PEGASO: Towards a Life Companion

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Abstract. In the frame of the PEGASO European project, we aim at promoting healthier lifestyles focusing on the alimentary education and physical activity. This paper presents the concept of health companion as the main tool to inform and push the user towards a healthier lifestyle. This companion is an advanced interface that assists and entertains the user, providing him an adequate knowledge about alimentary and physical education. The companion is based on a knowledge model of the user and its behavior; it is composed of three main facets: is tailored to the user, is based on affective design and is designed to be a life companion.

1 Introduction

Lifestyle has been identified as the main preventive methods for several health risks [1]. Among the main emerging problems, overweight ranks probably at first place. Overweight could also easily become obesity, which is now epidemic in many countries so that a general alarm has been issued worldwide [2]. Several researches have demonstrated that health risks are associated with overweight and obesity, e.g., [3-7]. If for adults this could be a result of a joint pathology, in teenagers counter fighting over-weight with proper strategies could be a win-win model for a real prevention of future pathologies. Obesity is due to several factors as genetic contributors, metabolic conditions (e.g. diabetes and hypertension), psychological and behavioral issues. Concerning the last two factors, an important role is played by an inadequate education [8], in particular about health literacy. We deal with the promotion of healthier lifestyles in an ongoing European project (PEGASO) aiming at developing a complete services' ecosystem that would be able to motivate teenagers to learn and to apply a healthy life-style effortlessly. In particular, one of the most important parts of this system is represented by the digital health companion.

The role of a health companion is to address the challenge to help individuals and their families to achieve self-management in different aspects linked to health [8]. Our companion is an advanced interface that assists and entertains the user, providing him an adequate knowledge about alimentary and physical education. An important aspect of the proposed companion is the presentation of the information using gamification

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approach. Gamification is defined as "the use of game design elements in non-game context" [9]. In particular, the PEGASO companion engages and motivates the user towards a healthier life style. The companion proposes games and supports him/her in the social community. It can propose challenges (like soccer matches) or workout group meetings (based on the common interests of the community) to promote the social aspect of exercising. The companion will follow the user in his/her everyday life and will learn his/her preferences and recognize his/her behavior. The companion aims at establishing a special and affective relationship with the user that should last for years, maybe all the rest of his/her life.

In Section 2, we present the PEGASO ICT system, which constitutes the hardware and software base for the realization of the health companion. In Section 3, we discuss the importance of the affective design in order to strengthen the tight between the companion and the user. In Section 4, we describe the importance of providing tailored solutions and how the companion can be adapted from a general to a specific, user-dependent model. In Section 5, we show how the health companion can become a *life* companion and follow the user during all his life. Finally, Section 6 conclude the paper summarizing the main features of the health companion model and presenting the future steps.

2 The PEGASO ICT System

The multi-dimensional ICT system of the PEGASO ecosystem plays a key role for the human-companion interaction possibilities. Fig. 1 depicts the PEGASO ICT system with some components highlighted. This system includes game mechanisms and social activities to influence users' behaviors in order to fight and prevent overweight and obesity in the younger population by encouraging them to become co-producers of their wellness and take an active role in improving it.

This form of education aims at generating self-awareness about the risks associated to an unhealthy behavior, at sustaining motivation to take care of their health with both short and long terms perspective and at changing behavior towards a healthy lifestyle based on balanced diet and adequate physical activity.

At the base of the PEGASO ICT System, there are the wearable and mobile sensors and devices such as smart garments, scales and smartphone. This layer allows acquiring implicit information about the user behavior and his/her daily habits. While implicit mechanisms will process the information linked to behavior of the user, explicit dialogs will prompt the user for information that is difficult to acquire automatically and also to establish an affective contact with the user (e.g., "what have you eaten today?"). In the first part of the project, the smartphone is designed as the main physical interface with the user. It acquires the signals from the different external or embedded sensors and presents the feedback to the user in a context-aware manner.

