



**Figure 1: Step-by-Step promotes the relay of fitness tasks among co-worker for improving office vitality.**

## Step-by-Step: Exploring a Social Exergame to Encourage Physical Activity and Social Dynamics among Office Workers

Xipei Ren\*, Lotte Hollander\*, Rylana van der Marel\*, Lieke Molenaar\*, Yuan Lu

Eindhoven University of Technology, Eindhoven, the Netherlands

lotte.hollander@icloud.com, {rylanavdmarel, lieke.molenaar14}@gmail.com, {x.ren, y.lu}@tue.nl

\* equally contributed to this paper as co-first authors.

### ABSTRACT

This paper presents an exploratory study of a social exergame, called Step-by-Step, to help office workers initiate physical movements and social interactions in the work routine. In this project, we developed a mobile system for exploring a new mechanism of office vitality, through which the fitness task can be relayed from one to another co-worker in a workplace (see Figure 1). Based on our prototypes, we evaluated the feasibility of Step-by-Step through a user study with five office workers and an expert interview with three senior designers. We discuss implications for the future development of the Step-by-Step system based on our qualitative findings.

### KEYWORDS

Office vitality; fitness breaks; workplace social dynamics; social exergames.

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**Figure 2: A visualization of design concept of Step-by-Step. (a) Step-by-Step prompts a fitness break involving a walking task. (b) Step-by-Step tells to relay the task to a next colleague.**

## 1 INTRODUCTION

Sedentary behaviors at work can lead to various sub-health conditions, such as metabolic diseases, musculoskeletal injuries, and psychological disorders [7]. Although there are some guidelines and interventions to prevent these sub-health issues, they do not seem to make a difference to office workers. In the Netherlands, for example, a recent working condition survey by TNO (2016) demonstrated that lower-back pain is the most common occupational disease, which is mostly related to sedentary activities in office work [12]. To tackle such issues, office vitality has become increasingly important, and challenges designers to create different solutions. One potential solution is exergame, which requires the player's physical exertion for reaching the game goal. Linking these games to a social aspect, as is done in HealthyTogether [2], gives a higher chance of succeeding its goal in encouraging active lifestyles. This inspires us to investigate designing an exergame system for promoting social and physical activities among office workers.

In this paper, we present the design and evaluation of Step-by-Step (see Figure 2), a workplace exergame system designed to reduce sedentary behaviors and stimulate physical activity in the work routine through leveraging a new social mechanism of office vitality. Explicitly, we designed a new mode of social fitness breaks based on a mobile device, which provides an exergame among co-workers. During work, one office worker keeps the device and initiates the game. The device monitors his or her sedentary duration and in turn to prompt a break with a fitness task involving walking. During the break, the device tracks steps of the worker and provides feedback in real time to support accomplishing the fitness task. After reaching the goal of the task, the device suggests the worker relay the device to another colleague, who is going to take over the fitness task. To demonstrate our concept, we developed two prototypes to present the functionality and the look-and-feel of Step-by-Step. We then carried out a qualitative user study ( $n_1=5$ ) and an expert interview ( $n_2=3$ ) to gain preliminary insights on the potential benefits of Step-by-Step to office vitality and find design opportunities for further explorations.

## 2 RELATED WORK

In Human-Computer Interaction (HCI), there have been some insights on how technology can be designed to support office vitality. For instance, Gorm and Shklovski [4] found that encourage active participation is critical for facilitating health tracking in the context of a workplace. They further recommended conceptualizing such a product as a sociotechnical system for health promotion rather than a design for single behavior change. In a later study, Chung and colleagues [3] indicated that the use of health-promoting technologies in the workplace could raise awareness of activity levels among employees. However, current applications could not help office workers find activities for improved outcomes, which can result in confusion and create barriers to enhance health and well-being at work. This has encouraged explorations of some new exergames designed to facilitate physical activity based on office settings, including walking [1] and stretching [10], as work break activities. These previous developments contributed to new sensors and user-system interactions for promoting fitness behaviors as a self-intervention in office work. Additionally, we think the social aspect can also be beneficial in workplace fitness promotion.

**Box 1: The scenario of using the Step-by-Step system for improved office vitality and peer bonding.**

Cynthia, a 27-year-old accountant, is sitting behind her desk and has the Step-by-Step widget with her. When Cynthia starts work, the widget shows light in a mild green color. Gradually, the light turns into a bright red color along with her continuous sitting time. After forty-five minutes of working, Cynthia decides to take a break, and she finds on the screen of the Step-by-Step, it gives her a task to walk 400 steps in 5-min. Cynthia accepts the challenge by picking up the widget and carrying it with her (see Figure 1(a)). During walking, the light of the device gradually changes (see Figure 1(b)). After 5 minutes of brisk walk, she lefts the task with 50 steps and the light returns to a mild green color. Cynthia receives a new message from Step-by-Step, which tells her to relay the rest of the fitness task to her colleague, Jenney, who is new in the office. So now, Cynthia has an excuse to introduce herself and have a bit of chat with her. Cynthia walks to Jenney and hands over the device to her. As shown in Figure 1(c), Jenney then explains how Step-by-Step works and they have a friendly conversation. After that, Cynthia goes back to her office and Jenney places Step-by-Step on her desk and keeps on working until her 'Step-by-Step break'.

