly leader board receives a prize, every pilot manager delivers the prize to the winners and notify the rest of the user about the result. For school and public buildings, the prize of the competition is a cup that passes from team to team every month, and it is managed by the teachers and building managers.
Gamified Household profile	A profile page for the users to provide information about their home configuration like the orientation of the windows, or the preferred thermal comfort. Points are awarded based on the amount of information provided by the user; the highest level of points is given when the full profile is completed, progress is also encouraged with badges.
Comfort feedback gamification	It provides an overview of saved energy and the average values of the indoor sensors: temperature, humidity and luminance, along with the inferred thermal comfort. Points are awarded for providing thermal and visual comfort feedback.
Personalized recommendations gamification	The recommendation engine assigns to the users tips that are suitable for his/her consumption and behavior. Points are awarded for reading the recommendations (100 points) and providing feedback (200 points) about them.

Detail explanation along with the theory and principles behind the visual aspects of each of the gamified features implemented and its adaption for the different user profiles is provided on the deliverable *D5.4 Final Visualization and feedback interfaces*.

Based on the information collected from the gamification engine during the beta testing phase, it was decided to change some rules in order to increase the incentive of saving energy and reduce the spamming attitudes of some user that were exploiting tip feedback take advantage in the monthly competition.

The implemented changes in the rules are:

- Decreasing the number of available saving tips: the available tips were reduced by half; tips automatically changed every month. This helps to keep the user interested in reading tips and keeps contained the amount of feedback that a user can provide in a month.
- "Read tip" action is awarded only if the user spends 5 seconds on the tip page: To ensure the user is reading the content of a tip at least 5 seconds should be spend on the tip page, if the user switches to other tips before, the "read tip" action, equivalent to 100 points, will not be awarded.
- "Tip feedback" action is awarded only if "read tip" action was awarded for the same tip: as in the previous rule to ensure the user is reading the content of a tip before providing feedback he/she should be spent 5 seconds on the tip page. If the user provides feedback before 5 seconds, the "Tip feedback" action, equivalent to 200 points, will not be awarded.
- The number of points awarded by saving goals was increased: The number of points was increased to incentivize further energy saving and making points awarded by spamming actions less significant. The ranges go from the 10% saving goal that awards 12.000 points, to the 30% saving goal that awards 48.000 points.
- An additional incentive for users that did not reach their goal was added: The additional incentive is awarded when a user did not manage to reach the saving goal but was able to save at least 10%, in such case a 3000 points incentive is given.
- The required points for Energy Saving Badges were increased: The badge requirements for energy saving were increased in the same proportion that the goals, to keep the balances of the thematic area.

The awareness application is available for Android and iOS:

- Google Play Store
- iTunes App Store

It can be accessed with the following test user:

Provider: SES
Username: test1
Password: test1

A detailed installation guide, including a public repositories with the source code, has been provided on the deliverable D6.4: Platform second prototype; the sections *2.4 Gamification Engine* and *2.9 Awareness Applications* describes a detailed step-by-step procedure to download the project code and build the server-side web application and the mobile clients, a list of the required tools and version has also been included.

2 FUNERGY CARD GAME

The card game has been designed to teach children the existence of the new European Energy Scale and to let them understand that the higher is the scale level the better it is for the environment from the energy efficiency perspective.

The title of the Game “Funergy” is an English word formed by FUN + ENERGY to disseminate the basic concept that we are not working on something that might be perceived as “boring stuff”, and that we can talk about a very serious matter without losing the pleasure to have some fun together.

The title is in English in order to have a single box for every country, reducing the production cost. The game is 100% language independent, and the rules are translated into Italian, German and Greek, that are languages of the countries where the pilots were deployed.

The game concept is based on a cooperative-competitive mechanic. Players are actually “competing” to score the highest total amount of points, but every time a player “wins” a stage of the game, points are shared among all the players.

The game mechanics were redesigned, with respect to the early version presented on deliverable D5.3, to simplify them and eliminate arithmetic operations during gameplay, making the game suitable for younger children from age 6 onwards. Also, the card design and the card illustration were improved to make them more attractive to children and parents.

2.1 PACKAGING

Game packaging has been designed to be compact (Figure 1), in order to help the delivery process for the pilots and storage for the families and schools.

