

# NutritionRush – A Serious Game to Support People with the Awareness of Their Nutrition Intake

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**Abstract**—Malnutrition poses a threat to our physical health and to our well-being. Among the effects of malnutrition are stunting, wasting, overweight, obesity or micronutrient deficiencies. All of which foster the onset of noncommunicable diseases, which grow at alarming rates, especially in the European Region, according to the World Health Organization. This problem can be found across all age groups. In order to raise awareness on that matter and educate about healthy nutrition the authors designed a serious game which was entitled “NutritionRush” together with a nutritionist. It offers a nutrition library to look up nutrition details regarding nutrients, nutritional values, daily energy intake and encourages users to actively employ their knowledge while trying to accomplish specific missions during the game part. The authors also evaluated the initial prototype of NutritionRush with 14 participants in terms of gameplay satisfaction, user experience, quality of nutritional content and the potential to educate or foster healthy eating behaviors. The feedback showed that there is a lot of potential for such serious games and that the prototype is a good initial starting point for different identified requirements.

**Keywords:** *user centered design; nutrition; serious game;*

## I. INTRODUCTION

You are what you eat. We all know this phrase. It is about the food we take in. It also amounts to the choices we make when we grab a quick bite, when we are out and about having a meeting coming up in the next half hour with the food truck just around the corner. The food we take in is the result of the meetings we have, the mood we are in when we need to prepare meals, the time we have on our hands until the next task is coming around. The food catalyzes our well-being and also determines different states of sickness or health in general.

Malnutrition has detrimental effects on one’s development, health and well-being. Malnutrition may result in stunting (i.e. low height in reference to age [1]), underweight, micronutrient deficiencies, overweight, wasting (i.e. low weight with respect to height [1]), and obesity [2]. They can further adversely impact health by acting as levers for noncommunicable diseases [3]. It also negatively affects people suffering from oncological diseases as it takes its toll on treatment outcomes and quality of life or even their survival [4].

Regarding elderly people, low nutrient intake has an impact on their frailty according to the InCHIANTI study,

which assessed the status of 802 elderly people over the course of 1.5 years [5]. A software helped determine what daily intake of energy and nutrients their food consisted of. A nutritional score represented the number of nutrients that were taken in at a low quantum. The principal investigators of the InCHIANTI study reported they found significant association of daily intake of energy  $\leq 21$  kcal/kg and frailty (odds ratio: 1.24, 95% confidence interval  $> 1.02$ -1.50). Having a low intake of more than three nutrients is reported to be significantly linked to frailty as well (OR 95% 2.12 CI: 1.29-3.50).

A qualitative study with sixty caregivers in rural China reports nutritional deficiencies and lack of information in complementary infant feeding practices [6]. By interviewing all these people, these authors established evidence that although educational programs are in place, little knowledge and misinformation is the number one factor of deficiencies yielding serious consequences like anemia in children. This undermines the authors’ opinion that educational programs need to be put in place that tackle the issue of miscommunication and misinformation from another angle.

Over the past 15 years, the number of children under five who are overweight has risen from 31 to 42 million worldwide [2]. Stunting is reported to have decreased from 198 to 156 million. However, reports suggest that this decrease is happening too slowly. 50 million children under five showed wasting as a form of malnutrition in 2015, whereas a big percentage of this group (14.1%) can be found in Southern Asia.

According to the Global Health Observatory data repository of the World Health Organization (WHO) about 61.6% (crude estimate) of the adult population (both sexes) aged 18+ years account for being overweight (having a body mass index of greater than or equal to 25) in the WHO European region in 2014 [7]. About 24.7% (crude estimate) of the same population group was obese (body mass index is greater than or equal to 30) in 2014.

To address the challenges associated with poor dietary habits, the United Nations set up a European Food and Nutrition Action Plan for the years of 2015 until 2020 [3]. There they discuss that malnutrition, excessive intake of food with high energy, trans fats, salt and sugar are likely to be the cause of chronic diseases. Their objectives are to create healthy food and drink environments, promote healthy diets, support surveillance, monitoring, research and strengthen cooperations to carry out inclusive health policies.