The effect of social support of fitness-promoting technologies in office environments has been studied extensively. Research by Ren et al. [9] has shown that social interactions and peer bonding can play a crucial role in the adoption of fitness tracking and health improvement for office workers. Besides improving health behaviors, social exergames in return could also improve interpersonal relationships. An example is *Pass the Ball* [11], which can track one member's activity in relation to the team score, has been found effective in improving social interaction within the team. Prior work [9] has also suggested leveraging physical presence in the social interaction to enrich social fitness breaks and support social relationship for office vitality. With these insights in mind, we conduct design explorations of Step-by-Step.

### 3 DESIGN OF Step-by-Step

According to [3,9], peer bonding can be effective in encouraging physical activity among office workers. Also, a co-located working context can facilitate the cooperation of fitness behaviors [9]. Based on these lessons, we identified a technology-assisted social mechanism of office vitality as following. *In the office, one worker receives a fitness break task involving walking to certain steps. The worker then commits physical activity (walking in this case) as a work break to accomplish the task. After that, the worker needs to relay the rest of this fitness task to a colleague in person. The colleague will take over the challenge, accomplish the fitness task, and then relay such task to another co-worker.*

Based on this new fitness work-break mode, we envision Step-by-Step as a social exergame system for workplace fitness promotion. The technical system was designed to collect data related to sedentary and fitness behaviors of office workers, facilitate fitness breaks with walk activity, as well as trigger the relay of fitness tasks and initiate face-to-face social interaction between co-workers. As shown in Figure 2, we designed a cubic desk widget in a gift format, which is equipped with an accelerometer, an ambient light, and a screen-based display.

In Step-by-Step, the motion data based on accelerometer is collected and analyzed to detect physical conditions (i.e., still vs. active) of the worker and track steps during the break. The ambient light and screen-based display are used to present information, in order to facilitate the workplace fitness program of Step-by-Step. Early research has shown that reminders, such as a pop-up notification, can interrupt the workflow and influence the productivity for office workers [5]. On the other hand, unobtrusive displays may lack clarity and cause mental burden during interactions [8]. In our project, we present feedback information to the user at two levels. At an implicit level, by gradually changing its color from green to red, the ambient light gives feedback on sedentary duration to prompt fitness break unobtrusively. Conversely, the light turns its color from red to green to indicate the progress of the fitness task subtly. At an explicit level, when the user interacts with the system, the screen on top of the Step-by-Step device is used to offer detailed information, including the assignment of the fitness task (i.e., a walking challenge), the feedback on the walking activity (i.e., the actual steps during the break), and the guidance of the fitness relay and social interactions (i.e., a colleague's name to take over Step-by-Step).

As shown in Box 1, we also created a scenario to demonstrate the use of the Step-by-Step exergame system in the real working context.



Figure 3: The functional prototype of Step-by-Step.



Figure 4: The look-and-feel prototype of Step-by-Step.

#### 4 THE STUDY

To efficiently evaluate the design concept of Step-by-Step, we carried out a user study and a session of design expert review based on a set of prototypes at different levels of fidelity, following the research suggestion from [6]. We developed two prototypes to demonstrate Step-by-Step's functions and outlook respectively. Figure 3 shows that the functional prototype was implemented as an Android-based app, which leverages the smartphone to realize the data collection and system interaction. Figure 4 shows that the look-and-feel prototype was made as a semi-transparent cube with RGB LEDs inside, which was made to give an impression about the final device. Based on our prototypes, we conducted a user study with five office workers to learn how they would perceive the system for office vitality. After that, we ran a session of expert review with three senior designers to gain some professional insights on how to improve our design.

**The user study.** We recruited five office workers (4 female and 1 male; all had a Dutch nationality), aged between 25 and 40, from an ICT company in Eindhoven. All participants were information workers who perform sedentary work for at least 6 hours per day. We conducted the test with each participant separately, at their own workplace. At the beginning of the study, the participant got an explanation about the concept of Step-by-Step and the working mechanism of the two prototypes. Next, we let the participant use the functional prototype (the mobile app) to take a walking break and hand it over to one of our researchers. This is followed by an experience session about how the light of Step-by-Step changes due to the prolonged sitting at work. As in this case the light did not connect to the fitness data, we invited participants to experience it using the 'Wizard of OZ' technique. During the user test, participants were observed and after the test they were asked for a semi-structured interview. In the interview, we asked questions regarding their experience and opinions on the concept and design of Step-by-Step.

**The expert review.** For the second study, we organized a semi-structured expert interview with a user experience designer, an engineering designer, and a product designer, at the largest Dutch design company of van Berlo. Prior to the interview, we explained our concept and demonstrated prototypes to our design experts. Once they came up with questions, we explained our design further in some detail. During the interview, designers shared opinions towards Step-by-Step. The interview was done as a natural conversation about our design.