The cover image shows some basic concepts:

- A child playing with the game digital extension
- The piggy-bank with the European Union stars represents the idea that together we can save money
- The building with solar panels show a “green town” that cares about the environment
- The European flag and the legend inform children and families that this project has been funded by the European Union
- On the upper right corner, the enCOMPASS logo reminds the name of the project

Figure 1. Game box and packaging

2.2 GAME COMPONENTS

Inside the funergy box, the players will find:

- 2 decks of cards: the points cards (35) and the playing cards (85).
- 3 booklets with the rules and other useful information about energy saving, it is available in Italian, German and Greek.

The digital game extension is a mobile app used in the game for scoring special points after answering simple questions about energy, and it is freely available on Google play store and Apple App store. It is important to notice that the card game can be played without the app, but the app provides useful information about energy efficiency in a fast and fun way.

The point cards (Figure 2) are based on the EU energy scale (from 'A' to 'G'), the seven levels of the scale represent the 7 rounds in the game. The game starts with the lower level that gives the player the fewer points, as the game progress it moves to towards the level A that provides more points.

Figure 2. Point cards representing the European energy scale

The playing cards are divided into 3 groups; the funergy cards (Figure 3) are numbered from 1 to 7 and are illustrated with images that represent several behaviours that can help to reduce energy consumption, a brief explanation of each of them can be found in the rule's booklet.

The second group is the "inefficient" cards (Figure 4) that are illustrated with images of old appliances with a high energy consumption level. As these cards do not have a value, they block the player to close the round as long as they have it in their hand, and they need to use the game mechanics to get rid of them.

Finally, the enCOMPASS wild cards (Figure 3) which contain the encompass project logo and a QR code. These cards are used to substitute any missing card in the hand of the player. When the player closes the round with a wild card, he/she should use the digital game extension to answer a question.

Figure 3. Playing cards showing energy efficient behaviours, on the left an enCOMPASS card to be used with the digital game extension

Figure 4. On the top: A group of "inefficient cards" showing old inefficient devices. On the bottom: Playing card showing energy efficient devices.

2.3 GAME RULES AND GAMEPLAY

The game, designed for 6+ age players, is divided into 7 rounds, one round for every Energy Scale Level. The game begins with the G level (the lowest one) and finishes when players reach the A level (the highest one). At the beginning of the game each player receives 7 cards (7 is the "magic number" recalling the 7 "levels" of the Energy Scale), the rest of the cards are put at the centre of the table as the drawing deck. The objective of the players is to form a combination of cards numbered from 1 to 7 by drawing from the deck and by exchanging cards with other players. The first player completing the right sequence is the winner of the round.

For every round, there is a small pack of 5 cards showing a piggy-bank with an increasing value, the winner of the round takes the highest card and distribute the remaining ones to the other players, then the player will draw from the deck 7 new cards and the next round can begin. The values of the piggy-bank increase level by level, so winning the last one can be crucial for determining the winner of the game.

The "inefficient" cards (Figure 4), illustrated with old appliances, do not have a number, therefore, a player cannot win a round while having one of this cards in its hand, but he/she can discard them or give them to someone else. Playing the game, the children understand that giving a "bad card" to someone else can be funny, but it's almost useless as they can give it back in the next turn, therefore discarding it to the deck is much better for everyone. It is a simple way to teach children virtuous behaviours.

The enCOMPASS wild cards (Figure 3), illustrated with a QR code, can be used to substitute any number, helping the players completing the winning sequence, a lucky way to "win", but to use this cards players need to answer a simple question, scanning the QR code with the funergy app.

At the end of the 7 rounds, all players reveal their score showing the Energy Scale Cards received during the game and adding 3 points for every enCOMPASS cards in their possession. The winner is the player with the highest score.

3 FUNERGY DIGITAL GAME EXTENSION

The funergy digital game extension is a companion mobile app for the card game, which can be used to further animate the gameplay while injecting it with elements of energy efficiency awareness.

The essential requirements for designing the digital game extension are as follows:

- The game must be playable by the following categories of players: players of the funergy card game, users of the enCOMPASS platform and casual players.
- The gameplay must be simple and quick, not to interrupt too much the course of the funergy card game.
- The gameplay must adopt a well-known game pattern, so to avoid any learning curve.
- The gameplay must convey some energy awareness content, without jeopardizing the playability.

