MATCHuP: An mHealth Tool for Children and Young People Health Promotion

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Abstract: The kids of European and occidental countries are threatened by obesity. They are potential persons to become chronic patients. mHealth technology can help them to change their nutrition and physical activity habits. This paper presents MATCHuP, a platform that involves several agents (kids, parents, healthcare providers) that collaborate and compete by games in a social network in order to create a enjoyable environment to promote a behavioural change towards a healthier life.

1 INTRODUCTION

Having care of our kids today is the best bid we can make to have a healthy society tomorrow [1]. However, three main diseases threaten kids health: obesity, diabetes and asthma. While parents are conscientious that diabetes and asthma are serious diseases, it seems that they are less aware about the harm of obesity. Obesity can be cured, avoiding reaching the adult age with related serious and chronic diseases with comorbidities.

Obesity is mainly caused by bad nutrition habits and the absence of exercise. The development of tools to support enhancing good nutrition and exercise habits would result in benefits for both, obesity and diabetes, known as metabolic diseases.

Nowadays, information and communication technology (ICT) is offering a means to support follow up of personal data, enabling the education on the right habits of obese children, but also offers clinicians a way to gather information about their patients, and other data coming from social workers. In that regard, Artificial Intelligence Techniques, including Machine Learning, have shown to be cornerstone to transform gathered data to knowledge, so as to support decision making towards a personalized health treatment (parents, clinicians) (Herrero et al., 2016; López et al., 2013). Games is another important technology that has been raised as a key issue for education, and can be a key issue for kids to be compliant with their treatment, especially if games are not designed as serious but popular games are paid via exercise or good diet instead of money.

This paper presents the MATCHuP platform centred on patient with metabolic diseases and their families to improve their education in the right habits towards a healthy future society. In so doing, MATCHuP aims to recommend actions connected to the patients community, using collaboration strategies to simplify input validation, and competition incentives so as to award the patient with gaming.

This paper is organized as follows. First, some related work is reviewed in Section 2. Next the description of the MATCHuP platform is presented in Section 3. The status of the current implementation is explained in Section 4. We end the paper on Section 5 with some conclusions and future work.

[1]The MOCHA project (Models of Child Health Appraised), http://www.childhealthservicemodels.eu/

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2 RELATED WORK

The use of mHealth approaches to child obesity has been evaluated in (Tate et al., 2013). Among the advantages, the authors highlight four issues. First, that adolescent would prefer mobile-based and iterative technology for treatment and prevention. Second, that mHealth is a useful tool for monitoring adherence. Third, that the reachability enhancement of the population of a higher risk for obesity. And four, a similar enhancement could be observed regarding of the lowest educational level and income. However, several challenges were detected, as the sedentary behaviour of screen technologies and the detected decreased ability to focus attention of screen users. In that regard, wearables technology is arising as a new tool for measuring the real activity of kids, enabling the development of alternative mHealth platforms that tackle such challenges. MATCHuP uses them.

Of course there are myriads of mHealth solutions. In the recent report (Aitker, 2015) about 165,000 apps were identifyed. Among them, the authors confirmed 46,188 mHealth apps and they focus their stydy on the English Apps from which 26,864 where consumer/patient and only 8,965 apps were related to healthcare providers. Our app includes healthcare providers as well as consumers, and it is multilanguage, currently in English, Spanish and Catalan.

Regarding apps for kids, Table 1 shows a list of several apps. The elements that configure a mHealth success regarding nutritional habits, as for example, sugar ingesta, have been studied in (Sanders et al., 2009).The key issues to have success tools involves how the information is delivered. In that regards, several agents are identified in order to improve the literacy on health: caregivers, health systems, family health literacy skills, the educational system and the community system. In our work, we involve most of such actors: caregivers (endocrinologists), family (parents), and the community.

3 PLATFORM DESCRIPTION

The goal of MATCHuP is to improve nutrition and exercise habits of obese kids from 5 to 16 years. To that end, the platform gathers information about kids meals and physical activity, and according to the healthy quality of the data entered, kids awarded with some points, that are translated in skill scores regarding a virtual game. The game is not played in isolation but in teams. Therefore, kids should collaborate among her mates in order to have a competitive team that beats their adversaries. On the other hand, the validation of the information entered by the kids is performed in a collaborative way.

Therefore, several actors are involved in MATCHuP. First caregivers set up healthy targets to the kids according to their progresses. Second, the kids that self-monitor their progress toward the targets. Third, the parents that collaborates in the monitoring, by validating the inputs entered by kids. And finally, all the community of users (parents and kids) collaborate in different way inside a social network implemented for their community. Moreover, kids can set up teams in the community which compete in virtual games, and the skills of the avatars (virtual representation of the kid) depend on their healthy progress. An overview of the platform is shown in Figure 1. In the remaining of this section the different roles of the agents involved in the platform are described, including the social network in which they collaborate, and how the games are approached.

