Fitbit+: A behavior-based intervention system to reduce sedentary behavior

Laura R. Pina
Department of Computer Science & Engineering
University of California, San Diego
9500 Gilman Drive, # 0404
La Jolla, CA 92093-0404
lrpina@cs.ucsd.edu

Ernesto R. Ramirez
Center for Wireless and Population Health Systems
University of California, San Diego
9500 Gilman Drive, Dept. 0811
La Jolla, CA 92093-0811
erramirez@ucsd.edu

William G. Griswold
Department of Computer Science & Engineering
University of California, San Diego
9500 Gilman Drive, # 0404
La Jolla, CA 92093-0404
wgg@cs.ucsd.edu

CHI 2012, May 7–12, 2012, Austin, TX, U.S.A
ACM 978-1-4503-0268-5/11/05.

Abstract
Self-tracking wearable devices are being used to track calorie consumption and physical activity, to support self-awareness and healthy behavior. These devices automatically capture desirable behaviors (such as walking) but do not typically detect unhealthy behaviors (such as sitting for a long period of time) or intervene in the moment to persuade users to correct these unhealthy behavior (e.g., by taking a break to go for a walk). There is an increasing trend for people with low physical activity occupations to sit for long periods of time, yet research suggests that lengthy sitting, independent of overall physical activity level, increases the risk of weight gain and mortality[4] . We aim to decrease the duration of sedentary bouts in the workplace by detecting when people have been inactive for a long time and then prompting them to do some physical activity. We present the design of Fitbit+, a system that realizes this strategy by leveraging Fitbit's near real-time, automated step logging to detect sedentary behavior and then prompt users to take a walking break.

Keywords
Self-tracking, sedentary behavior, in-situ intervention

ACM Classification Keywords
H.5.2 Information Interfaces and Presentation: User interfaces – Evaluation/ methodology

Introduction

Currently, there is an obesity crisis affecting the United States and other developed nations. A possible cause of this crisis is the increasingly sedentary lifestyle, especially during working hours. People tend to sit between 4.5 to 9 hours during the workday[1, 6]. Sedentary behavior has been shown to have a negative impact on both short-term and long-term health through the increased risk of weight gain, metabolic disruption, and premature mortality[5]. Also, there is a growing body of research that suggests that breaking up sedentary periods with short periods of physical activity has a positive effect on health[4].

In response to the obesity crisis, an array of health and fitness devices have been created to encourage healthy behaviors by supporting people's awareness of their nutrition and fitness. One these is Fitbit[1]. This device detects and stores steps taken, physical activity intensity, duration of movement, distance travelled, and estimated caloric expenditure. This data is presented to users on the device as well as online through different visualizations.

The following scenario expands on the use of Fitbit: *Joe is concerned that he is not active enough. He likes using Fitbit because it is not intrusive, it has a long battery life, and it counts his steps automatically and accurately. Joe likes that he can get immediate feedback on his activities and can view his activity history and track progress toward his goals online. He also likes that the data is automatically uploaded to his computer when the Fitbit is in close proximity of its base station.*

Using the Fitbit helped Joe become aware of how little he walks on a regular basis, which he attributes in part to sitting for long hours at work. He decides to make an effort to walk more and sets the goal of walking 10,000 steps a day. However, in the first week of trying to reach his daily goal, he struggles. He is busy at work and finds it difficult to remember to take walking breaks regularly. Typically, when he gets home from work, he is still short by 5000 steps. Sometimes he makes an effort to go for a walk to reach his goal, but often he gives up frustrated.

As the scenario reflects, Fitbit alleviates the burden of self-reporting by automatically tracking a person's daily step count but it cannot intervene when undesired behavior is occurring. We see an opportunity to create an in-situ behavior-change intervention by extending this self-tracking device. Our system, Fitbit+ seeks to close the feedback loop by detecting prolonged sedentary bouts and making users aware of such behavior through Fitbit+'s interface.

In this paper, we present Fitbit+, a low-cost, nonintrusive behavior-based intervention system for decreasing sedentary behavior in the workplace. We propose to leverage Fitbit's near real-time activity tracking and extend it with a light weight prompting mechanism to encourage people who have been sedentary for a while to do some physical activity. We introduce our system and describe interaction strategies we are considering employing.

Fitbit+: A behavior-based intervention system

We aim to persuade users to increase the frequency of breaks from sitting, and increase, as a side effect, their daily step counts . We hypothesize this can be achieved by prompting users with behavior-based in-situ persuasive messages. We

[1] www.fitbit.com

present the design of our system, which analyzes data from a Fitbit device and prompts users to take walking breaks when they have been inactive for lengthy periods.

In our system, users wear a Fitbit device, which automatically transmits data in near-real-time to a base station connected to their work computers. Additionally, our system has two primary components: a recognizer and a notifier. The recognizer regularly polls and analyzes users' Fitbit data to detect periods of inactivity. When such a period is detected, the notifier, implemented with Growl[2], displays a message to the user on his/her workstation to encourage him/her to take a break.See Figure 1.