Based on such requirements, the choice has focused on a simple binary quiz game, in which much of the fun of the game is obtained by the variety and curiosity of the questions, which must be designed to provide a good mix of purely educational and entertaining contents. Furthermore, questions have three levels of difficulty (easy, medium and hard), which may serve the purpose of increasing the level of difficulty during a session, so to make the challenge more difficult as the gameplay proceeds.

3.1 FUNERGY GAMEPLAY

As mentioned on the previous section, Funergy is a quiz game that presents the players with questions and 2 possible answers, the player makes a choice and the app provides feedback if it was right or wrong, after

that it also offers an explanation about the topic of the question. There are 3 levels of difficulty, as the player improves the questions become harder. Table 1 shows some examples of the questions that have been integrated into the game.

The game graphics were improved, with respect to the early version presented in deliverable D 5.3, have a uniform visual identity with the card game and make it more attractive to children. Further improvements like the random selection of the questions and the general user experience design were also added to the final version of the game.

Question	Correct Answer	Wrong Answer	Difficulty Level
Leaving electrical devices, such as the TV, on standby does not affect the electricity bill	False	True	Easy
What are phantom loads?	Appliances that consume power when they are turned off but still plugged in	Appliances that consumer power during the night	Easy
What is a greenhouse gas?	One group of gases (of which carbon dioxide is the most abundant) which are accumulating in the atmosphere, trapping heat and warming our planet	A gas that comes out of houses	Easy
What does LED stand for?	Light emitting diode	Low energy device	Medium
What is a cool roof?	A roof that uses materials that reflects more sunlight and absorbs less heat than a standard roof.	A roof partially or completely covered with grass or vegetation.	Medium
What is the voltage in a typical household electrical circuit in Europe?	230	110	Medium
What is the unit of electric current?	Ampere	Volt	Medium
What is the definition of power?	The amount of energy that is being moved at a certain time.	Power is just another term for energy.	Hard
Are instantaneous hot water heaters more efficient than tank water heaters?	Yes	No	Hard
What was the first electronic musical instrument?	The Denis D'or, the "Golden Dionysus"	The Theremin	Hard

Table 1. Example of questions used by the Funergy App

There are 2 game modes in the game:

- Single Player: In this mode the player receives a continues series of questions, as the game progress if the player is able to answer 10 questions correctly in a row the game will level up and questions will become harder; if the player answers incorrectly 2 times in a row the level will decrease.
- Decode a Card: This mode is used while playing the card game, when a player uses an enCOMPASS "wild card" he/she will have to use the app to decode the QR code of the card, the app will show a question if the user answers correctly he/she can keep the card and will be awarded points.

Both modes and the settings option can be reached from the Home screen of the app (Figure 5), the settings allow the user to change the language of the app and the questions, 4 languages are available: English, Italian, German and Greek.

On the Quiz screen (Figure 6) the app presents the quiz and the 2 possible answers, a badge with a number on the top right corner of the screen represents the players current level when the player levels up or down a popup will notify about the change and the badge number will be updated.

The application provides feedback to the players whether the answer provided was right or wrong (Figure 7), the vibration of the device is part of the feedback. On the feedback screen the players are presented with the possibility to read an explanation about the topic of the question (Figure 8) to help them understand why they were right or wrong; the content of the explanation has been designed to be short and concise, to be easy to understand and to keep the flow of the game.

On the "Decode a card" mode, the player will have to point the camera of the device to the QR of the enCOMPASS "wild card" that is been played in the card game, the app will decode it and present a new quiz.