Table 1: Apps for healthy Children. Physical activity: v → virtual exercise; t → teach about exercise.

App Name	Food	Nutrition	Physical Activity
Easy Eater 2	x	x	
Eat and Move-O-Matic	x	x	v,t
Healthy Heores	x	x	
Perfect Picnic	x	x	
Smash Your Food	x	x	
Veggie Circus Farm	x	x	
Body Quest - Food of the Warrior.	x	x	
Grow It-Know It	x	x	
Catch the Carrot	x	x	
Snack Planet	x	x	v
Work It Off	x	x	t
Max's Plate	x	x	
Frutas y verduras para nios	x		
Hora de Comer	x	x	v
Emma breakfast - KIDS	x	x	
EduKitchen-Kids Educational	x	x	
Veggie Bottoms Lite	x	x	
Sopa Hacedor	x		
Awesome Eats	x	x	
Cocomong Season 2	x	x	

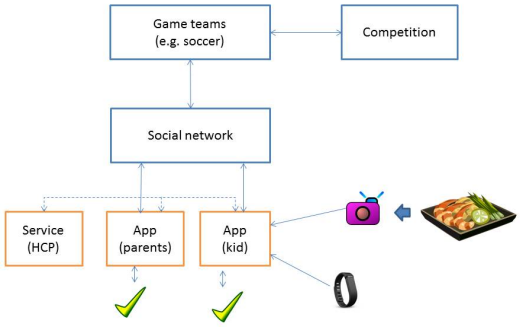

Figure 1: MATCHuP overview.

3.1 Kids App

The kids app includes several modules in order to respond to the following requirements:

- Nutrition: enable the entering of the different kid meals
- Exercise: register the activity of the kid
- Validation: check and receive information about the data entered as so far by other kids or by herself
- Assessment: acquaintance of the healthy behaviour progress

Every time the kid eats, she should register the nutrition information in the system. However, this information is not entered manually neither with a text, or by selecting photos in a library, as many other apps in the market, but by making a photo of the dish he is just eating. Next, the kid has three sliding buttons to label the photo, according to his knowledge, which is the amount of fruits and vegetables, carbohydrates, and meat that contains the served meal (see Figure 2). From the sliding button, a percentage on nutrition components is derived.

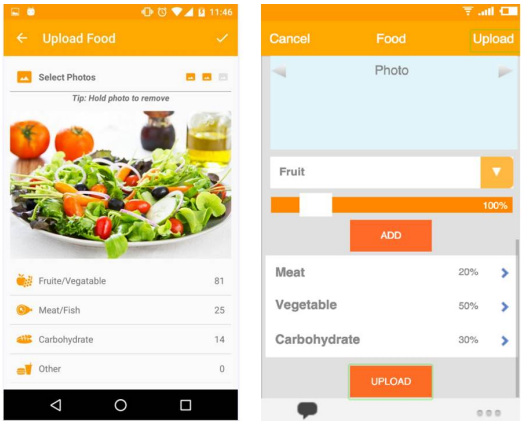

Figure 2: GUI for food labelling.

Of course, the information entered by the kid should be validated. Validation is performed in a collaborative way. That is, parents and other kids in the community validate the labels assigned to the photo (see Figure 3). Once a day, every kid receives a set of photos from other kids in the social network (see parents and community validation on Sections 3.2 and 3.4 correspondingly). The owner of the photos received for validation is unknown. They could come either from kids in the same team or from adversary teams. Therefore, the kid cannot manipulate the outcome to favouring her mates. In order to incentive kids in this validation process, some points are given to the kids that actively participate in this process that contribute to win the game match of the week (see Section 3.5).

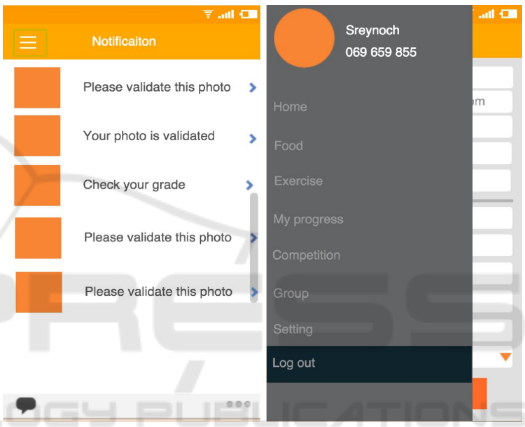

Figure 3: GUI for food validation.

