Towards Healthy Office Environments: A worker-centric Internet of Things Approach

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Abstract

Health promotion in the workplace is one of the main challenges that the World Health Organization (WHO) has set in its agenda for the 21st century. Motivated by this concern, many companies have reacted launching awareness campaigns and wellness promotion programs that often encounter lack of adherence or follow-up by the target audience. Information and Communication Technologies (ICT) and the emerging paradigm of the Internet of Things (IoT) can play a mediating role between the campaign's proposers and the employees to increase their motivation to stick and prevent early dropouts. Hence, this PhD work presents a participatory worker-centric concept for enhancing individuals' wellbeing in office environments. The approach seeks to stress the importance of empowering workers to control their own wellbeing and self-care, turning work environments into succeeding confident settings to persuade and motivate end-users to attain health related changes in the mid and long-term.

Author Keywords

Health promotion; Internet of Things; workplace; office environments; persuasive computing; user-centered design

ACM Classification Keywords

H.5.1 [Information interfaces and presentation (e.g., HCI)]: Multimedia Information Systems

Figure 1: An example of how different objects (a chair and a bottle) can be enhanced by attaching the smart devices of the provided toolkit.

Introduction

The direct influence of work on individuals' physical or physiological health is a renowned problem. Consequently, wellbeing at work is gaining increasing significance on overall health promotion [5]. In particular, office environments and their inherent occupational sedentary behavior stand out as one of the most addressed health related concerns [6]. Beyond sedentarism, unhealthy practices associated to this space involve deleterious impacts in health (i.e. ergonomic-related problems, musculoskeletal disorders or computer vision syndrome) that are directly related to a decrease on health and comfort [10]. Under this context, health promotion interventions involve correcting these bad practices and promoting new healthy ones that persist over time. ICT can enable the possibility of monitoring human factors and provide context-aware guidance, achieving the purpose of delivering information to anyone, anytime and anywhere. Specifically, IoT can be considered an emerging paradigm to mediate the relationship between employees and their self-care, providing insights of the transformations that workplaces could undergo to become socially-engaging places that respond to the workers' needs.

Related work and Motivation

The analysis on the effectiveness of workplace health promotion programs carried out until 2013 [9] shows that, although they obtained promising insights about positive effects, the majority of health interventions in workplace suffer from high rates of attrition and drop out. This is a consequence of having no incentives for engagement, a poor follow-up and the fact that the people do not really trust on their companies measuring what they are doing (i.e schedules or work performance) [1]. Moreover, some of the works fall into over-instrumenting the spaces, which creates a sense of surveillance in office environments that contrasts with the ethical concerns of personal data collec-

tion [2]. From the review the literature, I noted that users have been historically left out of the decisions related to their health promotion at workplaces. To this end, this research introduces a human-centric proposal through IoT which places workers at the center of the process of caring for their own wellbeing and responds to the workers' needs, removing the barriers for engagement. The suitability of the IoT technology in health and wellbeing promotion is not new and has been already validated [8]. Some scholars have presented e-health intervention to increase workday energy expenditure [7], avoid lower back injuries [11] or encourage workers to take more regulars micro-breaks [4]. However, to the best of our knowledge, there is no advancements on applying IoT for increasing engagement and interest on wellness self-care in office environments.

Hypothesis: A Worker-Centric Proposal

This PhD thesis is envisaged to reinforce the role of end-users as a mean to design successful interventions for wellness promotion in work environments, addressing how IoT can contribute to promoting changes that persist over the time. To this aim, a new concept of tangible and unobtrusive electronic smart toolkit is proposed. This kit is in charge of obtaining data related to the state and actions of the workers (e.g. hydration or sitting posture) and providing them with personalized information and guidance (i.e. just-in-time feedback). For that, it is comprised of an assortment of different kind of small sensors and actuators that enable workers to augment their work environment and directly decide and control what is monitored (see Fig. 1).

