

BYE-TAL: Designing a Smartphone App for Sustainable Self-Healthcare through Design Thinking Process

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ABSTRACT

It is not easy for people to consistently take care of their health without motivation. Existing smartphone apps have assisted with people managing their health, but there still remain questions about whether target users' needs were addressed to support the users. We report on each stage of a design thinking process for redesigning experiences of people who are in their 20s to 40s for managing their health. Especially, we were able to empathize with our target users by making the empathy map. This helped us to identify real users' needs. Outcomes from each stage of the design thinking process show that the process is applicable to other domains when people create a smartphone app to address the needs of their target users effectively.

Author Keywords

Personal health management; Smartphone app; Design thinking process; User-centered design

CCS Concepts

•Human-centered computing → User studies; •General and reference → Surveys and overviews;

INTRODUCTION

According to one study, as of 2015, 64% of the overall US population and 82% of persons aged 18-49 years owned an app-enabled mobile phone. Additionally, 15% of the population now owns a mobile phone-connected wearable device, such as a Fitbit or smartwatch [8]. Therefore, the popularization of health apps is inevitable. Over 40,000 health-related apps were available for download from the Apple iTunes store alone of 2013. Therefore, the importance and accessibility of

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Figure 1. The history of prototypes. From left, each image represents a start screen of the low-fi prototype, med-fi prototype, and hi-fi prototype, respectively.

health applications is becoming important. This study reported that people who had never downloaded a health app, the most important reasons they had not done so were the following: lack of interest, high cost, lack of trust in apps collecting their data. The most frequent reasons for discontinuance were the following: took too much time to enter data, loss of interest. One of the most important factors that make people using continuously or motivates people to start to use health apps is to improve the lack of interest [8]. Previous studies proposed apps to support patients or healthy people interested in managing their health. For example, researchers developed and evaluated smartphone apps to support patients with diabetes in Japan [11] and in Korea [7], chronic kidney disease in Taiwan [9], cardiovascular disease in Korea [1], and cancer in Korea [6]. While the majority of the existing apps aimed to support patients, multiple apps were designed to support people who did not have any diseases, such as people interested in diet management in Singapore [10], children who need to pay attention to salt intake in China [5], and older adults more likely to get three major diseases in Taiwan [3]. Prior studies showed examples of smartphone apps to support a variety of people for managing their health. Of course, they did suggest a need for discussion but not specific ideas on features that could help motivate users to use continuously.

In this paper, we report an example of how we applied a design thinking process for creating a user-centered smartphone app in a health domain. Our study developed a low fidelity(low-

<p>[SAY] “I stretch only when I see something about posture on YouTube videos or in newspaper articles.” (P2) “Social beginners have no information on when or where to get medical checkups. So I don’t know much about my current state of health.” (P4)</p>	<p>[THINK] P4 needs something to remind them of their bad habits by checking their biorhythm. P6 does not feel the need to visit a hospital or get a medical checkup if it is not seriously ill.</p>
<p>[DO] “I do not visit the hospital because going to the hospital is bothersome and I do not think it is a serious illness anyway.” (P5) “I could not visit the hospital because the hospital closed too early and it was too busy because I am an examinee.” (P6)</p>	<p>[FEEL] P1, a medical expert, was very sad because patients make the disease worse by ignoring initial symptoms. P3 was a little ashamed, saying she didn’t know her health status.</p>

Table 1. Key quotes were filled in an empathy map. The SAY quadrant contains what each participant says out loud in an interview. The THINK quadrant includes what each participant is thinking throughout the experience. The DO quadrant encloses the actions each participant takes. The FEEL quadrant is the emotional state of each participant, often represented as an adjective plus a short sentence for context [4].