Serious games are considered as helpful tools in educating or training people, while still entertaining aims to motivate desired behavior (or behavior change) in playful and fun ways [8]. They may help call someone's attention to topics like malnutrition and their devastating effects on our health, where other tools or policies may fail in conveying their messages. In fact, studies show that serious games positively affect healthy lifestyles, even if reported effects are only small [9][10]. In particular, knowledge about health, for instance, nutritional knowledge, benefits strongly from such games [9][11]. Also, given that marketing strategies like food advertising directed at children are in place, which adversely influence eating behavior or desires of our youngest [12], serious games can also be of assistance.

The authors of this publication believe that in order to address above issues, serious games that are specifically tailored to the target group may support the awareness of nutrition intake. In this case, the target group includes those people, who lack information in the field of nutrition or who want to achieve a healthier and more balanced eating behavior, regardless of age. The authors also want to teach users about healthy food options in fun and entertaining ways and think that these aspects are very important to address and may pose a supporting mechanism in terms of nutrition intake.

This paper introduces *NutritionRush* - a serious game, which aims to increase the awareness of what we eat or should not eat on a daily basis in a playful manner. The game, which is developed for Android mobile devices, contains a nutrition library that educates on basic information like daily intake of energy, nutrients, calories or carbohydrates. Several created levels require users to apply this nutrition knowledge in order to accomplish their game missions. In addition, *NutritionRush* lets players customize their profile, whose data then determine what the actual goal of a game level looks like for an individual user.

The remainder of this paper is structured as follows: Section II contains the description of related work. Section III then gives an overview on the methodology used throughout this research. Section IV delineates the results comprising initial requirements, prototype details and its evaluation. Afterwards, the authors present the conclusion in Section V. This publication finishes with a discussion of benefits and drawbacks, as well as potential future work ideas in Section VI.

## II. RELATED WORK

Researchers have established a multitude of serious games that focus on nutrition and increasing people's behavior to stay healthy. There is also a growing amount of research studies focusing on behavior change or knowledge gains, which couple real-life activity with in-game rewards [11][13]. Their findings seem promising in increasing potential and willingness on motivating behavior change. At this point, however, research on effectiveness of such serious games is still a bit scarce according to Shiyko et al. [11].

*Nom Nation* is a serious game in the category of jump&run which aims to educate players about balanced and

healthy eating as well as exercise habits [14]. The main game character, a chef, is on a mission to recover missing pages of the book of noms, which is a collection of several healthy food recipes. Along the way, the chef encounters a variety of food items (such as broccoli, rice, hamburger or milk) that can be collected and/or eaten and ought to help the chef reach his goal. Each food item represents a certain characteristic, which will temporarily transform the appearance of the chef as well as his player characteristics. For instance, taking in some fat will turn the chef into an overweight character and slow down his running speed, while exercising will help him get rid of a couple extra pounds. The key of the game is to understand the relationship of food items and their functions as well as the necessity to take charge of balancing out one's dietary intake and physical activity.

The iOS application *Healthy Food Monsters* is designed for kids at the age of 6-8 years to help them learn about what kinds of food are considered healthy and what kinds are considered unhealthy [15]. The main character in the game is a little furry monster that constantly moves through a world where food floats by. Every time the monster touches a healthy item, like fruits or vegetables, the monster is rewarded a point, while an encounter with junk or unhealthy food results in instant death of the monster, respectively a game over. Besides food items, the game introduces obstacles that destroy all unhealthy food upon contact with the player's character. The velocity and number of food items floating around increases over time. The app displays the points collected as well as time passed since onset of the game in the upper right corner. The collected points can be used to unlock additional monster characters, while the time counter does not seem to have any further effect as the game does not come with a high score or a leader board.

The mobile application *Healthy eating with Diana* aims to teach kids about healthy eating habits [16]. *Healthy eating with Diana* is a game, which contains a series of different quizzes, where children need to decide which food items are healthy and should be eaten on a regular or rather on a rare basis. To accomplish this, children ought to drag and drop food objects into the right box or category they represent.

