

Well-Being on the Go: An IoT Vending Machine Service for the Promotion of Healthy Behaviors and Lifestyles

Sauro Vicini, Sara Bellini,
Alice Rosi, and Alberto Sanna

City of the Future Living Lab, Fondazione Centro San Raffaele - Milano, Italy
{vicini.sauro,bellini.sara,rosi.alice,sanna.alberto}@hsr.it

Abstract. Vending machines are often considered mere dispenser facilities that elicit only low engagement in their users. Instead, it is a market that is not only growing and expanding, but also evolving from a technological as well as service point of view. The City of the Future Living Lab in Milan has designed alongside its users an interactive Internet of Things vending machine based service which has been successfully deployed and is being tested in a public space within the Living Lab. This paper would like to present this as a case studies of designed experiences for behavior change.

1 Introduction

It is widely recognized that healthier nutritional behaviors are a powerful means for the prevention of numerous chronic disease such as obesity, type 2 diabetes mellitus, cardiovascular diseases and one third of cancers [1]. Therefore eating healthy has direct consequences on an individual's state of health and quality of life. Nonetheless, people still decide (more or less conscientiously) to eat in an unhealthy manner. But how can society's eating habits be affected in a positive and constructive manner in order to bring about long lasting change?

City of the Future Living Lab is a real and virtual research environment and community that embodies a Smart and Intelligent City, run by the e-Services for Life and Health department of the San Raffaele Hospital in Milan (Italy). The unit is specialized in the application of Information Technology to healthcare, and its aim is to develop and deliver services for everyday life and well-being that are designed by the user and that can empower the user to live better lives.

The researchers of the eServices for Life and Health believe that building a common knowledge of nutrition that is delivered in a context-driven, personalized and entertaining manner through an interactive eService can be a solution to help Individuals adopt healthier eating habits and lifestyle behaviors, and for this reason have developed an innovative IoT-enabled vending service which has been deployed in the City of the Future Living Lab entitled Well-being on the Go. This paper presents the case for this eService, the process behind its implementation, and the results which are being collected from its instantiation.

2 The Context

This section will provide a description of the context in which the vending machine based service was developed, and the fundamental approach used by the eServices for Life and Health Unit.

2.1 Nutrition Knowledge as One of the Solutions for Changing Society's State of Health

In his review of the studies executed by his peers in the realm of nutrition and health [2] Worsley states that nutrition knowledge, or a person's knowledge of the nutritional content of food and its effect on a person's state of health (e.g., the necessary number of fruit and vegetable daily servings that guarantee a correct intake of vitamins and minerals), is significantly associated with 'healthy eating'. Worsley cites numerous works to uphold his claim: a study by Wardle et al. [3] shows that those individuals who possess this nutrition knowledge eat healthier (knowledgeable individuals are 25 times more likely to consume adequate amounts of fruit and vegetables daily), whilst a study by the USDA's Economic Research Service [4] shows that the more mothers know about food and nutrition the better the quality of their children's diets, especially younger children's diets.

Nevertheless, an individual's knowledge of nutrition is not the sole trigger for adopting healthier eating and lifestyle behaviors. Information can help build common beliefs and values that the individuals of a society can refer to, but providing information alone is not the only answer.

There are a list of factors which complement and enhance nutrition knowledge, which have been verified by the eServices for Life and Health research unit in past clinical and user research and which are very well summarized in Worsley's article. In order to stimulate a new consciousness of what is meant by health and how behaviors have a direct consequences on one's state of health, nutrition knowledge must be supported by a set of perceived consequences, based on the Expectancy value model [5]. Promoting skills related to nutrition, such as learning how to shop and how to cook, are also important, as well as building an individual's confidence in being able to perform the desired behavior is also key, based on self efficacy in models such as the Social Learning Theory [6]. Repetition and entertainment are also factors that play into the acquisition and use of knowledge, where the former refers to the act of repeatedly receiving information or perpetuating a behavior until it has become acquired and spontaneous, whilst the latter refers to the act of learning through entertainment (also called edutainment or serious gaming) [7].