Regarding physical activity, each kid defines a profile regarding her preferences about sports and the timetable they use to practice (supported by parents when under 12 years old). To validate the activity, wearables are offering a smart way of capturing it. To that end each type of activity, and its intensity is measured according to METs (the ratio of work metabolic rate to resting metabolic rate) (see (Ainsworth et al., 1993) and (Ainsworth et al., 2011) for further calculation descriptions). Some activities could come with non-scheduled hours (as for example, playing soccer in the school playground).

Kid assessment about her progress is provided by plots in which the differences between the current state and the targets is shown following a colour code (see Figure 4). The nutrition information is not taken from the kid' labelling, but from the outcome of the validation process. An aggregation method is used to combine the information of the kid (self information and the validation data from other users), giving a higher importance to the information coming from parents. The final nutrition fitness is provided in a

scale from A to E, being A the best value. A similar outcome is obtained for the physical activity, obtaining a second value defined in the same scale. Both fitness values, nutrition and physical activity, are finally aggregated, obtaining the kid current healthy state.

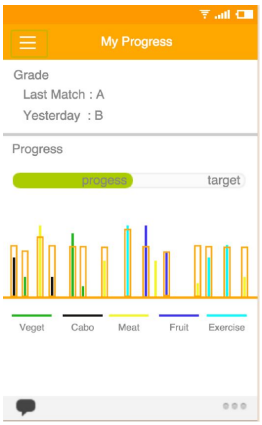

Figure 4: Kid assessment.

3.2 Parents App

Parents role is mainly focused on providing reliable validation information. In that regard, parents receive once a day a set of labelled photos that they need to revise. As in the kid case, they are not aware about the provenance of the photos (i.e. whenever they belong to their kid or do not).

3.3 Healthcare Professionals Web Service

Healthcare professionals are in charge of setting up the nutrition and exercise targets for the kids. They can also follow the kid progresses thanks to a visualisation screen that shows the distance between the target and the achieved results, in a colour code (see Figure 5).

Healthcare professionals access to the platform has been designed as a web service, instead of an mobile app because this facilitates the integration of the tool in the current Healthcare Information Systems of our region.

3.4 Social network

The community of users is managed by means of a social network, where collaborative and competitive events take place.

Regarding competition, users in the network are identified according to their sportive preferences (soccer, basket, dance, etc.), and her healthy status. This

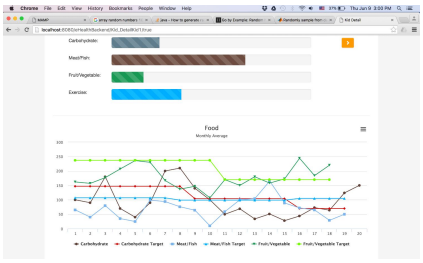

Figure 5: GUI for healthcare providers.

data enables the configuration of sport teams and the corresponding game competitions (see Figure 6). In so doing, two conditions should be fulfilled:

- There should be enough teams in each sport to set up a game (sport competition matches)
- There should be a certain satisfaction degree among the kids preferences and the team assigned.

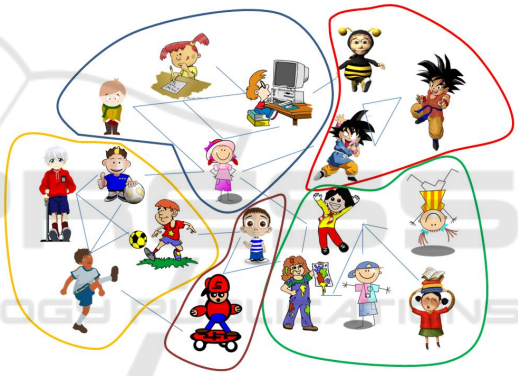

Figure 6: Physical activity teams.

On the other hand, collaboration arises in two directions:

- Help team mates to achieve their healthy targets (see Figure 8)
- Validate food photos from other users (see Figure 7)

Regarding the validation of photos,

- 25% of the photos of a kid are validated by members of the same team
- 50% of the photos of a kid are validated by members of other teams of the same sport
- 25% of the photos of a kid are validated by members of other sports
- 50% of the photos of a kid are validated by parents, selected at random

Therefore, the number of validations obtained per photo is expected to be higher than 1. The worse case

scenario would be when no validation is achieved for a given photo. In that situation, the photo is scored neutral. Future work should include a monitoring module to facilitate the assessment and control such situations.

The validation feedback can help to understand the kid about the real contents of the meals, and learn about nutrition.

