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Development of a Weight Management Service that Considers Individual Physical Characteristics and Psychological Factors

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ABSTRACT

Recently, as the healthcare service industry develops, demand for weight management services is also increasing worldwide. However, in South Korea, especially people in their 20s and 30s, they often focus on external appearance and experience severe health problems during weight management. This study aims to propose a healthy weight management service design. To accomplish this, we conducted digital ethnography and in-depth interviews to analyze users' needs and pain points and define fundamental problems. Further study on related research substantiates specific solutions for service directions, the psychology types of each user, and the behavior inducement. Finally, this paper presents the user interface design using a smart mirror.

Keywords: Healthcare, Service design, Weight management, Smart mirror, DTC genetic testing, Improving lifestyle

INTRODUCTION

In modern society, life expectancy has increased, and the digital healthcare industry has grown up as people are more interested in health. Moreover, the recent spread of COVID-19 has increased the time spent at home, increasing the demand for weight control such as diet and nutrition-related products, exercise & fitness services. In the United States and Europe, weight management is mainly implemented to improve health or reduce health risk factors, whereas, in Korea, weight management is highly focused on external appearance alone. The purpose of this study is to propose a healthy weight management service design for users in their 20s and 30s in Korea who experience severe health problems in their weight management program.

This study follows the double diamond model process, one of the service design methodologies. First, we conduct a digital ethnography and in-depth interviews to collect users' verbal and non-verbal raw data during the weight management process of target users and define service directions based on users' pain points and needs. Furthermore, based on prior research, the study substantiates specific solutions for service directions, the psychological factors, and the behavior inducement and develops the service flow

and wireframes. Finally, we implement service staging utilizing the service prototype to collect user behavior data based on the heuristic evaluation and discover service improvement requirements.

USER ANALYSIS

Digital Ethnography and In-Depth Interviews

This study presided digital ethnography using image data, one of the observational research methods, to find users' behavior context and needs in their 20s and 30s by observing weight management behaviors occurring in actual living environments. Based on the Purposeful Sampling (Patton, 2014), we selected 20 daily weight management videos among the videos searched by the keywords; weight management, diet, weight loss, health, and v-log on YouTube. The total length of the selected video is 215 minutes and 37 seconds, and the number of subscribers is from 10,000 to 100,000. The observation accompanied collecting raw data of users' verbal and non-verbal behaviors on nutrition, physical activity, weight measurement. Furthermore, proceeding in-depth interviews of 9 people with various weight management experiences in diet, exercise, medicine, and programs provided further information such as behavior cause and personal emotion. As comprehensively analyzing the collected data, the user's weight management behavior appears in four stages: determination, preparation, execution, and continuation, and users have different pain points and needs in each stage.

1) In the determination stage, users often have difficulties setting an appropriate goal. Sometimes their goal is hard to reach; they regard it as a task to solve and quickly feel burdened. For example, the user makes excuses not having enough time to execute the weight management behavior during the daytime because of other work and becomes passive in setting up a plan. Likewise, users often compare their achievements or progress with others', which causes demotivation. Not only the fear of failure but also inferiority from comparing make users hesitate to determine fulfillment of weight management. The user needs to set a feasible goal based on the user's body data and lifestyle.

2) In the preparation stage, numerous users take more time preparing behavior than the execution. For example, users spend more time choosing exercise tutorial videos than practicing time, and on some occasions, their attention does not last enough, and they fail to practice. Furthermore, users must go through trial and error to identify suitable and effective weight management methods. Some users even spend 3 to 10 years finding appropriate methods enduring all the side effects. In this regard, simplifying the process between determination and execution encourages the completion of the intended task. With a micro perspective, the user needs a shortcut to react. At the same time, with a macro perspective, the user needs a solution to detect appropriate methods for healthy weight management without difficulty.