A video game called *FatWorld* teaches its players about the underlying politics of obesity and nutrition and the socioeconomics in the United States [17]. A player sets up an entire virtual world by establishing its political regime, by setting up an economy, introducing market regulations, subsidies, and special interest groups. The user then slips into the role of a citizen of this *FatWorld* and configures their characteristics, e.g. specific food allergies, walks around in the city, buys houses, opens up a restaurant, pays taxes etc. To bypass malnutrition and overweight, the citizen can choose to do exercises and eat healthy or indulge in a more sedentary lifestyle. The life a player chooses to live in *FatWorld* will have an impact on the character's well-being and health, regardless if the player sets any deliberate actions.

A 10-episode video game called *Squire's Quest! II* targets children at the age of 9-11 years and aims to increase their daily fruit and vegetable consumption [18]. *Squire's*

Quest! II involves both children and their parents as the home environment and family support has substantial effects on a child's eating and exercising behavior [19]. The player turns into a squire, whose quest is to become a knight, thus help save the Kingdom of Fivéalot, where enemies are destroying fruit and vegetable crops. Squire's Quest! II comprises 10 mini games, each offering specific challenges. For instance, bubbles containing food are floating around and the player needs to pop those bubbles that contain vegetables and identify those that are vegetable impostors, i.e. high fat items that pretend to be vegetables but only contain very few of them or none at all. To evolve the squire's character further during the game, the child needs to attain their goals of fruit and vegetable consumption in real life [18][20]. During gameplay, children are assigned to four groups that determine how they pursue their goal throughout the game. One group sets up a coping, another one an action plan, yet another group a simple plan of plain goal setting and another group employs setting a combination of a coping and an action plan. Parent's involvement was to read newsletters, additionally, they got access to a website delivering information alongside video game that their child played like child asking behavior or recipes.

An evaluation by Thompson et al. [20] with 400 parent/child pairs revealed that children from the action and the coping plan group showed significant increase of daily fruit and vegetable consumption at post 1 evaluation compared to the baseline (action plan: 0.72,  $p < 0.0001$ ; coping plan: 0.48,  $p < 0.001$ ), change from baseline: 0.72. Only the action group plan was able to maintain the increase in fruit and vegetable consumption at post 2 ( $p < 0.0001$ , change from baseline: 0.68). They also reported a statistically significant time main effect regarding fruit intake (0.32 at post 1 with  $p < 0.001$  and 0.23 at post 2 with  $p < 0.01$ ). Parent intervention was reported as low, although they rated the behavior change program positive for their children.

The serious game *Cibopolis* concentrates on delivering knowledge regarding nutrition and healthy life styles [13]. Its goal is for players to gain citizenship of the city of Cibopolis. Citizenship is granted once a player successfully mastered the challenge of obtaining the 5 meals cup. On a daily basis, healthy meals need to be prepared and cooked. To that extent, players need to buy the food they need in a virtual market, store them somewhere in their houses, and afterwards, select those ingredients necessary to prepare their meals. *Cibopolis* uses a virtual currency to allow purchasing/selling food. Players can earn more money by contributing healthy recipes to the community, by designing new game missions or by carrying out specific nutrition and exercise missions in real life. Experts then assess these newly created missions before they are published. 65 people between 14 and 32 years participated in evaluating *Cibopolis* in terms of usability, knowledge gain and behavior change. They reported that usability was regarded above average (score of 75.22/100 on the System Usability Scale). However, only 4% of the participants wanted to use the system more frequently. Further results indicated that perception of the game, like enjoyment, significantly

affected user's behavioral intentions ( $\beta = 0.21$ ,  $p < 0.01$  on Goodness of Fit indices).

Shiyko et al. designed a browser-based serious game, which aims to promote nutritional knowledge, help women eat healthier and exercise more [11]. The game centers around establishing and maintaining a spa resort, whereas doing exercises and eating healthy in real life can speed up a player's game progress. 47 women participated for a period of 90 days. The authors of this study saw a big increase in nutritional knowledge mostly attributed to the fact that participants were engaging in week-long food quests in real life. An example for a food quest was described as substituting a beverage containing lots of sugar with water multiple times a week. They argued that gains in nutritional knowledge can happen over the course of three months already.

