Persuasive technologies in building support system to prevent non-communicable diseases caused by sedentary lifestyle

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Abstract. In this paper, we present the use of persuasion to help people who want to change their everyday behavior technologies. Méxmov and Lifestyle Change Recommender Systems (LSCS) ¡Camina!, are designed to reduce sedentary as prevention of non-communicable diseases.

Key Words: Ubiquitous Computing, Lifestyle Change Recommender Systems, Persuasive Computing, e-Health, Non-communicable Diseases.

1 Introduction

Non-communicable diseases (NCDs) are now the cause of more than 36 million deaths worldwide and 80% of these deaths occur in low and middle income [1]. NCDs have in common four risk factors: snuff consumption, physical inactivity, harmful use of alcohol and unhealthy diets. A risk factor is any trait, characteristic or exposure of an individual to increase your chance of getting a disease or injury.

Throughout the last decade, there has been an alarming increase in the prevalence of overweight and obesity among adults and adolescents worldwide. Overweight and obesity are according to WHO [2] is the fifth leading risk factor for death in the world. Every year die at least 2.8 million adults as a result of being overweight or obese [3]. In addition, 44% of the incidence of diabetes, 23% of the incidence of ischemic heart disease and between 7% and 41% of some cancers are attributable to overweight and obesity.

It is estimated that one in every two people overweight or obese in more than half the countries in the Organization for Economic Cooperation and Development (OECD). The average of the OECD nations obesity is at 22%. In particular we note that there are significant variations among OECD countries such as Japan and Korea have a 4%, and in contrast the U.S. and Mexico reach 36%. This trend is expected to continue increasing in some countries and two out of three people will obesity in ten years. Moreover, obesity and its consequences, not only affects the health of individuals, but also impacts their economic resources and budgets of health systems, triggering financial crises.

Obesity is a worldwide problem largely determined by lifestyle. Excess food intake is certainly a determining overweight / obesity factor however, combined with obesity

in most cases, individuals who suffer perform little or no physical activity and generally lead a sedentary life. In recent clinical studies on obesity [4], physical inactivity has a prominent place. The lifestyle of modern society causes, most people spend a lot of time a day in sedentary activities, which is why in recent years there has been numerous medical tests to generate tests and collect data on the impact health of sedentary behavior and in particular on the relationship between physical inactivity and obesity.

In epidemiology, lifestyle, lifestyle habit or way of life is a set of behaviors or attitudes that the individuals, who are sometimes healthy and sometimes are harmful to health. In the field of psychology today has renewed interest in the psychological processes that guide the daily habits [5] [6] [7]. This interest is partly driven by the recognition that there is no single and automatic building habits, and there is no convergence in the psychological mechanisms underlying habits. Habits can be defined as psychological dispositions and repeat past behaviors are gradually acquired as people respond repeatedly with a similar attitude in similar contexts. Most researchers agree that habits often originate in the pursuit of a goal, since people tend to repeat actions that are rewarding or desired performance outcomes. In addition, the force of habit is an ongoing, with weak habits and moderate these occur less frequently and / or more variable contexts that strong habits [8]. This consensus is not clear how the objectives and context influence the habit automatize. Goals are motivational states that (a) define a valuable outcome (b) energizes and directs the action (for example, in order to use a particular piece of clothing energy to increase daily exercise routine). Moreover, the product of a context, habits reflect the characteristics of the environment in which the yield response typically occurs (eg, eating popcorn at the movies). Some research indicates that habits are automatically activated by targets [9], while others indicate that habits are activated directly by context cues, with minimal influence of the objectives [7].

The questions we want to solve in this project are: Can information technologies contribute to the formation of new habits?, How to get adherence by users to these tools of computer character?, What features should have the tools designed to offer incentives that encourage the user to change unhealthy behaviors?, Are recommender systems change lifestyle a cost-effective solution for a society like ours are?