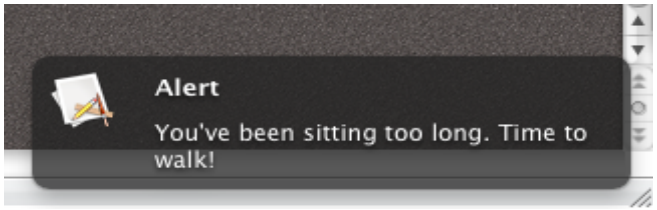

Figure 1: Prototype of message

The design of Fitbit+'s user interface is intended to support awareness without being overly disruptive. Notification messages are displayed in a small window on the corner of the users' computer monitors, leveraging the fact that users are likely already looking at them as they work. Users can glance at a message, and quickly decide whether or not to act on it, with minimal disruption to his/her workflow in the latter case.

We are currently exploring the use of four different message strategies for encouraging users to take breaks and walk away from their desks: *action* (*specific* and *vague*), *reminders* (*positive* and *negative*) and *feedback*. A *specific action* message is a short prompt to engage in a specific physical activity (e.g. *Thirsty? Go grab a quick drink from the nearest water fountain*). *Vague action* messages will prompt users to get up and move without suggesting specific activities. The *negative reminder* messages will mention the negative consequences of prolonged sedentary behavior, and *positive reminders* will mention the positive consequences of doing some activity (e.g *Moving helps with creativity. Take a short walk around the office to help yourself solve a difficult problem!*) We would also like to explore the use of informative *feedback* to support users awareness of their activities (e.g. *You've taken 5 breaks today! Keep up the good work!*)

The following second scenario demonstrates how we foresee our intervention system being used. *Joe installs Fitbit+, to remind him to take regular breaks. During his busy workday he notices a message in the corner of his screen reminding him to walk, so he takes a walk back and forth in his hallway. He's relived that he didn't have to remember to take a break in addition to everything else he has to do at work! Fitbit+ detects that Joe acted on the prompt and does not send another prompt until another long bout of sitting is detected.*

After lunch, Joe feels lethargic because he ate too much. He loses track of how long he has been sitting until Fitbit+ makes him aware of it, and this time he decides to ignore the reminder to walk. Fifteen minutes later, he receives a second reminder message, which says that walking will reenergize him, and he walks around his office for 5 minutes. Notifications show up a few more times before the end of his work day and he acts on the majority of them. At the of the day, Joe glances at his Fitbit and notices that his total step count significantly increased compared to before he was using the notification system, and he feels encouraged! He thinks to

[2] http://growl.info/

himself that he will make an effort to walk a little more the next time he is prompted.

Fitbit+ aims to improve over previous methods for reducing sedentary behavior by closing the feedback loop. Prior approaches typically changes to the work environment, e.g. by introducing standing desks or under-desk pedaling devices, which may not be used consistently and may be impractical for some[2, 3]. Our system instead leverages near real-time information about users' behavior to provide automatic feedback, interceding to prompt change at the moment when sedentary behavior is occurring. This approach precludes the need for users to explicitly seek out information on the Fitbit device or website and the need for changes to the workplace environment.

Proposed Study

As mentioned previously, we have developed categories of messages that we believe will be effective for prompting behavior change. We feel it is important to further develop and test the messaging content by including members of the population of interest: people with sedentary work styles. In order to do this we are proposing a three-phase study.

1. We first plan to run a focus group, to discuss, and brainstorm on what sedentary office workers believe would be effective messages for Fitbit+.

2. Integrating the feedback we plan to run a a short pilot study to test our first iteration of the system, as well as the message content.

3. Finally, we plan to recruit current Fitbit users (n = 28-30) and implement a randomized controlled study to test the efficacy the proposed system.

References

[1] W. J. Brown, Y. D. Miller, and R. Miller. Sitting time and work patterns as indicators of overweight and obesity in australian adults. *International journal of obesity and related metabolic disorders journal of the International Association for the Study of Obesity*, 27(11):1340–6, 2003.

[2] L. J. Carr, K. a. Walaska, and B. H. Marcus. Feasibility of a portable pedal exercise machine for reducing sedentary time in the workplace. *British journal of sports medicine*, pages 1–7, 2011.

[3] N. D. Gilson, A. Suppini, G. C. Ryde, H. E. Brown, and W. J. Brown. Does the use of standing "hot" desks change sedentary work time in an open plan office? *Preventive Medicine*, pages 2009–2011, 2011.

[4] G. N. Healy, C. E. Matthews, D. W. Dunstan, E. A. H. Winkler, and N. Owen. Sedentary time and cardio-metabolic biomarkers in us adults: Nhanes 2003-06. *European Heart Journal*, 32(5):590–597, 2011.

[5] S. J. Marshall and E. Ramirez. Reducing sedentary behavior : A new paradigm in physical activity promotion. *Building*, In Press(x), 2011.

[6] K. I. Proper, E. Cerin, W. J. Brown, and N. Owen. Sitting time and socio-economic differences in overweight and obesity. *International journal of obesity 2005*, 31(1):169–176, 2007.