The environment and its properties where food is purchased and consumed also influence an individual's behaviors towards eating and health (the smell of freshly baked bread, for example) as well as a vast multitude of motivators. These can range from the individual's personal attitudes and beliefs (such as the perception of good value for money), to his or her cultural values, to his or her psychogenic needs (such

as the need to feel rewarded), to social or peer influence, all of which are present in Grunert's Food Lifestyle Model [8].

From the above paragraphs, it emerges that nutrition knowledge must be supported and delivered alongside a series of elements in order for it to have an impact on an individual or a society. For nutrition knowledge to be meaningful, it must be easy to understand and implement, contextualized, personalized, relevant and fun to acquire and put into practice. These elements formed the basis for eServices for Life and Health's vending machine service.

2.2 New Emerging Behaviors

It is estimated that almost 8 million people consume a meal outdoors [9] every day in Italy. If one considers also the snacks individuals consume throughout a typical day, the percentage rises, and indeed it is estimated that outdoor food consumption amounts to almost 50% of the average food shopping of an Italian [10].

According to a report by Censis (the main Italian research Institute for socio-demographic research) and Coldiretti (the Italian agriculture association), Italians eat outdoors not only for work or leisure reasons, but also to transgress: indeed, consideration of nutritional values plays a much less important role in the choice of what to eat outdoors as to when at home (29,7% at home as oppose to only 14,9% outdoors) [11].

The World Health Organization has selected Food Security and Food Safety as the two main areas within the realm of Nutrition that are in need of interventions in order to preserve and promote society's health. The aims of future actions are those of ensuring a correct consumption of foods that are safe, healthy and sustainable, especially in public spaces such as schools, workplaces, healthcare institutions and so on. For this reason, food businesses including cafés and restaurants, as well as vending machines, must abide by the same diet guidelines [12]. The Italian Ministry of Health has developed a plan that is in line with WHO's directives in order to promote healthy lifestyles and behaviors in Italy, through a series of actions whose aim is to spread a culture of healthy eating and virtuous lifestyles [13], especially in public spaces such as schools and hospitals.

It is for these reasons that the eServices for Life and Health Unit decided to tackle the concept of vending machines – not only are they a controversial topic but the potential is huge considering the number of people who everyday depend on them for their nutrition.

3 The Process

The City of the Future Living Lab strongly believes in involving the end user in the innovation process of successful and truly user-centric products, interfaces and services, and for this reason has developed a revised Living Lab methodology based on co-creation. This section describes the process adopted by the City of the Future Living Lab that generated the Well-being on the Go eService.

3.1 Understanding Behaviors – The Living Lab Co-creation Method

Living Labs are innovation environments that focus on user communities embedded within ‘real life’ situations and environments. The fundamental concept at the base of a Living Labs [14] is to gain direct and unfiltered access to users’ ideas, experiences, and knowledge, based on their daily needs and desire of feeling supported by products, services, or applications. City of the Future Living Lab, as the name suggests, is a miniature version of a city (with a hospital, a university, a hotel, stores and offices, a supermarket and a post-office, an automatic metro rail and bus service as well as streets and parks) and it articulates itself in numerous scenarios where a multitude of stakeholders and partners can work alongside each other, sharing knowledge and experiences whilst interacting with a wide variety of ICTs. Its aim is of understanding, studying and measuring the interaction dynamics among users and services offered and the potential of Internet of Things technologies.