2 Persuasive Technology: Lifestyle Change Recommender Systems

A recent trend in computing is the application of persuasive technology [10] to help people change their daily behavior to support the lifestyle you want to lead. In this paper, a *lifestyle* is defined as a pattern of behaviors that an individual enacts and characterizing who she is and how it is perceived. Therefore, a lifestyle is the result of the choices that an individual makes. So you get to convince a person to change their everyday behaviors and therefore their lifestyle is a challenge.

People want to be fit and healthy, however, physical inactivity and poor eating habits are causing serious health problems. The discrepancy between the desired and the actual lifestyle can in part be attributed to simple everyday decisions. Sometimes these decisions support to achieve the desired lifestyle; other times they do not. Often,

it is a pattern of poor decisions that prevents an individual achieve their desired lifestyle [9].

One of the most interesting applications that are possible with persuasive technologies is building recommender systems to support users in taking decisions related to various aspects of their lifestyle; we call them Lifestyle Change Recommender Systems (LSCS). These systems are computer applications that enable people (healthy or unhealthy behavior any) in health and wellness, teaching them how their actions affect their health, this being an important step to improve the quality of life and reduce disease future, contributing to the empowerment of the individual over their health by strengthening their self-care agent.

Since psychological and social processes that promote behavior change depends on many factors, different established theories emphasize different aspects that can drive change. Most theories are used Technology Acceptance Model (TAM), the Theory of Planned Behavior (TPB), the Theory of Significant Behavior (TMB) and the Theory of the Big 5 Personality. The model of technology acceptance is to predict whether a technology will be accepted and adopted by users. This model says that for a system or technology is accepted must address two key components: the perceived usefulness and usability sense of [11]. TAM is generally used for the interface design of such systems, ie, the system is designed to provide useful information for the user and the interface is designed to the target user group. Significant Behavior theory emphasizes how internal and external incentives can help promote behavior change [12]. External incentives can be viewed as rewards for behaviors, such as getting a prize if you get good grades or a medal if they meet such goals established physical activity. Internal incentives are incentives that have internalized and associated personal rewards such as personal satisfaction. Generally the design is initiated by external motivators such as an agent or a motivator and / or by phrases and is expected to monitor the internal motivations are generated, in the case of a system like the one we implement, with the association of physical activity and the idea of belonging to a healthy community. The Theory of Planned Behavior, moreover assumes the existence of key components that affect behavior. These components are perceived as control standards, and subjective attitudes and behavioral intention. In TPB, perceived control is based on how to the individual will be easy or difficult to adopt the suggested behavior [5]. The attitudes and subjective norms refer to the influence that other people can have on the individual and their behavior affects. Finally, behavioral intention or Big Five Inventory refers to, if a person wants and agree to adhere to the behavior for which a test is performed on your personality.

In LSCS development, the concept of persuasion, as already mentioned, is an important character. One theory in the field of persuasion is called captology (Computers as Persuasive Technology) JB Fogg [10]. In this methodology, persuasion is presented as an attempt to influence behaviors, feelings or thoughts but states that these attempts should be non-coercive influence (not to be influenced by force), non-manipulative and not misleading. It also states that there must be intentionality behind the attempted influence, and accidental changes in behavior, feelings or thoughts should not be seen as persuasion.

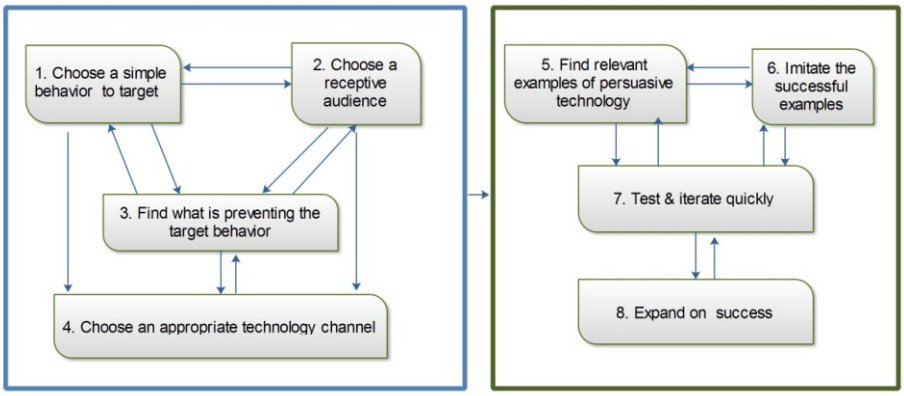

Figure 1. Methodology used in persuasive design MexMov system.