The hypothesis of my PhD is stated next: "if end-users are provided with a toolkit for self-measuring a list of activities at workplace (e.g. water or coffee intake, activity, periods without getting up, back problems due to uncomfortable way of being sat at their chairs, etc.) and they are involved

Sensors toolkit

The following examples correlate different sensors, their possible function and their attachment. The aim is to let the system know how and when these objects are being used (i.e. activity recognition) and to provide the users a set of subtle interactions to let them understand if the action they are doing is being performed properly or not.

Accelerometer:
Physical activity (body)
Hydration level (bottle)
Caffeine intake (coffee mug)
Posture (workers' back -several sensors-)

Temperature sensor:
Inactivity (chair -several sensors-)
Posture (chair)
Caffeine intake (coffee mug)
Ambient conditions (place)

on their self-performance in the follow-up, higher rates of engagement and lower rates of abandons will be achieved". In my PhD, involving means that end-users decide what to measure by placing sensors in surrounding objects such as their mug, chair or even themselves. This sense of bringing data closer to the user correlates to the Fog Computing paradigm that allows a local processing of the data instead of a Cloud one. Furthermore, actuators will serve to aware users about unhealthy practices or raise their attention to certain habits that may hinder their wellbeing by applying technological persuasion techniques. Letting the people be the owner of their highly sensitive information by deciding what information can be shared or what data have to be personal seeks to avoid the reluctance to adopt health care interventions in work environments.

Current status and Future directions
The main ideas previously expressed will be reflected in a three-years-long PhD thesis which is currently at the end of the first one. The starting point of this thesis was a conducted research that evaluated the suitability of a Smart Mirror to motivate more physical habits in the workplace [3]. The obtained findings evidenced promising insights to trust on the potential of technology-enhanced objects to act as suitable engagement elements to encourage the adoption of lifestyle changes at workplace.

The PhD work plan and methodologies are designed to be covered in several stages. The first one corresponds to an exploratory phase in which main health implication related to office environments are being analyzed. Tacking into account the role of end-users, this phase combines a study of the literature with several work sessions involving employees of my own research center where more than 100 people work. At the time this work is written (March 2018) this phase has already started. The second stage consists

of a preliminary experiment, using commercial devices (i.e. wearables or embedded sensors), to detect what is more interesting to be measured and how sensors should be placed to that end. From this knowledge, the envisaged toolkit of devices will be designed and developed following the principles of a User-Centered Design. The challenge of this phase and a pivotal condition to achieve the final engagement to technology is to get efficient and reliable instruments that employees feel comfortable with. Then, the last step will be a mid-term experiment to contrast between two treatments, one in which sensors are already placed by computer scientists and technicians on an instrumented workplace and the second where the user is free to place the sensors to monitor what they want. Both from a quantitative and qualitative point of view, this study will be used to validate the initial hypothesis by comparing the level of the participation and motivation of employees when monitoring is imposed and when they take part actively.

Conclusions and Advice Sought
The explained PhD is thus dedicated to improving the role of technology and in particular the Internet of Things paradigm for health promotion in office environments. Moreover, this thesis empowers the role of employees presenting a self-exploring process of obtaining the monitoring data that reflects the idea of technology appropriation and makes the user feel and appear as the center of an intelligent workplace. The main social challenge arises from creating socially-engaging places to encourage the adoption of lifestyle changes that persist over time, succeeding on the first step for influencing workers' health. In the sense of scientific implications, the current solution is designed to respond to real workers' needs, instead of just providing or deploying technology from the point of view of the things that computer scientists can do rather than the things they should do for wellness promotion.

By presenting this work on the Doctoral Colloquium what I would like to obtain is advice from the faculty panel experts on health domain and pervasive technologies. Despite having expertise in fields such as Ambient Assisted Living or Human Computer Interaction, the research group in which this PhD is being conducted does not have a wider knowledge in this domain. Therefore, getting the opinion of other researchers will help me to guide better the future path of my research and detect possible hurdles or improvements on the concept or the methods envisaged.

Acknowledgements

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