3) In the execution stage, diverse self-inducing methods appear on user behaviors. For instance, the user lying down decides to start with the workout lying down motion, and it leads to performing other exercises; users watch the picture of low-fat diet posted by others and decide to resist their

appetite. In this manner, a positive trigger changes one's behavior. However, many users cannot objectively assess their actions, and they instantly make an excuse when a negative trigger happens. To illustrate, one of the users ordered a low-fat diet and received high-calorie food as a free gift. The user gets blinded by the negative trigger and easily falls to comfort itself to rationalize the behavior. In conclusion, the user needs a proper trigger and an element objectifying one's behavior.

4) In the continuation stage, the majority of users have a cumbersome experience recording and confirming their process. However, many users show they feel positive emotions when checking their efforts and time records. Consequently, improving the process of recording and visualizing the user's behavior helps the user persist in weight management. In addition, each user has a different preference on the type of methods depending on user tendency. To be specific, salient features came from the following: workout alone/workout together, positive feedback/negative feedback, scheduled on the list/concentrate on one. Thus, considering user tendency and offering options is essential to provoke user motivation.

DEFINING PROBLEMS AND SERVICE SOLUTIONS

We defined the following problems based on the user's needs found earlier. 1) Users have difficulty identifying their innate physical characteristics and measuring physical changes. 2) Users have difficulty making weight management activities a part of their lives. 3) The existing weight management method does not induce behavior through motivation and relies on the user's will. 4) No platform can accommodate weight management behavior that considers users' biological, behavioral, social, and environmental factors.

Selection of Technology to Identify Innate Physical Characteristics

In order to solve the inability of the user to identify their body features and find a suitable way for them, goals should be set based on the person's innate body information when entering the preparation stage. Many people believe that ice cream increases human blood sugar more than brown rice. However, according to the study of Eran Segal (Segal et al., 2015), some people react higher to blood sugar when ingesting brown rice showing different reactions to diet. Additionally, according to Samsung Hospital's Genetic Research Institute (Cha et al., 2018), efficient diet methods were different for each individual depending on the combination of genetic mutations. As a results, individuals should understand their physical characteristics and accept diet methods that suit them. Representative body identification technologies include Gut microbiome testing, Sasang constitutional medicine, Body composition analysis, and DTC(Direct-to-Consumer) genetic testing, and their characteristics are described in (Table 1).

DTC genetic testing allows individuals to take a test at home by sending the testing kits to testing institutions without going through medical institutions. Moreover, it can identify 70 genetic features, including FTO related to obesity, MC4R related to appetite suppression, and relevant factors in exercise and

Table 1. Body identification technologies.

Technology	Features	Suitability
Gut microbiome testing	It helps prevent obesity and adult diseases by balancing intestinal microorganisms called microbiome.	To check the changes intestinal microorganisms, through body stool should be checked every two weeks.
Sasang constitutional medicine	A constitutional analysis medicine according to the structure of eight strong and weak arrangements of organs in the human body	Results may appear differently depending on the subjectivity of oriental medicine doctors.
Body composition analysis	A test that quantitatively analyzes the body composition balance state, and body moisture, protein, minerals, and body fat	Results may appear differently depending on the user's lifestyle before measurement.
DTC Genetic testing	A test reveals 70 characteristics of an individual's body based on genetic information	Information does not change throughout life.

nutrients (MOHW, 2020). In conclusion, DTC genetic testing helps identify suitable weight management methods.

Weight Management Service Platform Selection

Identifying body changes and responding to the change is crucial during weight management progress. Users mainly check body changes in two ways: numerical changes by weight measurement and body composition analysis, and visual changes by mirroring the body. According to Rhee Sang-youl's research team (Chin et al., 2016), people who continuously record their body changes on smart devices lose 1kg more than those who did not. Moreover, according to a research team at the University of Maastricht (Jansen et al., 2016), observing external body changes with the eyes acts as a visual stimulus and helps improve body satisfaction by resolving negative perceptions of the body. Therefore, using a smart device to monitor numerical and visual data is practical in weight management. Naked Labs (2018) had developed a smart mirror with an infrared camera scanning the body into a 3D model and measuring the body circumference. Moreover, it collects body composition measurements with a scale connected to a smart mirror based on IoT technology. As we consider the usage of the smart mirror for weight management, it is the ideal device for visualizing and displaying data using a sufficient sized interface and automating acquiring body change data. In addition, in a situation challenging to use sports facilities for social distancing due to COVID-19, smart mirrors have the advantage of running in individual spaces without space restrictions.