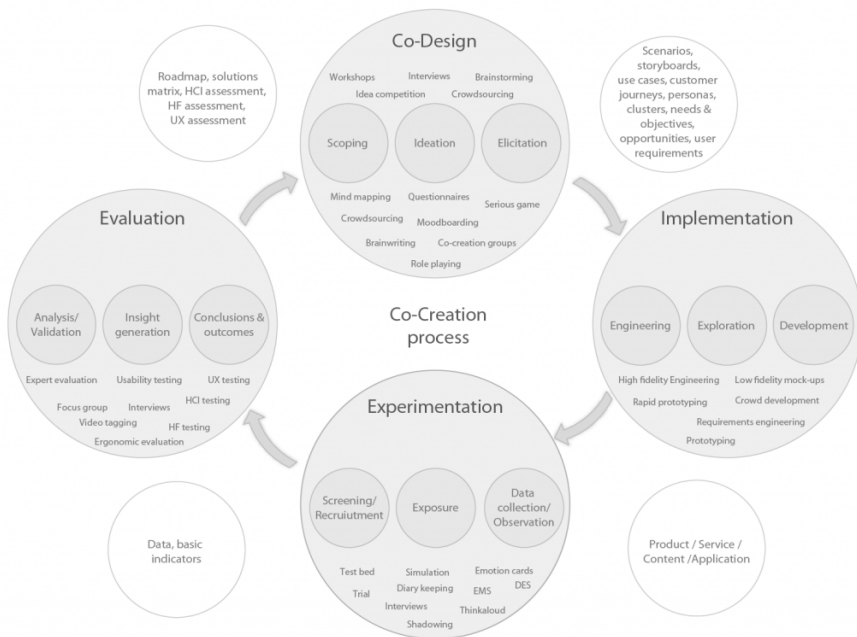


Fig. 1. The Co-Creation methodology ideated and adopted by City of the Future Living Lab

The City of the Future Living Lab has decided to push this concept of user involvement and active participation even further by adopting a methodology that is entirely based on co-creation, thus inviting volunteers from its living lab to freely participate and contribute to all the steps of the design process that is illustrated in the following image (Figure 1). The methodology consists of four main phases, each composed of a set of sub-phases: Co-Design (a phase in which users are observed

interacting with existing services or products in the identified scenario, where they are questioned in order to gain a 360° understanding of their needs and aspirations, and where they are involved in generating ideas and concepts that can drive the innovation process), Implementation (where users are involved in developing, personalizing and fine-tuning prototypes), Experimentation (when the final concept is deployed in a real-life context and users are observed interacting with it) and Evaluation (where the data collected throughout the Experimentation phase is analyzed by a team of experts in order to evaluate whether the concept developed fully responds to users' requirements). Since the Co-creation process is iterative and reflective, there is no real starting point and not all sub-phases must be carried out necessarily, making it a very adaptable, scalable and easy to personalize according to a project's aims and resources.



Fig. 2. Examples of personas and a simplified customer journey

The Well-being on the Go project commenced with a period of user observation and interviewing within the grounds of the living lab. Researchers identified three main behaviors: consumers increasingly depend on vending machines for their feeding throughout the day (which can involve breakfast, mid morning snacks, lunch, afternoon snacks, and in some cases dinner), and this translates into needs which are becoming more articulate than in the past regarding the type, range and quality of products supplied by vending machine. At the same time, users are increasingly more careful about what they eat, interested in learning how to eat better but without disrupting their everyday lives. The third insight is that users are becoming more tech savvy, across all age groups, which means that they have expectations towards

vending machines are able to communicate with ‘things’ and not only supply goods but also services. These three main behaviors, alongside the demographic data collected, were translated into a set of persona profiles and corresponding customer journeys, which helped guide the project throughout its course (Figure 2).

The previously described information collected during the Co-design phase was used to develop a first concept of an interactive vending machine during the Implementation phase. The idea proposed consisted of using an existing vending machine and integrating it with an ad hoc IoT system that could make it capable of offering more of a service rather than just sell food. Three evolutionary steps were identified for this concept: the first consisted in equipping the machine with a touch screen, video camera, proximity sensor, internet connection and speakers, so that the machines could not only dispense healthy foods but also edutaining content regarding the food offered as well as the most basic and vital nutrition knowledge (in the form of digital art, videos and music) and practical information (such as a map of the hospital grounds as well as the schedule of the shuttle line and local bus service). The second step would be to integrate an NFC reader or Smart Card reader so that the vending machine is able to recognize its user and therefore administer personalized information and content that can therefore offer targeted motivational strategies. The third step would involve the vending machine being able to communicate in a secure manner with the hospital’s database so that each user can monitor over time his or her state of health and correlate it to what he or she eats, how much physical activity he or she does every day, and so on – in particular it could offer those individuals with a health condition or illness additional support in order to correctly manage them, and provide pertinent information to those who instead are at risk of developing a health condition.