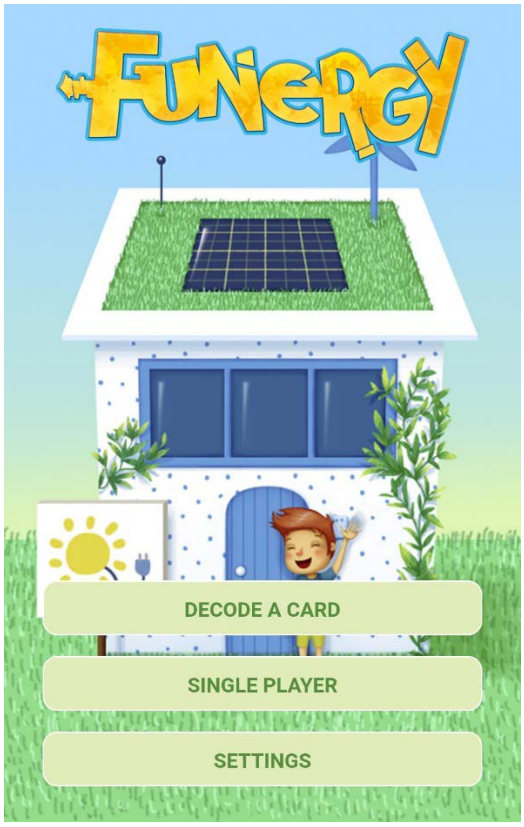

Figure 5. Funergy Home screen

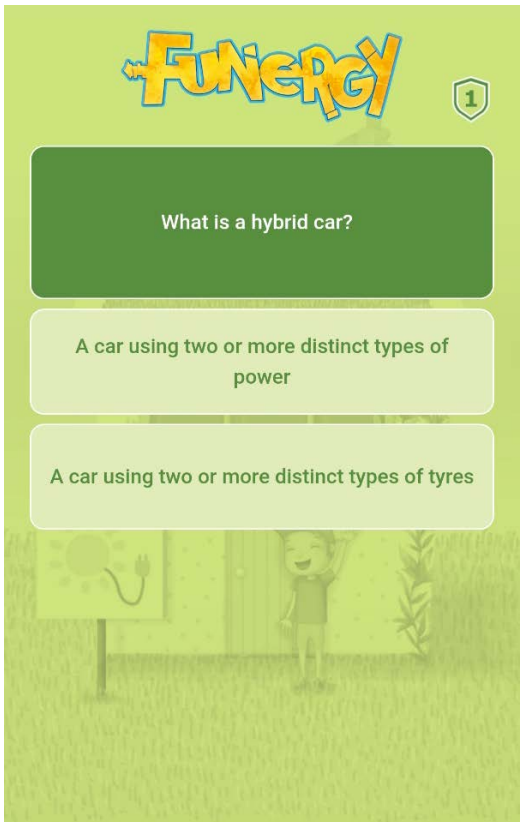

Figure 6. Quiz screen showing the question and 2 options.

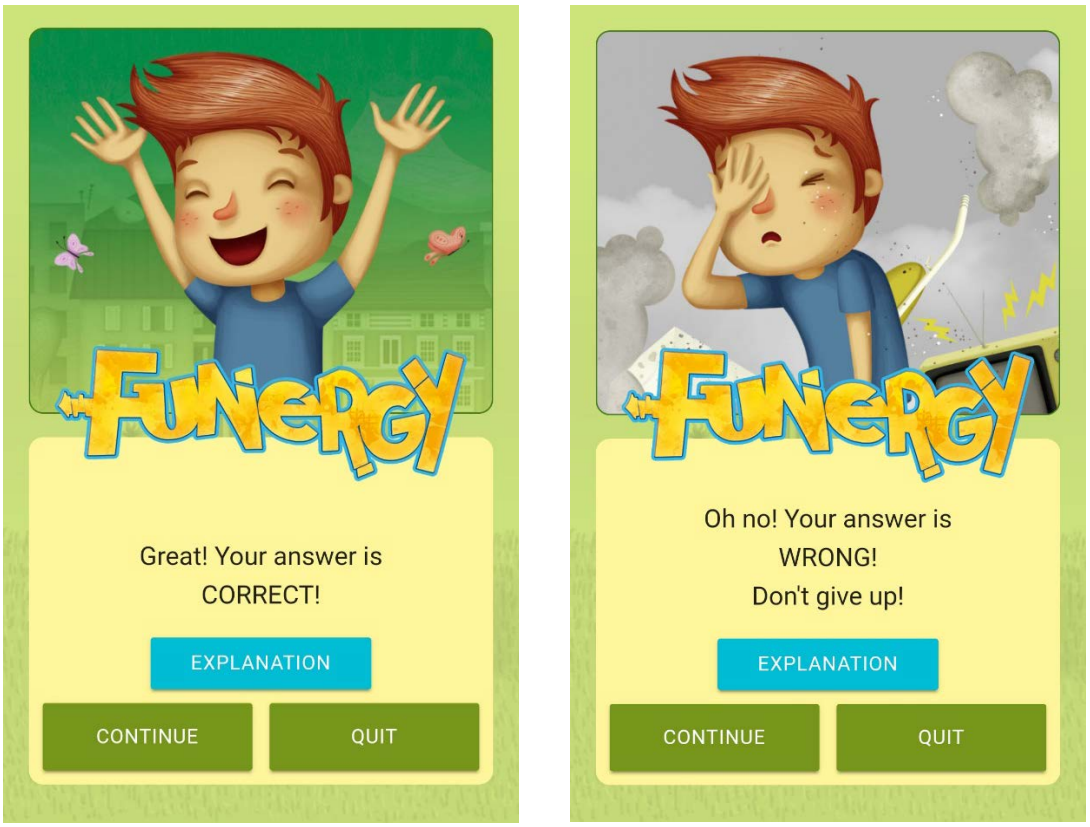

Figure 7. On the left: Positive feedback for a correct answer. On the right: Negative feedback for a wrong answer.