The persuasive computation can then be defined as the use of technology for the explicit purpose of changing attitudes and behaviors of people. Persuasive computing studies the use of computers and technology in general, as devices of persuasion. It should be noted that not only the theories of behavior are important for developing persuasive technologies, if not a critical component in the design, which is the proper selection of the technology to be used as a means of interaction between individuals is required and LSCS's, based on the importance of these technologies be effectively integrated into the daily life of individuals and are likely to be used in various circumstances of personal and work life thereof.

3. Lifestyle Change Recommender Systems Design

As discussed in the preceding sections MéxMov the project aims to use information technologies, pervasive computing, ubiquitous computing technologies and user-centric design in the construction of a LSCS to promote physical activity and reduce physical inactivity in Mexican society.

As we have argued, the design of this type of technology to help people to change their unhealthy habits is complex, so the decision to make a first prototype for a small group of individuals took; Following development of LSCS methodology shown in Figure 1. research on the behavior change was made in the first instance, in this case physical inactivity and its consequences for health and the university population was chosen as the target population.

3.1 Collection and Analysis of Data

To provide relevant information profile to future users initially have to collect data and behavioral characteristics of potential users of the system, the latter to determine what kind of tips are the most appropriate and the current status of the target population to clarify what points should be to concentrate the activities to be performed by users. To get this information to a group of 1334 people all were evaluated with university studies (494 women and 840 men) with the Baecke questionnaire of physical activity [13]. As a result of the study, the target population obtained a sedentary index of 0.55, which is comparable to that obtained by the survey ENSANUT 2012[1]. If we compare the results obtained with the Baecke survey indices ranging from 0 (not sedentary) to 1 (highly sedentary) we have that we face a *sedentary* population as shown in Table 1 below.

Table 1. Results of the survey Baecke physical activity applied to the student population of the School of Computer Science at the Autonomous University of Puebla.

Results of Baecke questionnaire for measurement of a Person's Habitual Physical Activity	Indices for physical activity			
	work activity	sports activity	leisure activity	physical activity index
Surveyed population results	2.2	1.98	2.65	6.83
Baecke estimate results	5	5	5	15

Analysis from body mass index of the population surveyed, finding that 31% are overweight was also performed. Besides the nutritional status of the population is estimated from the body mass index and found that they are more likely to find people with underweight overweight or obese in both sexes ($\chi 2 = 24.44$, $P < 0.00005$), this pattern is conserved between women and men. We can conclude that being overweight is a normal condition in college students.

To have an overview of the attitude of the target population was included in the survey the option to participate in preventive health programs, to which 62% of respondents answered negatively, thus raises the monitor to users through persuasive computing. The use of non-invasive methods, allows to track the health status steadily without intervening directly with their daily processes and propose preventive actions to improve physical activity. For this reason asked about mobile devices like phones and only 20% of respondents do not have phones with Internet access, so it is also considered the use of pedometers to obtain a similar result to which it was proposed to achieve with the application developed for the platform, although it users have to manually enter what they do every day and pedometers restart the next day.

