Embedding Additional Behaviors Into Users' Daily Routines for Improving Users' Awareness of Self-Health Condition

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Abstract. Nowadays, lifestyle diseases have become a global social problem. As a treatment, it is necessary to review people's life patterns and lead them to a better lifestyle, which is called "Behavior Change." With the progress of information technology, many pieces of research and developments have been conducted to assist people with their daily life, trying to induce behavior change. The common approach used in the existing systems is altering users' target behaviors to new behaviors, such as drinking more water and walking further. However, this approach considers less about the timing of proposing and the relevance between users' target behaviors and new behaviors, which limits the effectiveness of the existing systems in inducing behavior change. To improve users' experience and effectiveness of the system, in this paper, we propose a new design of behavior change support system which promotes behavior changes by embedding additional behaviors into users' daily routines, trying to improve users' awareness of their health condition.

Keywords: Behavior Change · Daily Routines · Environment Side

1 Introduction

Lifestyle diseases such as obesity and diabetes have become a global social problem, and they are usually caused by peoples' lousy daily habits, as the name implies. As a treatment, it is necessary to review people's daily life patterns and lead them to a better lifestyle, which is called "Behavior Change" in the medical field. In recent years, many researchers and developers have employed information-technology to enable behavior change. For example, Consolvo et al. [1] proposed an application embedding gamification in which the users' physical activity leads to a more beautiful and growing virtual garden. Wang et al. [9] developed an application that visualizes users' stress degree estimated by the user's heart rate to promote users to do stress self-regulation. These kinds of systems are also called as "Behavior Change Support System (BCSS)" in

the BCSS theory [7]. The typical approach used in the existing BCSS is altering users' target behaviors (the behavior that the user is doing or planning to do at the moment) to new behaviors such as promoting users to drink more water, walk further, stand up, take a deep breath, and so on. However, this approach considers less about the relevance between users' target behaviors and new behaviors, which limits the effectiveness of the existing systems in inducing behavior change. Moreover, the existing systems are usually designed as mobile applications due to the information reachability and prefer to use push notification to sending proposal, which makes it difficult for adjusting the timing of proposing since people nowadays receives a considerable number of notifications from various applications every day, and it may interrupt users from noticing the message from the BCSS. Therefore, an alternative approach is needed. To improve users' experience and effectiveness of the system, in this paper, we propose a new design of behavior change support system which promotes behavior changes by embedding additional behaviors into users' daily routines, trying to improve users' awareness of their health condition.

The rest of this paper is organized as follows. Section 2 describes the related work and our previous interactive signage system. Section 3 and Section 4 describes the details of the proposed design and the prototype we developed. In Section 5, we provide conclusions with some future work.

2 Related Work

The BCSS theory is an extended version of the Persuasive System Design (PSD) model [8], aiming at forming, altering, reinforcing attitudes, behaviors, or an act of complying without using coercion or deception [7]. In this section, we introduce practical examples applying the BCSS theory and interactive signage system.

In recent years, many developments apply gamification to induce behavior change since gamification contains many attractive elements, which enables to maintain users' motivation for a long time and affect users' attitudes and actions through the game. A famous example of this approach is an augmented reality game called Pokémon Go. Kari et al.'s research [3] has proved that Pokémon Go can influence users' behavior on all three levels as it can form, alter and reinforce users' attitudes and actions (e.g., encouraging users to start walking). Pokémon Go has successfully added activities in users' life, to enhance routines and exploration, increase physical activity, strengthen social bonds, lower social barriers, and increase emotional expression and self-treatment [3]. Consolvo et al. [1] proposed an application embedding gamification in which the users' physical activity leads to a more beautiful and growing virtual garden.

Other than gamification, an approach called "social support" is also getting popular in recent years. Social support induces behavior change through the influence of users' social relationships. Jaques et al. [2] developed a web-based pairing service. In this service, two people paired need to help each other to achieve their own goals, such as drinking more water and doing more exercise. By pairing and encouraging paired people to support each other, the service

manages to induce behavior change successfully. Luhanga et al. [4] conducted a study to induce behavior change through group competition and support from group members to make the user's diet successful.

Besides, according to Matthews et al.'s research, self-monitoring is the most applied approach in the BCSS [5]. Self-monitoring induces behavior change on users' attitudes and actions by asking users to record their data and supervise them by themselves. As an example, Wang et al. [9] developed an app that visualizes users' stress degree estimated by the user's heart rate to promote users to do stress self-regulation.

Instead of distributing a mobile application, in our prior work, we developed an interactive signage system that can actively talk to the passing user, trying to induce behavior change by stimulating users' visual and audio senses [10, 11]. Through a three-week survey experiment, we found that people respond to the utterance from the system with high probability, and the system can promote low time and labor costs behavior effectively.

The common approach used in the existing BCSS is altering users' target behaviors to new behaviors such as promoting users to drink more water, eat more vegetables, walk further, and so on. However, this approach considers less about the relevance between users' target behaviors and new behaviors, which limits the effectiveness of the systems in inducing behavior change. Pokémon [3] promotes users to play the game no matter whether users are busy or not. During the experiment of our prior work [10,11], there was only one participant who stood on the weight scale to weigh himself, even this action only takes less than ten seconds. The reason for this could be considered as there was no attractive feedback, and the proposal was little relative to participants' behavior at that moment. Moreover, the existing systems are often developed as mobile applications due to the cost and information reachability and prefer to use push notification to send a proposal. Although this method is convenient, people nowadays receive a considerable number of notifications from various apps, which often interrupts the users and may diminish their chance of noticing triggers from the behavior change applications so that the system misses the timing of promoting behavior change.