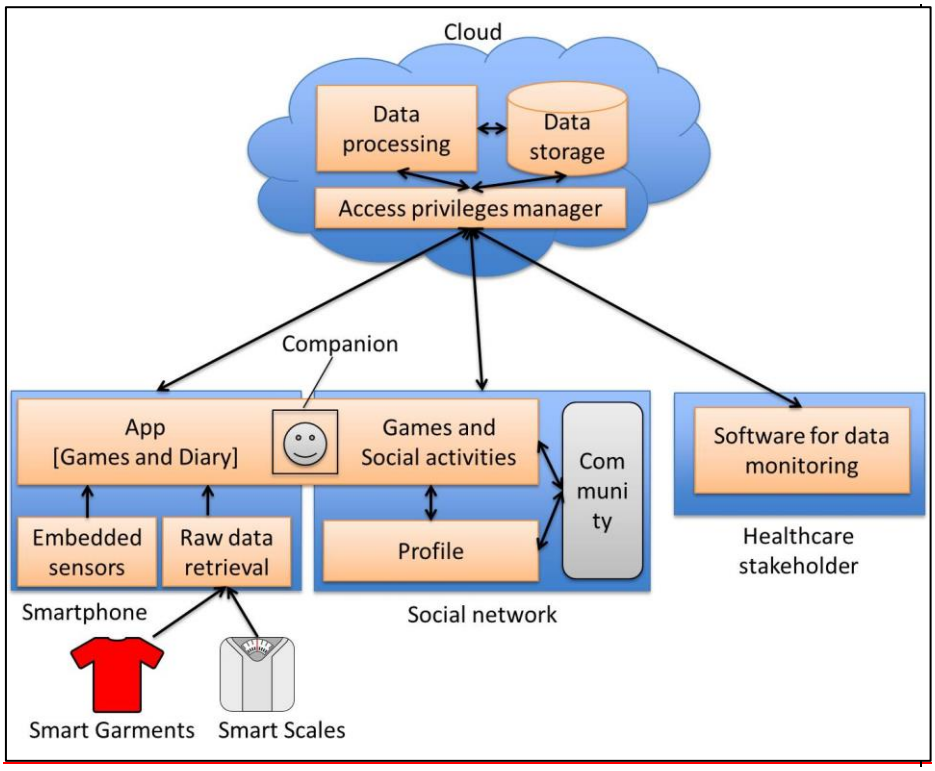

Fig. 1. Figure 1. The PEGASO ICT system.

As presented in Fig. 1, the interface can be one or multiple applications and different games and social activities. However, not all the information is contained in the smartphone; most of the data will be encrypted and made available on the cloud to the healthcare stakeholders (the user family, the doctors and/or the researchers).

Finally, from an interaction perspective, the health companion constitutes the main interface between the user and the system. This interface is bi-directional: to the user, suggesting activities and games and providing information, and from the user with explicit and implicit interaction.

3 Affective Design

Changing lifestyle is often a challenging task. In order to foster the user engagement and to facilitate the adoption of the proposed activities, it is important to create an emotional link between the user and the health companion. In fact, a modification of the emotional state means switching among different ways of thinking. In particular, positive affects increase intrinsic motivation and has some effects on cognition.

Not only the affective design will encourage the prolonged use of the system but it will improve the learning of the proposed concepts. In fact, affective learning is based

on the idea that emotions are intertwined with cognitive capabilities and several researches demonstrate its influence in conditioning the rational behavior and the decision making of the learner [10].

Embedding the companion in the users' smartphone is an appropriate way to make it perceived in a positive way (especially, thanks to a good tailoring). Indeed, the smartphones are already perceived as a companion and it is most likely that this relationship between user and smartphone will strengthen in the future [11]. The smartphone is ubiquitous and is private, and it is the perfect medium for the companion, which is personal.

The eating behavior is not only related to homeostatic reasons. In fact, an important factor that influences people's need and choice of food is represented by the emotional state [12]. Although this psychological state is intertwined in physiological responses, these non-homeostatic eating patterns can be reeducated [13]; and this is part of the goal of the PEGASO system. Therefore, the companion will ask every day how the user is feeling. This mechanism has a twofold aim: establishing an affective relationship and creating an emotional log in order to provide enough information for the learning algorithms. In fact, this information can be used to find some specific behavioral pattern related to emotional eating in order to generate the best feedback.

The emotions will be also recorded in the food diary and using wearable systems (when available). All these data, elaborated also with the information about social interaction, physical activity, food intake and health condition will provide the correct trend in order to identify the key factors that will help the system to encourage and support the user in keeping his/her healthy life style.

A change in the lifestyle demands a specific knowledge of the user habits and needs, for this reason the companion should integrate mechanisms to customize its communication with the user, as explained in the next section.