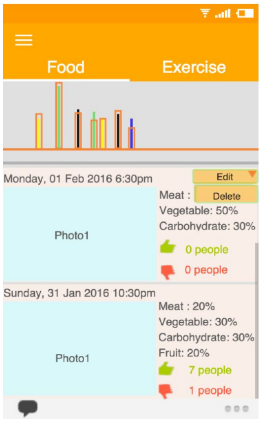

Figure 7: Food validated by the community.

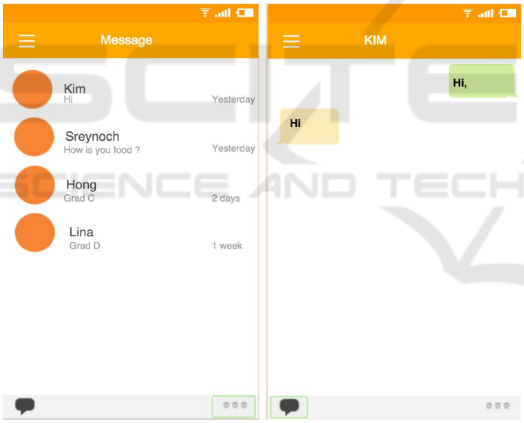

Figure 8: Chat functionalities for kid collaboration.

3.5 Games

In the social networks, there are n games, according to the kids sportive preferences, although it depend on the number of users, too. For example, there could be a soccer game, or a skate game (see Figure 6). For each game, there are a given number m of sport teams. Once a weak (e.g.Sunday),all teams play a match.

Ideally, the match should correspond to a market available game integrated in the platform. For example, there are soccer games which teams could be configured by the user. However, in the first approach of MATCHuP, the game is a simple rank of scores: the winner of the match is the team with the highest score (see Figure 9). The team score (defined in $\Im$)is obtained by the aggregation of the healthy state values of all of its members.

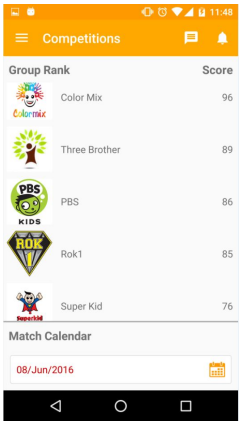

Figure 9: Competition outcome.

4 FIRST VERSION

The system has been developed using the Spring Java environment. The mobile application is deployed in Android (Figure 10). The first version deployed with all of the involved agents, but physical activity enter manually. Current languages are English, Spanish and Catalan.

The design goals of MATCHuP are simplicity and easy to use. Thus, photos favours usability and collaborative validation is simply. Of course, some image processing engines could be used to obtain nutrition components from photos, for example, but the state of the art of such engines are still under research for such purpose.

Next step will consider the inclusion of the exercise activities by means of a smartwatch or activity band. Other technological advances that are ready to use and that could be incorporated in a near future are Artificial Intelligence techniques to handle preferences to set up teams, as well as to aggregate information.

5 CONCLUSION

Obesity is a main issue for many people, specially children. It is becoming a big concern in European and occidental countries. Obese persons are not considered patients (as diabetic persons are), and therefore, they are very difficult to motivate for bringing them to healthier states. This paper presents the MATCHuP platform with the aim of helping obese

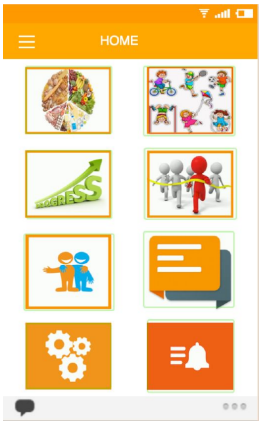

Figure 10: Home page for kids.

children and young persons (under 16) to reach a healthier state with the supervision of healthcare practitioners, families, and other users in a similar situation.

Along the paper, the system has been described, and the first version of MATCHuP presented. Next steps include the integration of smartwatches or similar wearable able to automatically detect the physical activity, as well as artificial intelligence tools to improve the aggregation methods and additional advices for further personalization and fast adaptation. Moreover, a the evaluation of the tool in for medical evidence is also required.

In that regard, the main challenge is to keep kids engaged in the platform. Clinicians argue that about 6 month of using the platform could be sufficient for obtaining some behaviour change. However, some studies have shown that having a kid engaged in a game more than 3 months is a great success. The long trial of the tool will provide inputs to that concern, and work for alternative artifaxts (Hevner et al., 2004) . A secondary, technological challenge, is the fact that sensitive data is stored in mobiles. The recent study (Blenner et al., 2016) highlights the necessity of consider privacy implications before using health apps.

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