Habituation of Weight Management by Improving User Behavior

According to Ahn (2016), the fundamental cause of the user's failure in weight management habits is the chain action of hormones affected by a

disorganized lifestyle which breaks down the hormone secretion system creating a vicious cycle. Therefore, to restore the user's hormone secretion system, the user needs to improve the improper weight management behavior.

Consequently, we propose a service function by applying persuasive technology to improve weight management behavior. The persuasive technologies proposed by Fogg (2009) include reduction, suggestion, cue, surveillance, and tunneling. 1) For 'reduction', customizing automation of physical data measurement, physical activity, and nutrients can reduce the level of behavior of users 2) 'cue', 'suggestion' aims to provide a suitable behavior model by evaluating and advising user behavior. 3) 'Surveillance' provides a visualized page of users' service usage for self-monitoring, allowing users to apprehend their progress objectively. 4) By designing a user's weight management process by assigning level and grade satisfaction conditions for 'tunneling', the user can go through a series of processes to reach the goal.

Motivation for Continuing User Behavior

In order to propose a motivation element to the user is vital to induce continuous behavior. Fowler (2017) explained that autonomy, relatedness, and competence should be satisfied as motivating users. Autonomy is a desire to have a choice, and one's actions come from one's will, relatedness is a desire to pay attention to or receive from others, and competence is a desire to feel that one is growing over time. When all of this is satisfied, it creates positive motivation for intrinsic motivation.

First, to meet the user's autonomy, we provide detailed options and services within the category provided as personalized to give the feeling that users can choose what they want. By giving these options, autonomy can be fulfilled and induce continuous participation.

Second, the competence element is strengthened by giving appropriate feedback and rewards according to the user's behavior to feel a sense of accomplishment. According to Kim Sung-il et al. (2005), feedback plays a decisive role in competence formation by providing standards and information for determining competence. Thus, we assumed that providing feedback based on measurement data according to the user's behavioral performance and body change and positive rewards such as levels will strengthen the user's competence.

Third, to impart a relatedness, activating interaction between user and users and user and device by utilizing digital and non-face-to-face platforms can be a solution. Recently, many users have had difficulty managing weight management and making new relationships since social distancing creates space constraints. Forming a platform within a smart mirror and communicating with other users in real-time can strengthen the relatedness.

PROPOSAL OF SERVICE DESIGN

Developing Service Architecture

The above service content aims to form a user's weight management habit. According to Lally et al. (2009), 66 days is required for a new behavior to

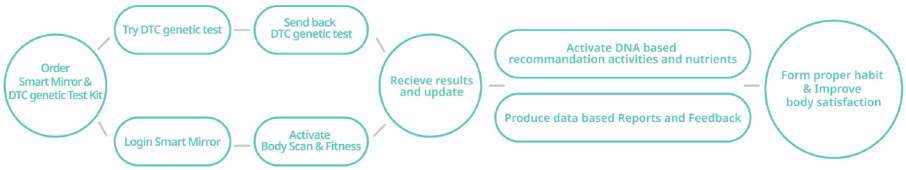

Figure 1: Service flow.

