From Mechanical Pedometer to Digital Pedometer: A Usability Study on a Walking Promotion System

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Abstract. This paper presents a usability study for Cardio Trainer, a popular step-counter program in Android market, utilizing a diary writing method. Previously, the mechanical pedometer was merely used as step counter to calculate the amount of calorie consumption. With the rapid diffusion of smart phones, however, the pedometer drastically became digitalized as an integrated form of a smart phone application and an accelerometer included in the phone. It is expected to soon be a key healthcare device, providing its user with richer health information with exercise, particularly walking. The analysis of the user study illustrates the potentiality of digital pedometers as major healthcare tools and identifies their usability problems. It hopefully helps healthcare systems designers develop better and usable digital pedometers.

Keywords: accelerometer, healthcare, pedometer, persuasive technology, smart phone, usability study, walking promotion.

1 Introduction

The development of smart phones has significantly improved various aspects of human being's quality of life, particularly in healthcare with a number of programs for healthy foods, diets and physical exercises. In particular, healthcare applications using smart phones have gradually increased in number from 4 or 5 years ago [1, 2]. Now, people are more aware of the importance of both their health and health related IT applications [3].

In the past, analog pedometers only expressed simple numerical figures, but now digital pedometers born with an emergence of smart phones expressed more than step counts. They provide users with rich and useful information and features, e.g. walking path and distance, monthly trend and exercise history, exercise scheduler, alarm and reminder, music support, and the like.

Therefore, it is timely to study such a new healthcare device of digital pedometers. This study has been carried out in order to understand digital pedometers from users' perspectives [4]. Taking a commercial walking promotion system called Cardio Trainer [5], we have conducted a usability test about it utilizing a diary study with 22 subjects so that we may identify both benefits and usability problems.

2 Background

2.1 Pedometer

In the past days, pedometers were analog devices based on mechanical switches and pendulums. But now they incorporate MEMS sensors, particularly accelerometers. Further, as smart phones include accelerometers as built-in sensors, pedometers began to be reborn as an integrated technology between software applications and accelerometers running on smart phones. This kind of digital pedometers can now provide a lot of information such as the number of steps, calorie consumption, exercise progress, and exercise duration. Cardio Trainer is a typical example for it.

2.2 Cardio Trainer

Cardio Trainer of Android Market is developed by Noom Inc. It is a pedometer application working with accelerometers within Android-based phones. During the exercise of walking, it calculates basic information including the number of steps, sends the relevant data to the server, and users can confirm what their exercise state is. Users can make use of various functions such as alarm, graph viewers, and so on. Features of Cardio Trainer are summarized as follows:

Fig. 1 Main screen of Cardio Trainer

Table 1 Features of Cardio Trainer.

Features	Explanation
	Users can listen to music during the exercise.
	User's routing path can be seen through the map.
	User can share exercise information with their friends.
MP3	Cardio Trainer displays calorie consumption by fruit pictures.
Map	It provides notifications for planed exercises
Friends' exercise state	Users are ranked worldwide
Result Viewer	Using exercise data of oneself, one can improve self motivation to exercise.
Alarm	
Ranking	
Self competition	

3 Method: A Diary Study

We have adopted a free form diary method, which helps capture a wide range of usability aspects. 22 students of computer engineering department in INJE University have been selected as subjects and requested to exercise walking everyday using Cardio Trainer. At the same time, they freely wrote their diaries about daily usage of Cardio Trainer, e.g. their experiences, its pros and cons, and their expectations. It took a week or so for them to carry out their tasks. The interviews were also conducted at the end of each usability test, based on the diaries that they had written.

4 Results

4.1 The positive aspects

Role as a motivator. The greatest advantage of cardio trainer was to motivate exercise. Twelve users (S2, S7, S8, S9, S10, S11, S13, S14, S16, S20, S21, S22) felt motivated by various functions such as map, social network, interface, alarm, and so on. For example, S10 said, "I have failed to keep exercising because I'm a man of weak-will. Who wants to exercise everyday and willingly? But alarm told me a time for walking. That motivated me to exercise, even when I didn't want to." The digital pedometer serves as a motivator. This is particularly important, in that technology itself motivates people and enables change of their behaviors, which is also the core objective of persuasive technology [6].

Satisfaction of information. In spite that users are aware of incorrect information of calorie consumption, distance, speed, and step counts, according to the data, they have expressed interests in their health information. This implies that users want a sufficient amount of health information rather than its accuracy. It confirms a finding concerning diffusion of innovative and newly emerging technologies that user acceptance is more important than technological accuracy [7]. Not only types of information, users are also satisfied with various functions of the pedometer such as MP3, alarm, self-competition, and social networks, and the like.

4.2 The negative aspects: usability problems

Inconvenient user interface. The number one negative side in the user data was inconvenient user interface. There were a number of UI problems reported. Typical examples are: "I didn't know how to exit and which button to press." (S2), "I wanted to change music. But I couldn't find any selection process to do it." (S7). In fact, the application does not allow users to select music. Due to this, users feel largely uncomfortable, and they cannot adjust the volume within the application running. Besides, too many exercise types and difficult terminologies were also sources of inconvenience.

Battery consumption problem. As battery consumption is a critical problem of most portable devices, so is Cardio Trainer's. This was confirmed by most subjects. "The battery runs out too fast. Perhaps because GPS is on, it does not go for less than a day." (S14)

Inaccuracy of data. S5 reported, "I was running with Cardio Trainer. But the data shown was different with the actual distance. One day, when I walked for more than an hour, the calorie consumption is 38 kcal. But the other day, I did exercise only for half an hour. But this time the consumed calories were 503 kcal". In fact, step counts and calorie consumption were wrong by a large margin. This experiment shows that the resulting data is less reliable than we expected. Further, it was reported that 3 participants found delayed data update in their social network, and so they felt annoyed (S14, S16, S21). 7 subjects (S2, S5, S12, S13, S15, S21, S22) also encountered the problem of inaccurate GPS information.

Inconvenience due to portability. Three users (S7, S10, S17) reported that they have felt it is uncomfortable when they do the exercise with phones. However, we believe that this problem is not a thing to resolve immediately, but an inherent problem. Partial solutions might be to make the phone lighter in weight, or to invent more convenient wearable devices, which is currently in the development in research community

5 Conclusions

Pedometers evolve from analog devices to digital ones, and from a simple step counter to a complex healthcare system with smart phones. Emphasizing this change, this paper presented users' responses to such an evolution. A user study for Cardio Trainer, a digital pedometer system, was conducted to reveal users' attitudes and identify usability problems. Among positive aspects, it is perceived as a motivator or a persuader to keep doing exercise by MP3, alarm, self-competition, and social networks. However, usability problems should be also considered to resolve in terms of UI, battery consumption, and data inaccuracy. Our findings hopefully are clues to lead to better and usable digital pedometers.

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