Such variegated and personalized content would allow the vending machines to become a point of reference for visitors, employees and patients, not only elevating the common attitude towards these machines but also offering an extremely innovative 360° service that integrates nutrition, healthy behaviors, illness prevention and management, edutainment and socialization.

Throughout the implementation phase, engineers, technicians, programmers and UI and product designers from the City of the Future Living Lab worked together in order to develop a first concept of the vending machine that responded to user requirements (Figure 3). At the same time, a team of healthcare specialists (including nutritionists, psychologists and biomedical engineers) from the San Raffaele Hospital collaborated with the design team to develop a set of menus as well as key nutrition information and knowledge to integrate with the concept, in order to align the Well-Being on the Go project to the Italian Ministry of Health guidelines and to the elements described in the first few paragraphs of this paper. Throughout this phase, volunteers recruited across the Living Lab grounds were asked to comment on the vending machines and suggest changes or improvements, specifically on the services offered, the graphics and the information supplied.

The refined concept of the vending service was then deployed in a space of the living lab during the experimentation phase, next to the shuttle line service and stores

since the customer journeys developed from the co-design phase showed the potential of this specific space (it is indeed a busy area where many people grab a bite to eat either before or after work, or during coffee breaks and lunch whilst they visit the local shops).

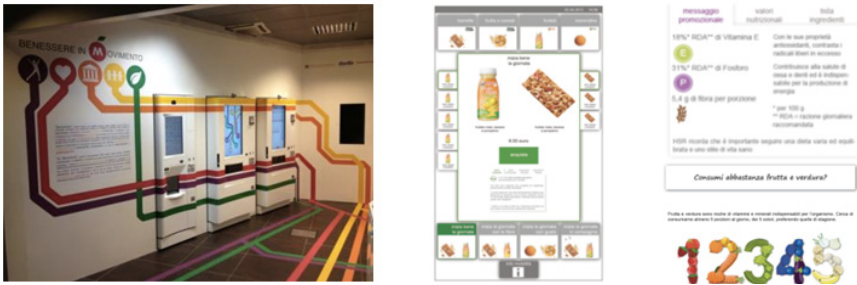


Fig. 3. The vending machine concept deployed in the Living Lab

For a period of five months, the vending machines were exposed to the public of the hospital and Science Park. Data was collected via the IoT system, the vending machine's software and direct user observation on behalf of a team of researchers in accordance with the Italian privacy laws and regulations. The project finds itself in the evaluation phase, where the qualitative and quantitative data collected during the experimentation is being analyzed to produce a series of insights which will determine whether or not the existing concept responds to the user needs and aspiration identified in the co-design phase and in what way the concept can be tweaked and fine-tuned before moving on to the next vending machine concept and new Living Lab cycle. More of these initial results will be discussed in section 3.3 below.

3.2 Supporting Behavior Change: An e-Service Design Model

Alongside the Co-creation methodology previously described, an e-Service Design Model was adopted, ideated and developed by the research unit e-Services for Life and Health which operates within the City of the Future Living Lab. This model consists of merging user needs, preferences and behaviors to produce a virtual profile that can be combined with the individuals Personal Health Record. Such a pairing produces a 360° vision of a person so that he or she can be provided with pertinent, contextual and actionable guidance from healthcare professional in order to stimulate them towards adopting healthy lifestyle choices and behaviors. This unique Service Design model synchronizes an Individual's three most important facets: Emotions (a trigger to an Individual's psychological reaction in context with his/her preferences), Relations (a trigger for a social interaction with other Individuals physically present or not, and/or with a proximity or remote environment in context with his/her preferences), and Functions (an Individual's practical need addressed by the service) delivered. This Service Design model called Engineering AwarenessTM [Figure 4].