Due to the fact that most of the found serious games do not deliver enough background information about nutrition or just teach what is good and what is bad, the authors decided to develop NutritionRush. Another drawback of current games is also the long-term motivation, which should also be improved with NutritionRush. Therefore this game should deliver an easy and fun way of playing a game and getting to know the basic information about nutrition and the effects of malnutrition.

### III. METHODS

The methodology used within this research consisted of an initial work-phase, where a search for participating nutrition experts as well as a basic literature review was conducted. Afterwards, an initial brainstorming with one expert was conducted to find out about the needs and wishes for a serious game in the context of nutrition. This resulted in an initial definition of use-cases and requirements, which were then used as a starting point for a user centered design (UCD) process [21][22] to refine and adapt those requirements through different iterations. Another important aspect after the initial game idea, which was described by using mock ups, was a technical framework research to be used for the development of the serious game. Within each

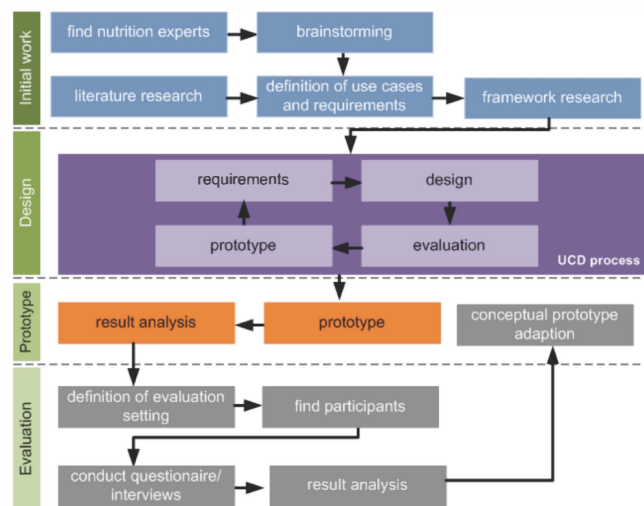


Figure 1 Methodology

iteration of the UCD process, the serious game was evaluated by this expert and changes were made to the prototype to fit his needs and wishes. In the end, a final prototype was presented and discussed. This prototype was then used for a larger evaluation.

For the evaluation part an initial setting was defined to clarify and state the basic conditions (e.g. who should participate). This step also included an interview guideline for the evaluation. In addition, the authors prepared a list of tasks related to the NutritionRush application. For instance, one of these assignments was to perform all necessary steps to create a profile and obtain one's body mass index in NutritionRush. This task list was then administered to participants with the aim to have them interact with the application while thinking aloud. Furtheron, participants received a mobile phone which had NutritionRush pre-installed to accomplish their tasks. Sessions where participants interacted with the application lasted from 45-60 minutes. Given consent of participants, their gaming sessions were also videotaped for later analysis. Afterwards, participants received a User Experience Questionnaire (UEQ) [23] and a questionnaire with open questions focusing on their thoughts regarding NutritionRush and its aim to motivate healthy eating behaviors. Afterwards, participating experts were interviewed to also get their feedback for the prototype. These conducted tasks resulted in an adaption of the prototype. This evaluation was done to get a better idea of possible users to gain a better knowledge about their acceptance and the overall design of the prototype. Participants received small nutrition packages for compensation, each containing a banana, an apple, and a cookie.

#### IV. RESULTS

Together with the nutrition expert, a prototype was designed and implemented. It consists of several initial requirements and the definition of its underlying technical architecture (which are outlined in Section A), and more details on the prototype (Section B). Afterwards, the evaluation of the prototype is explained in more detail and some improvements based on the results are discussed (Section C).

##### A. Initial Requirements

The brainstorming phase with one nutrition expert combined with further literature research ended in an initial idea how such a game should be set up. After the basic requirements were identified, an evaluation for the technical implementation was conducted for the development of the serious game. The architecture for the prototype uses a frontend implementation in the current state. The target platform for this serious game is Android to deliver a wide range of usage.