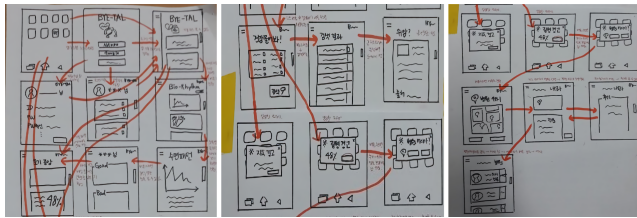


Figure 2. This shows a UI storyboard of how a user would perform easy, normal, and difficult tasks with a smartphone app, respectively.

fi) prototype, medium fidelity (med-fi) prototype, and high fidelity (hi-fi) prototype, which is the closest to the final version of the app (see Figure 1). The higher the fidelity of the prototype is, the more detailed, closer to the final solution. In particular, we investigated the experiences of people managing their health in their 20s to 40s living in urban areas. On the basis of users’ experiences, we developed and evaluated a mobile app to assist with sustainable self-healthcare of the people through a design thinking process. To create a list of goals by the app, we identified target users’ needs and challenges the target users faced when they manage their health.

RECRUITMENT AND INTERVIEW PROCESS

We went through multiple steps for designing, developing, and evaluating BYE-TAL. As an initial step, we conducted nine semi-structured interviews with eligible study participants to understand their needs. Interview questions covered topics about users’ experiences of self-care for personal health management. Initially, we conducted surveys and qualitative interviews with our target users who are in their 20s to 40s without disabilities and live in urban areas. We focused on the experiences of target users’ self-healthcare to understand their needs and challenges they faced when they took self-care of their health using a smartphone app. The inclusion criteria were individuals who: 1) are in their 20s to 40s, 2) are able to understand spoken Korean, 3) are without any disabilities, 4) live in urban areas. Then, the exclusion criteria were people who: 1) have disabilities, 2) do not have smart devices, such as a smartphone and tablet. Semi-structured interviews were conducted through phone calls, e-mails, and face-to-face. Participants obtained full information about the study’s content and the rights to stop. They participated in the interviews voluntarily. At the beginning of each interview, the verbal consent was given by each participant for recording the interview and

using data anonymously. Each interview lasted 20 to 25 minutes. All interviews were audio-recorded and transcribed. We removed all personally identifying information and assigned a unique identifier to each participant. We used the following topics when conducting semi-structured interviews with participants:

- Do you use your smartphone for health care? *e.g., what is the reason for that (if you use a health app or not), etc.*
- Do you do something for your health? *e.g., what kind of effort do you make to solve (if you have any symptoms or chronic diseases due to your job characteristics), etc.*
- Do you usually self-diagnose your health? *e.g., do you usually visit the hospital if you feel sick or if your symptoms last for a certain period of time, etc.*
- Do you want any improvements in your health care experience? *e.g., why did you say you did not visit the hospital even if you were sick, etc.*

DATA ANALYSIS USING AN EMPATHY MAP

For analyzing the qualitative data from the interviews, we collected statements from scripts of interviews that described each participant’s experience of self-care for health and notes of the participant’s nonverbal expressions. We made an empathy map (see Table 1) and this map helped us to empathize deeply with participants’ experiences. Therefore, we were able to identify the real needs of users, not the needs we predict. We identified important topics about how people in their 20s to 40s without disabilities engage in the step-by-step process of self-care for maintaining their health. We then classified participants’ experiences of self-healthcare such as lack of hospital information, sustainability issue of using a health app. Through qualitative interviews, we identified challenges that our potential users faced when they tried to take care of themselves. We summarize these challenges into the following the empathy map (see Table 1). We found the user’s needs and insights using the empathy map (see Table 1). Based on the results of the interview, We identified needs and insights from our target users of people in their 20s to 40s without disabilities. Most of all, they had some problems that they tend to exacerbate their illness by ignoring their initial symptoms, not to visit the hospital due to lack of information, and to manage their diseases improperly even after the diagnosis of disease. Besides, they wanted to know the extent or duration