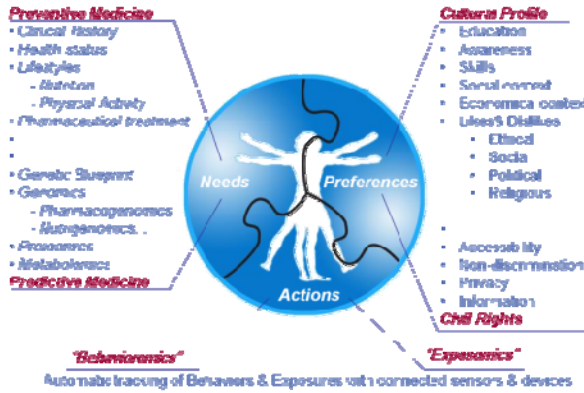


Fig. 4. The Engineering Awareness™, an e-Service Design model

Designing for an Individual's awareness is the primary ethical objective of any personalized service developed within the eServices for Life and Health unit. Individuals should not be manipulated or pushed to adopt a specific lifestyle or behavior, rather they should be provided with unbiased and personalized information so that the Individual is empowered to make informed choices. With a complete understanding of an Individual, the service provided can respond to all of his her needs, expressed and unexpressed, physical as well as emotional, biological as well as sociological, and therefore truly bring about long lasting and widespread change [Figure 5].

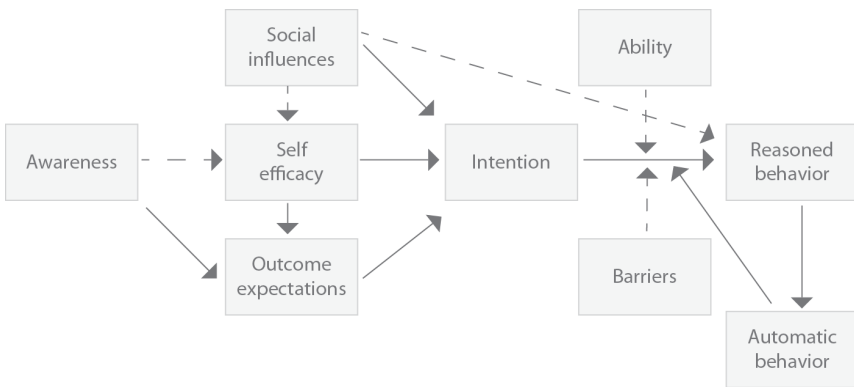


Fig. 5. How awareness can influence behaviors

4 Initial Results of the Project

As previously mentioned, the Well-being on the Go project finds itself in the experimentation phase of the living lab cycle. In order to evaluate the impact of the project on users of the City of the Future Living Lab, a series of questionnaires, interviews and thinkaloud exercises were carried with walkers-by who fitted the personas

identified during the co-design phase. This evaluation phase is still occurring and not all results have been collected. Feedback from these initiatives was coupled with data from the vending machines' sensors and software in order to depict a clearer picture of the user experience. Attention throughout the evaluation phase was focused on: the usability of the interface; perception of the space; monitoring of behavior changes.

At the moment a total of ten people were interviewed and asked to participate in a thinkaloud exercise. The questionnaires consisted of a series of closed and open questions, aimed at collecting information on the Individual's demographic details, attitudes towards vending machines in general, feeling of the way the space was designed and the initiative was communicated, and perception of the new vending machines proposed. What emerged from them was that the mission of Well-Being on the Go was successfully decoded by users, for they felt that the initiative promotes healthy eating and well-being as a whole, in a relaxing as well as energizing space where people on the move can enjoy nutritionally correct food that fits their preferences. The majority of individuals interviewed stated also that having screens on the interactive vending machines added to their everyday experience of vending machine elements of playfulness, but also intuitiveness, and that the music, media, games and videos often attracted them to the space but also made them return to the space with others and talk about health and well-being related issues.