4 Companion Tailoring

The proposed companion is based on a dynamic, personalized model. In fact, a crucial characteristic is the possibility to specialize, to tailor the interaction between the user and the system. The companion starts from a general model provided by clinicians and psychologists, then progressively it gets to know the user's preferences and according to the most successful strategies it will keep supporting the user [14]. The tailoring takes into account several aspects:

- The companion learns when and how is best providing a reminder or a message.
- The companion learns to know the user and to become a personal counselor. In fact, the companion is able to make personalized interventions, which provide the users with information that is based on their individual characteristics (e.g., dietary behaviors, motivations, attitudes, and culture). Tailored interventions make the information personally relevant and researches demonstrate that computer-tailored health education is more effective in motivating people to make dietary changes [15] and that it could be also a good practice to promote physical activity [16].

Personalization is based on both user settings and automatic tailoring involving machine learning techniques that specialize and personalize the model. The companion personalization is also aesthetic to reflect the user's personality and style in order to strengthen the emphatic relationship between the user and the companion [17].

The European dimension of our study will allow us to take into account also the different ethnological specificities impacting on adolescents' lifestyle and that should be taken into account in the companion. This will open the possibility to define socio-cultural facets in our tailoring approach. During the PEGASO project, three pilots in different countries will take place (Italy, Spain and United Kingdom). These pilots will allow us to examine the cultural differences that may impact on teenagers' lifestyle and to adapt the model underlining the companion accordingly.

5 Towards a life companion

The companion will know the user's personality and will establish with him/her an affective relationship. The companion will participate to the whole user's life in order to become a real life companion. Different ages have different requirements and the companion has to be able to continuously adapt to novel needs and propose appropriate activities.

While in the first phase of the project, the smartphone will incarnate the companion, the companion idea is not linked to a unique physical device but it is ubiquitous and will change form over time. The companion will be an interactive teddy bear when the user is a child and will become a smartphone during the adolescence; the companion can follow also an adult to support his/her work as a laptop or will accompany him/her during the old age as a smart bracelet (Fig. 2).

Such an evolution will allow designing the human-companion interaction on the user needs and specificities over time.

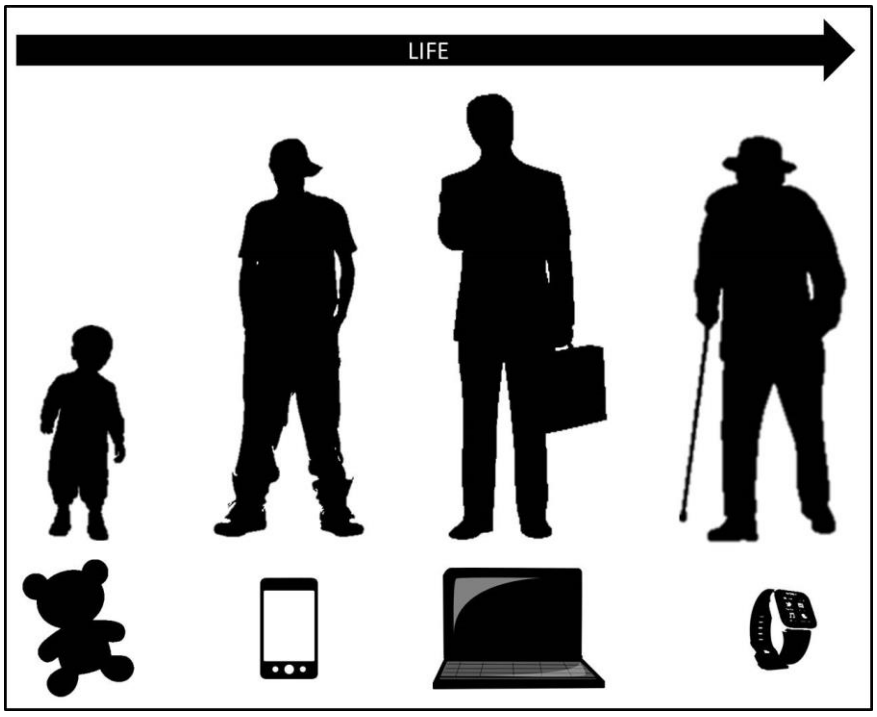

Fig. 2. The life companion vision.