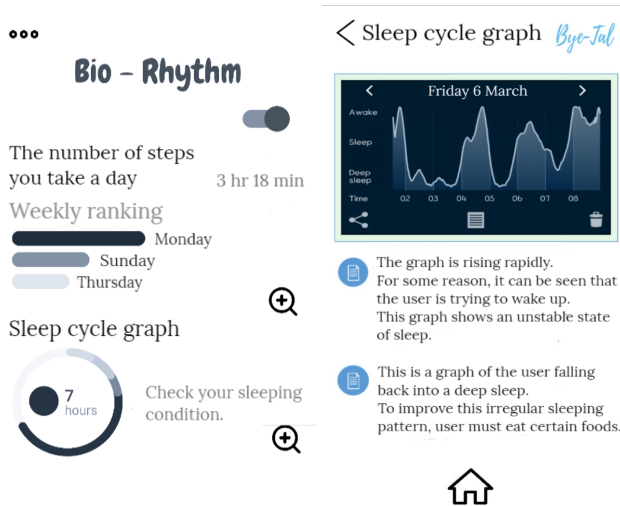


Figure 3. BYE-TAL visualizes users’ biorhythms and provides detailed descriptions of each item.

of the symptom they had to go to the hospital because they do not visit the hospital until they feel the symptoms are serious. Based on this, we created a Point-of-Views (POV) statement as follows: People in their 20s to 40s need something to check their daily biorhythms and get accurate and prompt information about their symptoms because they want to maintain a healthy daily life.

IDEATION FOR POTENTIAL FEATURES

The goal of the ideation stage in the design thinking process was to generate solutions that would be potential features of our prototype to be produced according to the POV of target users as illustrated in [2]. On the basis of the point of view derived in the previous stage, we created multiple “How might we” (HMW) questions (e.g., How might we help users not ignore the initial symptoms of a serious disease?, How might we provide accurate and reliable information about health to users?, etc.). Three researchers who took the design thinking process selected three best answers from ten HMWs through the brainstorming process. In brainstorming again, we have created ten potential solutions for each HMW and chosen three of the best ideas. The criteria for selecting the best ideas were as follows: 1) the three selected ideas must keep diversity, 2) the chosen idea must be feasible, 3) the chosen idea must be related to the corresponding HMW. For instance, one of the best ideas for each HMW is as follows: the idea for how might we motivate people to use the app continuously is that if the app is not used for a certain period, a warning alert is given. Also, BYE-TAL compliments the users by bringing up the notifications that they are doing well if they have lived regularly or used this app consistently.

PROTOTYPING AND TEST

We observed three participants of the test interacting with BYE-TAL to discover problems or factors that need to be fixed. The low-fi prototype was produced to check for unusual and nonintuitive connections on our user interface (UI) storyboard. First, we identified assumptions that were included implicitly in the ideas we generated at the ideation stage. We

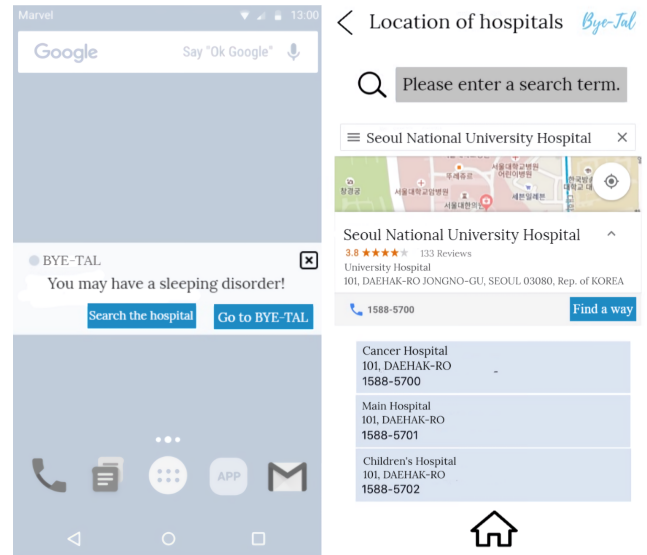


Figure 4. The screen on the left shows one of the alert features of BYE-TAL. When BYE-TAL detects a suspected disease, it alerts users to visit the hospital. The screen on the right shows that we provide information about the location and reviews of the hospital.