The thinkaloud sessions consisted in three sets of exercises, where Individual's were asked to buy a product, followed by a combo and then obtain the directions to a point of interest on the other side of Milan. The aim of these sessions was to gain feedback on the usability, efficacy and satisfaction of the user interface designed for the vending machines, and verify the impact of the information delivered. Overall, usability was ranked highly since the interface was perceived as being self explanatory and easy to learn how to use. Errors were low across all age groups, and described as easy to remedy, and the average time spent purchasing single products was consistent with traditional vending machines. Language and design were described as coherent throughout the navigation and the overall esthetics was appreciated because felt to be innovative, cheerful and playful. What stood out from these sessions was that though people turn to vending machines for a fast bite of food, the added information (such as nutritional content, ingredients lists, diet recommendations, and general health information and knowledge) was not seen as a deterrent nor time-consuming, rather something that enriches the user experience, allowing for more pondered and attentive choice of food.

5 Conclusions

The healthy food option isn't always perceived as the most appealing one, especially when dispensed by a vending machine. A healthy food choice can be made more interesting and attractive not by imposing it through strict policies or rigid regulation, but rather by promoting awareness in Individuals on a widespread scale so that they can appreciate the effect of choosing a healthy food option on their health and well-being. By empowering Individuals through pertinent, personalized, contextualized

and fun information which they can retrieve at any point of their busy day, they can appreciate the impact of their everyday lifestyle choices and make informed decisions that can promote long-term behavioral change. Nevertheless, a 360° understanding of the Individual, in all of its facets, must be gained and the user must be involved in all the phases of the development of a concept (be it a product, an interface or a service) so as to design solutions that truly respond to their functional, social and behavioral needs and therefore successfully permeate everyday life.

The next steps of the Well-being on the Go project will be to continue the interviewing phase to include the remaining personas, and move on to the next concept evolution where the remaining sensors for the identification of users will be implemented in order to provide a fully personalized and truly innovative user-centric and user-driven eService.

Acknowledgements. City of the Future Living Lab and the eServices for Life and Health research unit would like to thank Rhea Vendors group for having shared with us their vending machines and knowledge.

References

1. Robertson, A., et al.: Food and health in Europe: a new basis for action. WHO Regional Publications, European Series No. 96 (2004)
2. Nutrition knowledge and food consumption: can nutrition knowledge change food behaviour? *Asia Pacific Journal of Clinical Nutrition* 11(supp. 3) S-579–S-585
3. Wardle, J., Parmenter, K., Waller, J.: Nutrition knowledge and food intake. *Appetite* 34, 269–275 (2000, 2002)
4. US Department of Agriculture Economic Research Service. Mother's nutrition knowledge is key influence on the quality of children's diets. *J. Am. Diet. Assoc.* 100, 155 (2000)
5. Feather, N.: Human values and the prediction of action: an expectancy value analysis. In: Feather, N.T. (ed.) *Expectations and Actions: Expectancy Value Models in Psychology*, pp. 263–289. Erlbaum, Hillsdale (1982)
6. Bandura, A.: *Social Learning Theory*. General Learning Press (1977)
7. Baranowski, T., Buday, R., Thompson, D.I., Baranowski, J.: Playing for real: video games and stories for health-related behavior change. *Am. J. Prev. Med.* 34(1), 74–82 (2008)
8. Grunert, K.G., Brunso, K., Bisp, S.: Food-related life-style: Development of a cross-culturally valid instrument for market surveillance, MAPP Working paper no. 12. The Aarhus School of Business, Aarhus (1993)
9. Elaborazione Centro Studi Fipe su dati Istat (2011)
10. Primo rapporto sulle abitudini alimentari degli italiani. Censis e Coldiretti s.l. (2010)
11. Primo rapporto sulle abitudini alimentari degli italiani. Censis e Coldiretti s.l. (2010)
12. European Action Plan for Food and Nutrition Policy 2007-2012. WHO, s.l.
13. Schema di piano sanitario nazionale 2011-2013. Ministero della Salute s.l.
14. Santoro, R., Conte, M.: *Living Labs in Open Innovation Functional Regions*, ESoCE-NET White Pap (2010)