[1] Encuesta Nacional de Salud 2012, México

3.2 Méxmov

There are three main challenges for LSRCSs: firstly, such systems have to assess the user's context for delivering such recommendations. Secondly, in order to promote any change in the lifestyle of the user, they have to recommend a tailored sequence of items, mostly actions, taking into account the dependencies between items and the effects of each item recommendation. Thirdly, the systems have to be defined in a way that favors the user's continuous attention, and allows to explain the reasons for the change in the user's future behavior, and to communicate the changes already effectuate. In this way on web platform implemented, to meet the requirements of our potential users included informative sections as well as a registration system. The latter because interested user's registration is required. The news sections and the user interface of the system are shown in Figure 2.

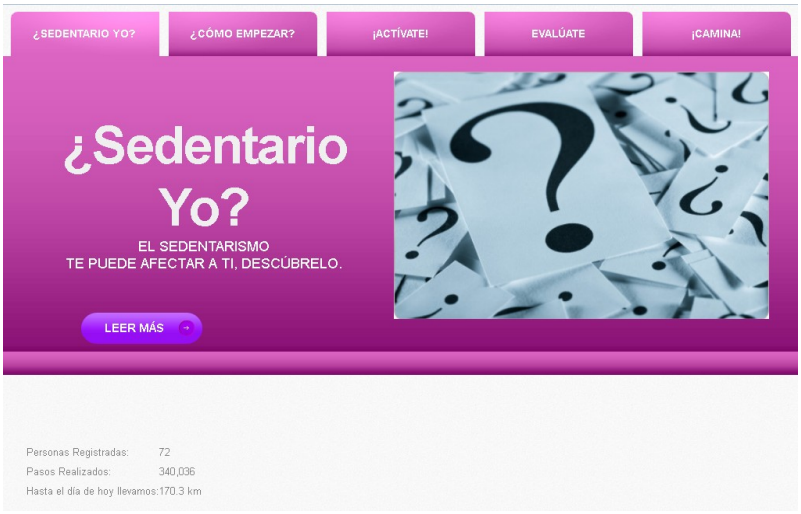

Figure 2. Informative features for MexMov. These features are available to anyone who accesses the platform

Based on studies of physical activity consider walking as the activity more accessible and feasible for the target population. We chose the walk as there significant evidence linking the health of people with the amount of steps you take a day. According to those who met the challenge of walking arises in various investigations around 10 thousand steps a day have better overall health and a better quality of life than those with little movement during the day.

MéxMov proposes the constant monitoring of users through sensors, allowing collecting information about their daily activities: times of activity, time to rest. Thus it is expected to attend, particularly recommending registered users: exercises, activities, articles on the importance of regular physical activity, as it is essential to strengthen the user's self-management of their health which will result in the prevention of non-communicable diseases and in reducing disease risk factors. To

make the feedback system users will have a personal monitor (coaching) that can support mold your lifestyle from your current physical activity.

3.3 Walk!

We named Walk! (¡Camina!), to LSRCS embedded in MexMov platform; In Walk! a series of incremental challenges, that user must overcome to reach the habit of walking 10,000 steps a day, were implemented. To position the user level, the RAPA[2] physical activity questionnaire was implemented and the user is invited to do it at the moment of their register in the system. The advantage of the RAPA questionnaire [14] which gives us is a level of inactivity, so that the recommendation system based on user responses can locate on appropriate initial challenge for him/her.

To set goals and evaluate them with the participation and motivation of registered users consider the following scale:

Level of physical activity	Number of steps
Sedentary	0-5,00
Low activity	5,000-7,499
Moderate activity	7,500-9,999
Good activity	10,000-12,500
Very god activity	12,500-more

the number of steps indicates the number of steps to be performed daily to achieve the level associated. Notably, about 2,000 steps make a mile. Furthermore the user has a profile where you can see your progress daily, providing a stimulus to the daily challenge and get racing it, so that seeks to overcome the above goal and thus to control the risk factors without kept in mind throughout the activities.

Walk! users initially have a progressive challenge that can be performed from five thousand steps to make more than ten thousand steps a day. Users who like to compete, may propose or simply state that wish to fulfill another goal, we chose to provide registered users on the platform to propose a form for the challenges they would like to perform. The challenges are considered virtual, to ensure the safety of users; before being approved these challenges are verified by the platform administrator. Challenges that do not have points of contact, addresses, phone numbers or any kind of contact are not considered as such; afterwards it is proposed to systematize parsing and lexical challenges in order to post automatically after being proposed, with the certainty that they are safe for others.