6 Conclusion

In this paper, we have presented the concept of life companion in the framework of the PEGASO European project. PEGASO focuses on the development of a complete services ecosystem that would be able to motivate teenagers to learn and to apply a healthy life-style. A crucial component of this ecosystem is the health companion that is introduced in this paper. Tailored user's model, affective design and over-time adaptive algorithms are the main aspects if the proposed concept. Tailoring allows the companion to shift from a generic model to a personalized, user-specific instance. The affective design aims at establishing an emotional link with the user. The over-time adaptive algorithms enable the companion to become a life companion that can follow the user during all his/her life. As next step, we plan to develop a mobile application in which to instantiate the life companion having the teenagers as target. In a later stage, three pilots in different countries will take place (Italy, Spain and United Kingdom). These pilots will allow us to examine the cultural differences that may impact on teenagers' lifestyle and to accordingly adapt the model underpinning the companion.

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8 References

1. A. H. Mokdad, E. S. Ford, B. A. Bowman, W. H. Dietz, F. Vinicor, V. S. Bales, and J. S. Marks, "Prevalence of Obesity, Diabetes, and Obesity-Related Health Risk Factors, 2001," JAMA, vol. 289, no. 1, pp. 76–79, Jan. 2003.
2. WHO Consultation, "Obesity: preventing and managing the global epidem-ic," World Health Organization technical report series, 2000.
3. P.G. Kopelman, "Health risks associated with overweight and obesity.," Obesity Reviews, vol. 8 Suppl. 1, pp. 13–7, Mar. 2007.
4. P.G. Kopelman. "Obesity as a medical problem". Nature 2000; 404 : 635–643.
5. W.C. Willett, W.H. Dietz, G.A. Colditz , "Guidelines for healthy weight". N Engl J Med 1999; 341 : 427–433.
6. M. Ezzati, A.D. Lopez, A. Rogers , S. Vander Hoorn, C.J. Murray, "Com-parative risk assessment collaborating group. Selected major risk actors and global and regional burden of disease". Lancet2002; 360 : 1347–1360.
7. D.W. Haslam, W.P.T. James. "Obesity". Lancet 2005; 366 : 1197– 1209.
8. C. Weinert, S. Cudney, and E. Kinion, "Development of My Health Com-panion to enhance self-care management of chronic health conditions in rural dwellers.," Public Health Nurs., vol. 27, no. 3, pp. 263–9, 2001.
9. S. Deterding, D. Dixon, R. Khaled, and L. Nacke, "From game design elements to gamefulness: defining 'gamification,'" in Proceedings of the 15th International Academic MindTrek Conference on Envisioning Future Media Environments - MindTrek '11, 2011, pp. 9–15.
10. R. W. Picard, S. Papert, W. Bender, B. Blumberg, C. Breazeal, D. Cavallo, T. Machover, M. Resnick, D. Roy, and C. Strohecker, "Affective Learning - A Manifesto," BT Technol. J., vol. 22, no. 4, pp. 253–269, Oct. 2004.
11. C. M. Kennedy, J. Powell, T. H. Payne, J. Ainsworth, A. Boyd, and I. Buch-an, "Active assistance technology for health-related behavior change: an in-terdisciplinary review.," Journal of medical Internet research, vol. 14, no. 3. p. e80, Jan-2012.
12. J. Brug, A. Oenema, and M. Campbell, "Past, present, and future of comput-er-tailored nutrition education.," Am. J. Clin. Nutr., vol. 77, no. 4 Suppl, p. 1028S–1034S, Apr. 2003.
13. H. O. den Akker, L. S. Moualed, V. M. Jones, and H. J. Hermens, "A self-learning personalized feedback agent for motivating physical activity," Proc. 4th Int. Symp. Appl. Sci. Biomed. Commun. Technol. - ISABEL '11, pp. 1–5, 2011.
14. A. L. Baylor, "Promoting motivation with virtual agents and avatars: role of visual presence and appearance.", Philos. Trans. R. Soc. Lond. B. Biol. Sci., vol. 364, no. 1535, pp. 3559–65, Dec. 2009.

15. D. Siewiorek, “Generation smartphone,” IEEE Spectr., vol. 49, no. 9, pp. 54–58, Sep. 2012.
16. C. Science, A. Kapoor, P. Johns, K. Rowan, E. A. Carroll, M. Czerwinski, and A. Roseway, “Food and Mood : Just-in-Time Support for Emotional Eat-ing,” ACII2013, pp. 252–257, 2013.
17. C. H. Gilhooly, S. K. Das, J. K. Golden, M. A. McCrory, G. E. Dallal, E. Saltzman, F. M. Kramer, and S. B. Roberts, “Food cravings and Energy Regulation: The characteristics of craved foods and their relationship with eating behaviors and weight change during 6 months of dietary energy re-striction,” International Journal of Obesity, vol. 31, no. 12, pp. 1849–1859, 2007.