#### 5 FINDINGS

**Findings from the user study.** Based on our observation and interview responses, we found most participants experienced the exergame system of Step-by-Step as positive. On the one hand, some participants expressed that relaying the device among the office co-workers could create more chances of social interactions, which may help to improve their relationships. E.g., *"it sounds like you exchange gifts with each other"* and *"I put my steps from the break as an additional present to my colleagues"*. On the other hand, they thought the system could increase their fitness awareness in the workplace, at both individual and collective levels. E.g., *"now I feel a responsibility to keep up my physical activity"* and *"by sending the box to my co-worker, I remind him active in a polite way"*.

Regarding the design of prototypes, most participants found the information was presented directly and clearly for facilitating the fitness program. On the flip side, they thought the visualization could be further improved. For example, the current app would count up the steps and present it as a number on the interface. However, participants found this kind of display is “distracting” during the exercise. They suggested us to explore some infographics to offer more fitness insights and support their motivation.

Beyond discussing the concept and the prototype design, participants also indicated several challenges for long-term use of Step-by-Step in their office work. First, most participants concerned that the usage of such technology may become burdensome in a hectic workday. E.g., “*I might be in an important meeting in which I don’t want to be disturbed by Step-by-Step*”. They suggested us to add a function that can help them easily subscribe or unsubscribe such a fitness program from the system. Second, some participants were also curious about what kind of data the system would collect and how the data would be stored. They did not expect the data with the personal identity to be visible by a third party, such as their employer. E.g., “*I don’t want my boss to see my data from this exercise game, otherwise feels like being watched about my work behaviors*”.

**Findings from the expert review.** Our design experts thought the concept is overall very interesting and pointed out some potential contributions of Step-by-Step to the context. For instance, they suggested that it can help new employees to integrate into the firm better and faster: “*The program could choose a colleague who is new to the firm. If his name appeared more often, he would get to know more people.*” To improve social interactions, they further stated to use the device as an ice-breaker for initiating chat when handing over the device to the next co-worker.

Another remark they made was about enhancing the gamification of the system. Their concern was that without some sort of game or score checking attached to it, the concept would eventually fail. In line with findings from previous research [2], they recommended us to explore the cooperative mechanics, instead of enabling co-workers to battle against one other.

Lastly, they suggested us to improve the shape-design and the aesthetic of system interactions. On the one hand, they encouraged us to design the shape of the widget that can have a stronger affective bonding with users. On the other hand, although it is easy to understand the meaning of the ambient light, they suggested employing some light transition mechanisms (e.g., a slowly flickering light) to make the system interactivity livelier and more intuitively.

## 6 DISCUSSION AND CONCLUSIONS

This paper presents design explorations of Step-by-Step, a social exergame system designed to facilitate fitness breaks among office-based employees, in two ways. First, it monitors the office worker’s sedentary behaviors and then prompts breaks with fitness tasks. Second, it enables such fitness tasks to be relayed among co-workers, which involves social interactions as a motivational factor to office vitality. A user study and an expert interview revealed that Step-by-Step was playful and enjoyable to use and has the potential to be a new form of workplace fitness program, which benefits both office vitality and social well-being. Also, these studies helped to yield design implications for our next development of Step-by-Step, which are summarized as follows.

**Combine social activities with fitness games to keep up motivations.** Step-by-Step was implemented with a simple social mechanism that colleagues relay the fitness task in the office. To make it more motivating, we learned that adding collaborative elements (e.g., group goals, social rewards) might be a solution. Moreover, fitness games have been suggested to be well-integrated into the office context [9]. Our experts indicated the potential of evolving Step-by-Step for enhancing the desirability of workplace social interactions, e.g., introducing a new colleague. In the future, it is worth to explore improving Step-by-Step that better blends social activities into fitness-boosting behaviors as a workplace exergame.

**Improve the affective aspect of the device for a strong connection with users.** As an exploratory work, we realized Step-by-Step in simplicity. However, users and experts suggested improving the visualization, shape, and interactivity to make the system more appealing to users, and more meaningful to the context. For our next step, it is valuable to polish the initial concept of ‘a gift between co-workers’ with more design considerations. Furthermore, the device might be designed as a virtual pet that office workers must nurture it by walking with it.

**Make the participatory mechanics adaptive.** From the user study, we found some barriers to implement Step-by-Step in a real workplace. It would be challenging for office workers to follow the fitness program in a working context strictly. Additionally, some employees may not want their personal data being recorded or published. Based on these lessons learned, we suggest investigating the participatory mechanics of Step-by-Step further to make it adaptive and adjustable according to the dynamic of the working context and personal preference.

## FUTURE WORK

For future work, we plan to improve our concept and design based on design insights derived from this study. Based on our updated design, we then plan to conduct a long-term study to validate the effectiveness of Step-by-Step for improved office vitality.

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