After different iterations with mock-ups, a prototype was implemented. Within each iteration the requirements were adapted and used for the next iteration. In the end, the prototype was stable and the final requirements were established. Those requirements can be found in Tab. 1.

TABLE I. INITIAL REQUIREMENTS

Requirement #	Description
IR01	A library with information on nutrition should be included (daily energy intake, nutrients, calories, carbohydrates, BMI)
IR02	Profile data should be entered
IR03	The game should contain several levels and missions
IR04	A mission summary and info if goal was met or not should be displayed after a level is completed
IR05	The game should deliver fun and entertainment ways
IR06	It should be possible to collect points, to view a high score and to see progress in time
IR07	A quiz should be included
IR08	Several avatars should be offered to choose from
IR09	Avatar's characteristics may be improveable (faster, may jump higher)
IR10	Levels on macro- and micro nutrients may be included
IR11	Levels should include health and unhealthy food items to be collected
IR12	The avatar should be able to progress during gameplay
IR13	Include personal data of user into the game

##### B. Prototype

Based on the architecture and the initial requirements from Tab. 1, a prototype was implemented: The NutritionRush serious game is a jump&run game, where the player needs to do different missions by moving an avatar called Timmy. The avatar needs to collect food to learn something about ingredients and to increase the awareness about good nutrition. Features and functionality of the prototype – as well as which initial requirement they satisfy – are described in more detail below. Requirements are given in square brackets and designated by their requirement number as given in Tab. 1.

Upon launching the application (see Fig. 3) the user has different options to choose from: He/she can start the game,



Figure 2 Game overview

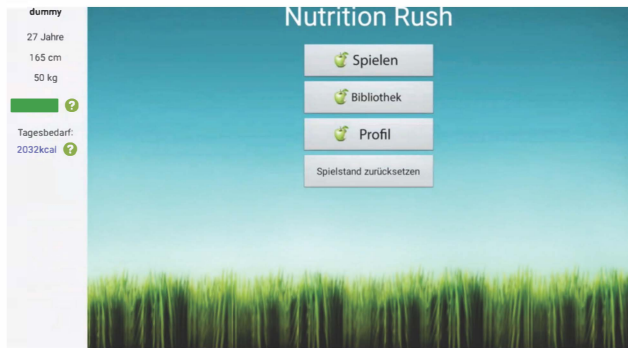


Figure 3 Game start

read about nutrition information (e.g. what are carbs – see Fig. 4, #IR01), enter or edit his/her profile information or reset the current score (#IR02). Based on the entered data in the profile (e.g. weight and height), the BMI and the daily consumption of a user is calculated and displayed. After starting the game (see Fig. 2), the mission overview is displayed, where different levels are available to choose from (#IR03). Before a level starts, a short description of the goals is given. The goal of a level is reached if a defined set of food (calories) is collected. Food can be collected by jumping and running in the game environment, which is controlled by buttons on the mobile device screen. There are also some obstacles (e.g. flying dog), which need to be avoided while collecting the food. If such an obstacle is touched, the player needs to restart the level. There is a wide range of different food which can be collected e.g. fruit, vegetables, eggs or pizza (#IR11). Each food has different nutrition data like protein content or fat, which is also explained in the mission overview in the beginning of the level. In addition to the food, coins can be collected for additional achievements and motivational aspects (#IR06). After a level is finished, a summary of the collected items and their nutrition data is given, as well as if the level was successful (#IR04).

Due to the prototypical character only a few levels were implemented. Currently, there are three different levels in the game:

- Level 1: Collect all food in this level to get to know the overall game and its controls;
- Level 2: Collect your personal daily consumption of calories; and



Figure 4 Library example

- Level 3: Collect a reduced number of your daily consumption of calories, to gain better knowledge about your BMI (#IR13).

### C. Evaluation

The implemented prototype was evaluated together with 14 users of various professions (including nutrition experts – see Tab. II) to get a better understanding of their needs and possible room for improvement within the initial prototype and the requirements in Tab. I. The participants were chosen because of their interest and relation (motivation) to nutrition/diet behavior. Those participants are considered as possible future users of the developed serious game.