To improve users' experience and the effectiveness of our system in inducing behavior change, we propose a new design of BCSS promoting behavior change by embedding additional behaviors into users' daily routines, trying to improve users' awareness of their health condition.

3 Proposed Design

In this section, we explain our proposed concept where additional behaviors are embedded into users' daily routines for promoting a behavior change. Figure 1 shows the overview of our proposed design. We add additional behaviors just before the target behavior, whereas traditional BCSS usually offers the alternative healthier behavior.

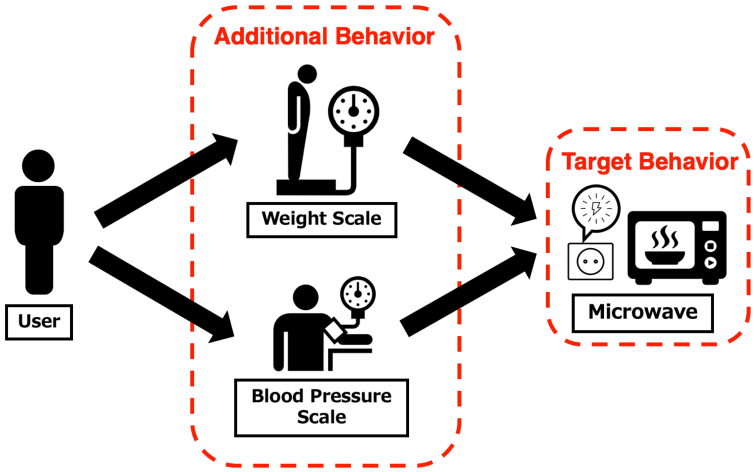

Fig. 1. Concept of embedding additional behaviors before the daily routine

The key point is that the additional behavior must be simple and cost only a little time and labor. We choose simple health checkups such as standing on a weight scale to weigh his/herself, using a blood pressure scale as the additional behavior, which usually cost users less than 10 seconds and little labor.

Simultaneously, the target behavior has to be attractive and essential to users because the user might change the target behavior for avoiding additional behavior. Also, the target behavior should be controllable by the program. Therefore, we focus on electrical appliances used in daily life, such as microwave, coffee maker, fan, air conditioner, heater, rice cooker, etc.

The following table shows the example combination of "additional behavior" and "target behavior".

Table 1. Example combination

additional behavior	target behaviors (appliances)
check the weight, check the blood pressure, check the body fat percentage, use stairs	microwave, coffee maker, fan, air conditioner,rice cooker,refrigerator

4 Proof of Concept

As an example, we developed a prototype that promotes users to weigh themselves when they want to use the microwave. Fig. 2 shows the layout of the coffee space where we deployed the prototype. The prototype consists of a smart plug,

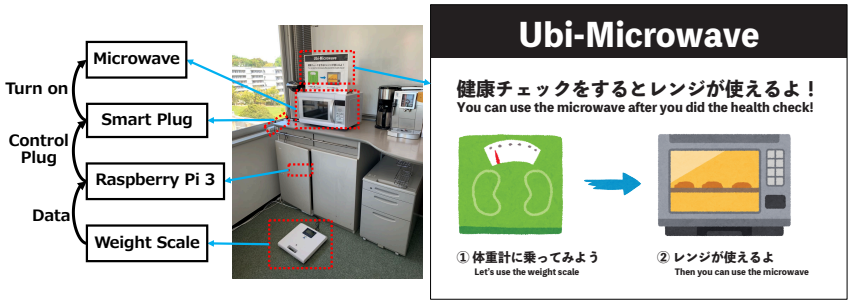

Fig. 2. Prototype of proposed design

a raspberry Pi 3 (in the storage), a weight scale, and a microwave. People who care about their health condition often take medical checkups, but those who are not interested may not even stand on a weight scale. This prototype is taking advantage of the timing and demand that users need to use the microwave to heat their foods, trying to change users' attitudes to their health condition by promoting users to use the weight scale and letting them be aware of their health condition. To improve the motivation, the user who has weighed him/herself can use the microwave as a reward. Since these smart devices are related to users' daily habits, we believe that is can improve users' motivation and effectively induce behavior changes.

5 Conclusion and Future Work

In this paper, we proposed a new design of BCSS to induce behavior change in users' daily life and improve users' motivation with the consideration of users' daily activities. Furthermore, as an example, we developed a prototype and deployed it in the coffee space near our lab to promote users to use the weight scale for weighing themselves.

As future work, we would like to experiment to investigate the answer to the question of whether this prototype can affect users' interest in their health condition or not. To ensure the quality of data and reduce the bias on participants, we would hold the experiment without holding an introduction of the contents of the experiment in advance. After the experiment, we would like to extend the prototype by combining it with the interactive signage system, smartwatch, and smart belt [6] and explore the effect of these smart devices in inducing behavior change.

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