The platform is multi-user, so it is endowed with a section for users to interact with each other, set up groups of more than two people, allowing competition and group motivation. By having the ability to form groups, a person can work with their daily

[2] Rapid Assessment of Physical Activity, RAPA

achievements overcome group challenges[3]. What is sought is that users can virtually interact with each other, and they relate to people who may not know but with common interests, so that persons belonging to a group have tastes similar goals or ideas for a well help achieve a group goal. It has been shown that physical activity in a group increases the success of programs of physical activity by approximately 44% [15]. Social support helps team members to fulfill their individual goals and further encourages healthy competition.

Each user has a profile where you can view your progress during the current month as shown in Figure 3, this type of monitoring allows users to assess their progress and setbacks in their daily challenges, this is done with the intention to motivate users to exceed the daily level of your graph, keeping in mind the effort and achievement obtained. The platform also has a mobile application developed for the Android system that allows us to be in constant communication with the user. This application is constantly polling the accelerometer of the device, taking the upper and lower peaks as a possible step. To be considered a full step the upper peak must remain until a lower peak and must exceed the threshold set at the time of calibrating the mobile device.

Fig. 3. Interface where the user can record their progress and have full information on their achievements, challenges and groups.

4 Results

Using the proposed methodology we included in the work team a group of potential users who actively participated in the design and subsequent implementation of the platform and LSCRS. That strategy inspired in the agile software design bring us the solution about the knowledge from two perspectives: one the one hand, from the user's point of view, give us options for actions in a certain situation and their

3 Depending on the nature and number of members allowed in the constitution of the group.

preferences that in the future may ensure their adherence to system; On the other hand, the knowledge of Health Risks of a Sedentary Lifestyle, is necessary to evaluate each option from an expert's point of view. A good recommendation of a LSCRS satisfies both user preferences and is compatible with expert knowledge. This property of a LSCRS is very challenging in terms of its algorithmic implementation and the acquisition and formalization of the required domain knowledge. Beyond that, in order to register up-to-date information about their physical activity, the recommender system need to have access to relevant sensor data and allow users to provide input and feedback about their steps and the recommended options, in that direction, the user-centered interfaces and mobile applications to keep in touch with the user and their achievements are already implemented. The prototype MexMov http://ubisalud.cs.buap.mx/mexmov/ system was recently evaluated considering the following principles of quality health pages [16]: 1) Formation 2) Responsibility: Editorial Policy 3) Reliability: Quality content 4) Current information 5) Protection of personal data 6) Graphic design / overall appearance 6) Accessibility. For the evaluation, was considered a different group from those potential users who contributed to the development of MexMov. The score 85 (good) was obtained and currently the proposed improvements, result of this phase, are in implementing process.

5 Conclusions and Future Work

Lack of physical activity causes deleterious changes in body composition, metabolism, and functional impairment and increased risk of disease in old age. The potential of Internet-supported interventions to increase physical activity and improve metabolism in older people is a great promise, but to our knowledge, has not been studied in the Latin American population. At the conclusion of the extensions and improvements resulting from the evaluation of MexMov we will do a randomized controlled intervention for a period of three months in a sample of 235 adult volunteers from the university. For the study consider two intervention groups; The first will use pedometers and manual recording of their achievements on the platform and the second will have access to the mobile application and automatic registration. Note that as the ultimate goal, we hope to influence increased physical activity in work and educational settings. The results so far obtained indicate that it is possible to raise awareness and persuade the target population to participate in the intervention, which will give us a better profile of stakeholders and their expectations. Moreover, this project will evaluate the efficiency of LSCRS and Web-based interventions that provide new opportunities for prevention of non-communicable diseases on a large scale.

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