This evaluation was split into two parts:

- Prototype evaluation with users: possible future users of the serious game were asked about their thoughts and beliefs as to what raises nutrition awareness;
- Prototype evaluation with experts: different experts from the nutrition domain were interviewed to get a better understanding of the theoretical backgrounds regarding the gameplay.

The output we gathered during these prototype evaluations directly fed into establishing a list of revised, final requirements (see Tab. III, Tab. IV, and Tab V). Specific final requirements that link to the excerpt of user feedback described below are given in square brackets, and are designated by their respective requirement number.

Analysis of participants' responses on the UEQ revealed following average values in regard of its six thematic scales: attractiveness: 0.226 perspicuity: 0.607, efficiency: 0.083, dependability: 0.732, stimulation: -0.661 and novelty: -0.339. Perspicuity and dependability were perceived as positive by most participants. Lowest values were found with the scales stimulation and novelty, indicating that participants found it rather uninspiring.

An overall number of 11 (out of 14) participants handed in their answers to the open questions. Key points were as follows: At least three participants liked the retro style of the game, which resembles the look and feel of familiar video games. At least two participants were fond of the idea to use games for education and for promoting healthy eating. One person did not find any pleasure in playing the game, whereas another one perceived the simplicity very enjoyable. Interestingly, this exact participant also criticized the one-

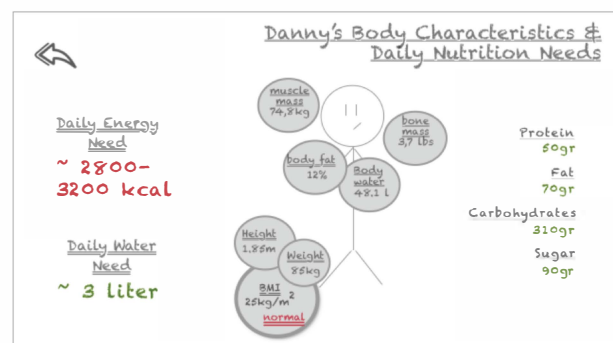


Figure 5 Possible improvements after the evaluation



sidedness of the game and talked about the desire to see more dynamics during the gameplay. One person mentioned the “flying, deadly dog” as an especially positively perceived aspect of the game.

Regarding the question what people disliked about the game, an overall number of five participants mentioned keywords like simplicity, excessiveness and primitivism. Their main point was their wish to experience more challenging tasks (#F15, #F16) as well as a higher graphics quality (#F20).

Interviews with experts revealed that they were much in favor of the jump&run category of the game. There also was unanimous consent on the fact that NutritionRush could be motivating and may benefit users interested in learning about nutrition at an early stage. Nonetheless, they stated that the current design could not nearly be enough to actually induce behavior change towards eating more healthy in the long run. They attributed this to the fact that behavior change is a complex phenomenon interwoven with a multitude of different factors. Experts also pointed out the necessity to focus more on the game design and actual game play/experience in order to make it less monotonous and more engaging for users (#F12, #F16). Another key aspect that was mentioned during the interviews was the desire to include the concept of exercising, which would also allow the virtual character in the game to eat less healthy stuff, as well (#F10). The overall results of the requirements after this evaluation can be found in Tab. III (nutrition details), Tab. IV (game play) and Tab. V (game design). These results also concluded with an adaption of the prototype on a conceptional level (see Fig. 5 for an adaption of the daily nutrition overview).

TABLE II. EVALUATION PARTICIPANTS

ID	Gender	Age	Group	Motivation
01	m	52	Nutrition expert (Professor)	Teaching
02	f	30	Potential user	Prevention
03	m	31	Potential user	Teaching
04	m	31	Potential user	Nutrition information
05	m	39	Potential user	Prevention
06	m	29	Potential user	N/A
07	f	22	Potential user	Well-being
08	m	24	Potential user	Nutrition information
09	f	46	Nutrition expert (Univ. assistant)	Prevention
10	m	33	Potential user	Prevention
11	f	27	Nutrition expert (Nutrition Trainer)	Teaching Prevention Well-being
12	m	10	Potential user	Teaching
13	m	18	Potential user	Teaching
14	m	24	Potential user	Well-being Sport