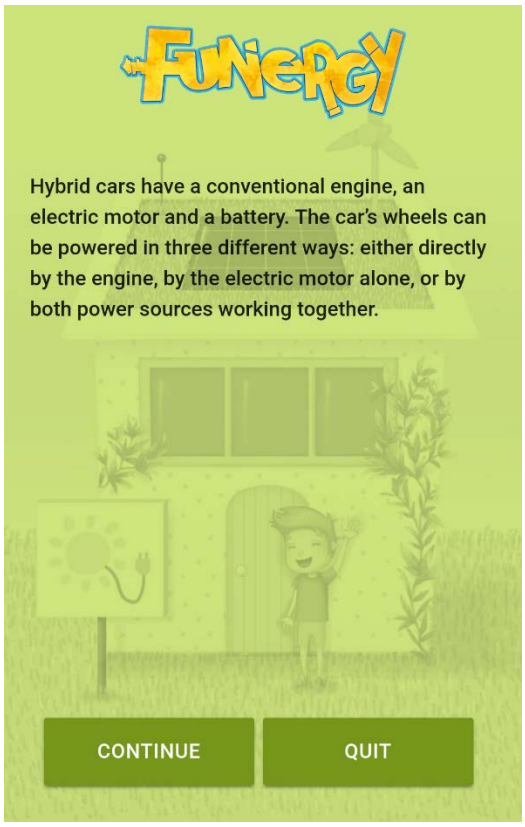

Figure 8. Explanation screen, showing the explanation to the question of Figure 6