then tested assumptions for each solution by interacting with our prototype. Our focus was to evaluate prototypes in real-world scenarios with potential target users of the prototypes. One of the features of the prototype is the notifications that alert users if symptoms persist or are suspected to be a precursor to some disease. Second, we created design materials, such as a series of tasks to be performed in real-life scenarios and a UI storyboard of how a user would interact with an app (see Figure 2). For the diversity of tasks, we created an easy, normal, and difficult task, respectively, in terms of the level of difficulty in performing each task. Third, we asked three participants to perform predefined tasks and observed how they communicate with the low-fi prototype. We observed them on the following criteria: 1) Is there a section where they ask us questions regarding the flow of the interface, 2) whether they are good at finding icons or buttons that need to be pressed to perform a given task? Through this process, we felt it is necessary to make a UI storyboard more detailed to make the connection between screens natural. We also learned that the icons or buttons should be redesigned so that users can understand them intuitively.

Based on the findings in previous steps, we produced a UI storyboard and medium fidelity (i.e., med-fi) prototype. We developed an Android prototype app by using a prototyping tool called MARVEL¹ available for free. In the med-fi prototype level, we conducted a heuristic evaluation with three design experts to verify the heuristic infractions of BYE-TAL. Through the heuristic evaluation, we found that every icon should be placed and configured consistently to a screen of BYE-TAL. We also discovered that each button should be added to make users can check activation for each item of biorhythm (e.g., sleep cycle graph, the number of daily steps, etc) in the hi-fi prototype (see Figure 3). We created a hi-fi

¹<https://marvelapp.com/>

prototype with Smart Maker² that allows us to create a functional prototype quickly with less effort. Unlike the med-fi prototype, the hi-fi prototype was linked to Google Maps to provide actual hospital locations (see Figure 4).

DISCUSSION

One of the most interesting findings in this study is that the users responded to the stimulus. In the first interview based on the survey, P2 said that he stretches when he watches YouTube videos or articles about posture (see Table 1). Not only that, in the experience prototype test, but we also found that participants were more sensitive to the notifications that alert suspected diseases than we expected. We concluded that BYE-TAL must give constant and certain stimulation in order to help users practice and maintain self-care for health. Another interesting finding is that the survey results of our study revealed that all participants did not have any additional medical checkups or close examinations except regular checkups. In addition, when asked why not go to the hospital (multiple responses available), 7(70%) responses were because the level of pain was not serious, and 4(40%) were because their symptoms were improved quickly. A medical expert P1 was skeptical at people's arbitrary decision because they worsen their disease (see Table 1). BYE-TAL provides a detailed description of the biorhythm and brings up the notification that recommends searching location information or reviews of the hospital near users (see Figures 3 and 4). Such findings confirm that BYE-TAL needs features that encourage people to use the app continuously (e.g., warning messages through notification).

CONCLUSION

Overall, the goal of this study was to present how a design thinking process can be used for developing a smartphone app in a health domain. The key contribution of this study is that each stage of a design thinking process has the potentials to support designers and researchers who aim to develop a smartphone app that meets the needs of potential target users. One of the key features of BYE-TAL is that it alerts users on suspected diseases and encourages them to visit hospitals by providing information on nearby hospitals (see Figure 4). While existing smartphone apps in a health domain have an issue about how to encourage people to use the apps, each stage of the design thinking process allowed BYE-TAL to encourage people to use app persistently (e.g., the notifications that recommend using apps to users). However, there are limitations that we do not know whether the notifications that recommend people to use BYE-TAL is useful to the target users, and we do not get feedback on hi-fi prototype yet. As for future work, we aim to examine potential users' evaluation of the hi-fi prototype (e.g., examining whether the notifications that recommend use actually motivate users). Also, a long-term period deployment study with target users may enable us to evaluate the feasibility and validity of BYE-TAL, though they were not evaluated in this study.

²<https://www.smartmaker.com/>

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