TABLE III. FINAL REQUIREMENTS REGARDING NUTRITION DETAILS

Requirement #	Description
F01	A target group needs to be defined.
F02	The information displayed to the users during the game should be presented in a concise, effective and efficient way.
F03	The correctness and validity of the nutritional information should be rechecked with experts.
F04	Figures (e.g. regarding collected calories) should be approximate and rounded-down values.
F05	Further occupation groups need to be added as available options under a user's profile.
F06	The game should provide a more diverse set of food items, a basis could be the food pyramid.
F07	The game should allow for differentiating between healthy and less healthy food items.
F08	The game should make the differentiation between healthy and less healthy food more apparent when the player collects it.
F09	The game should let the player know why one item is more or less healthy than the other.
F10	Exercising should be included in the game.
F11	The game should incorporate reward or punishing mechanisms.

TABLE IV. FINAL REQUIREMENTS REGARDING GAME PLAY

Requirement #	Description
F12	The game should put more focus on its fun and entertaining structure.
F13	Knowledge should be less heavily based on text.
F14	Instructions should be less lengthy.
F15	The game should include more challenges and also include missions that come with a higher level of difficulty.
F16	The levels should be more diverse and exciting.
F17	On game over, the player should be able to see a summary of collected points.
F18	The game play and structure should more accurately reflect individual profile data.
F19	Existing scoring functions should be extended and coupled with rewarding mechanisms.

TABLE V. FINAL REQUIREMENTS REGARDING GAME DESIGN

Requirement #	Description
F20	Graphics should be of higher quality/more modern.
F21	Sounds should be of better quality/more modern.
F22	Game elements should be bigger/more distinctive as well as more easily accessible.
F23	Access to information should become easier – at best, the information ought to be integrated into the game (the levels) itself providing higher visibility.

## V. CONCLUSION

NutritionRush tries to deliver a new serious game approach to raise awareness about nutrition. This serious game was developed for mobile devices, where the player can navigate an avatar within a jump&run environment. This

game contains different levels with different goals. It was created together with a nutrition expert and focuses on information about proteins, carbs, fat vitamins and the overall energy transformation. Based on this prototype a larger evaluation with potential users and other nutrition experts was carried out. This evaluation ended with different additional requirements and a concept for the improvement of the NutritionRush prototype.

## VI. DISCUSSION

The proposed NutritionRush serious game aims to deliver new aspects for the development of a game within this domain. There are a lot of different games available, which target nutrition awareness and motivate people to keep track of their nutrition and to motivate them to stay and eat healthy. In the authors' opinion all those games do not deliver enough background information about nutrition, therefore a new game was developed. Only one nutrition expert was included in the development of the initial prototype, which might be seen as a drawback. But the results are considered as a good starting point for the evaluation, which was done together with different other users and experts. Although these results were not implemented yet, they deliver a very clear idea of requirements for a new prototype and some improvements. Another drawback of this initial prototype is the lack of different levels. Just three different levels were included, which do not deliver long term motivation to play the serious game. Therefore, the next step will be the inclusion of different new levels. The overall serious game should also be enhanced with some of the identified requirements from the evaluation. Afterwards, another evaluation with the final serious game is planned to find out, if using this serious game can increase the nutrition awareness. Another possibility for future work is the inclusion of more gamification elements (e.g. leaderboard) or possibilities to play against each other. On a more technical point of view, the development of an iOS or web/HTML5 version is also thought of. There is also the possibility to allow the usage of the integrated sensors in the mobile device to navigate the avatar or to include movement as additional benefits in the game (e.g. if player goes for a walk often, a benefit in the game is received). Another aspect, which was not looked into was the possibility of individual configurations, to adapt the game to the needs of a nutrition expert for his/her patients. The overall game difficulty is also not configurable (e.g. easy or hard), which might pose a possible improvement in future work. Although there are some identified drawbacks, this prototype may pose a good starting point for additional work to increase the awareness of nutrition.

## ACKNOWLEDGMENT

We would like to thank the participating experts and users who helped develop this serious game. Without their help, time and ideas this publication and the final prototype would not have been possible.

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