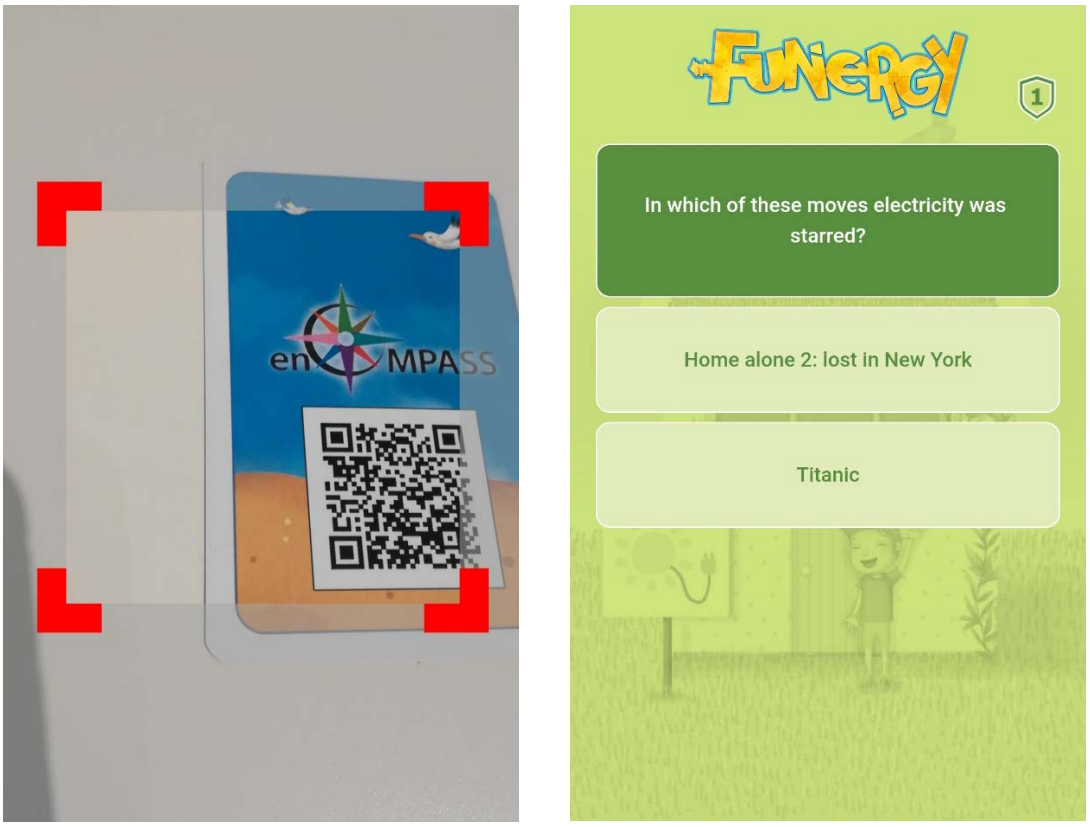

Figure 9. "Decode a card" mode to be used with the Funergy card game.

3.2 INSTALLATION GUIDE AND PUBLIC REPOSITORY

The funergy game has been developed following a Model-driven approach, that enables the generation of code from models representing the different aspects of the application, the selected tool for the development was IFMLEdit[1], an open source platform for the development of web and mobile applications based on the OMG standard IFML. This platform generates an Apache Cordova[2] project that can be used to build and deploy applications for Android and iOS with a significant reduction of the effort.

The application is available on both stores:

- Google Play Store
- iTunes App Store

A detailed installation guide, including a public repository with the source code, has been provided on the deliverable D6.4: Platform second prototype; the section *2.11 Digital Game Extension* describes a detailed step-by-step procedure to download the project and build the application for Android and iOS, a list of the required tools and version has also been included.

4 APPENDIX: IFML DIAGRAMS OF THE GAME

In this appendix, the specification of the funergy game is provided, expressed using the IFML OMG[3]/UML standard.

The model file (*ifml.json*) can be found in the software repository, together with the generated code. The model can be imported to the IFMLedit editor.

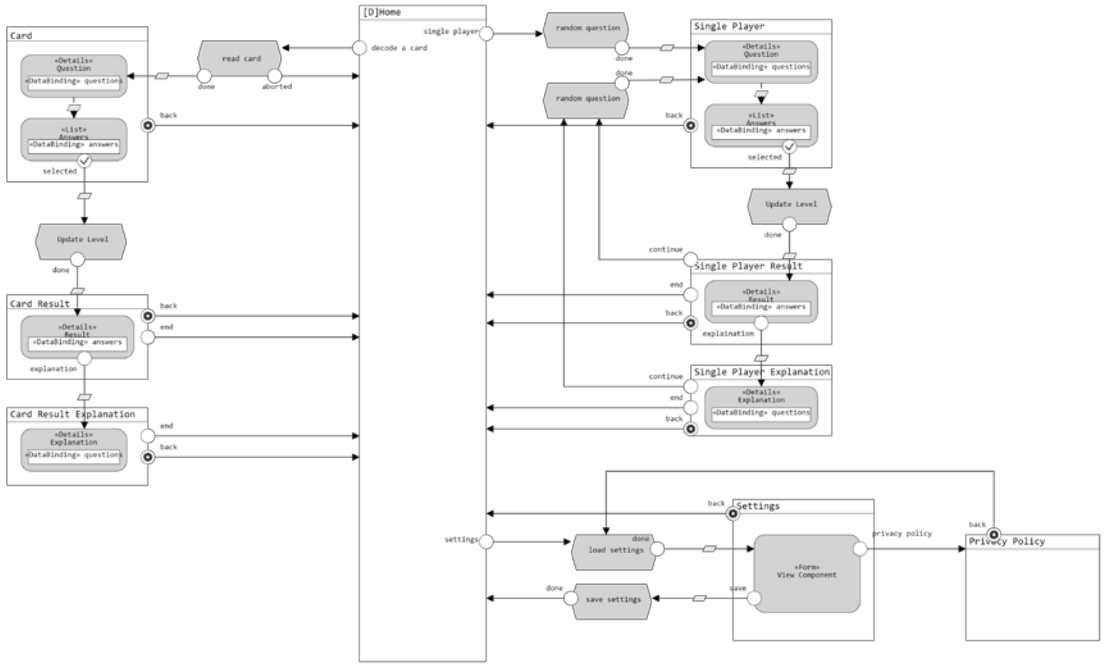

Figure 10. IFML diagram of the Funergy game app.

[1] http://ifmledit.org/
[2] https://cordova.apache.org/
[3] https://omg.org/spec/IFML/