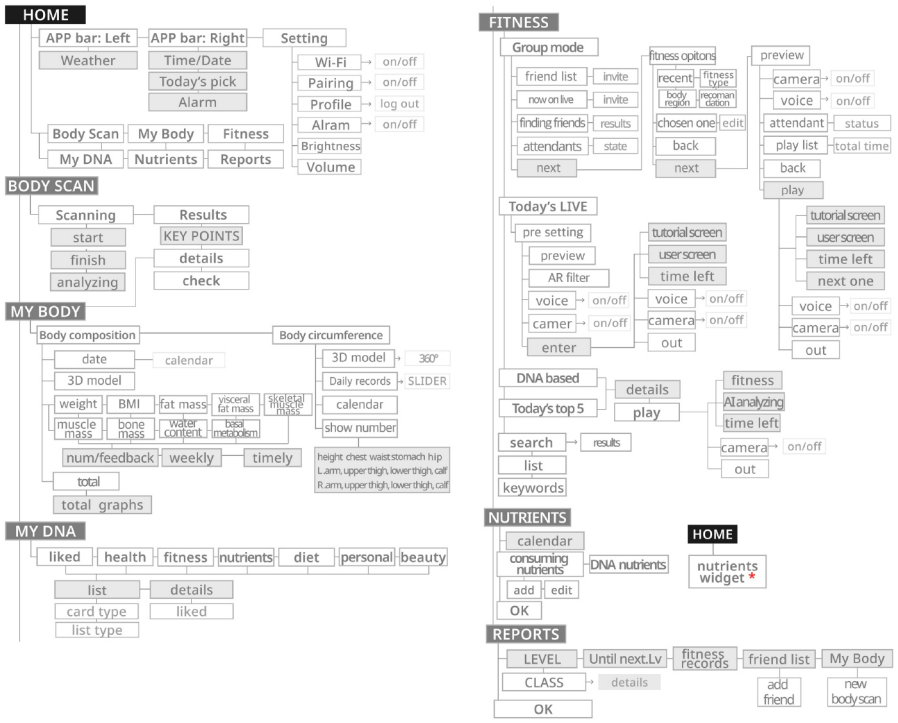

Figure 2: Information architecture.

become a habit for the user, and we set 66 days as 1 unit of service. To maximize service contents' availability, we referred to the lifestyle improvement model devised by Ajou University's research team (Jo et al., 2014) to design service flow (see figure 1). First of all, DTC genetic test results, body composition analysis of smart mirrors, and 3D scans provide 'awareness' of individual body information.

We reflected 'Foundation work on self' and 'setting the focus' through recommending activities based on individual body data and 'steady attempts' through contents such as 'fitness,' 'nutrition,' and 'today's recommended activities'. Reports generated by accumulated physical activity and body measurement data while using the service 'Body Scan' leads to 'deeper work on self'. Suggesting continuous behavioral models such as customized activities and feedback helps users form the proper habits and 'Lasting lifestyle change'. Furthermore, we structured information architecture in Figure 2.

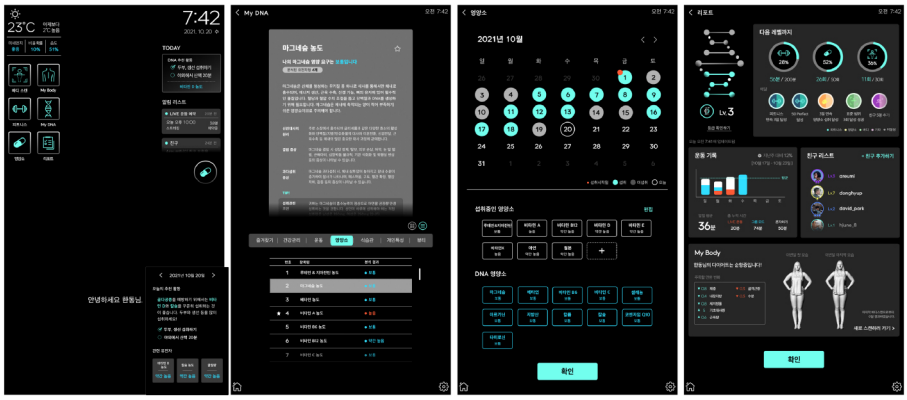

Figure 3: Smart mirror GUI (1–5).

Service contents and user interface

Based on the previous study, we derived six main functions: Fitness, My DNA, Body scan, My body, Nutrient and Reports, and additional service contents using DTC genetic testing and smart mirror interfaces. First of all, 1) Six main function icons were placed on the home screen, and alarm widgets and basic information were displayed together to give the user a sense of control. 2)Today's customized recommendation activity proposes behavioral models such as diet and exercise to be executed on the same day based on the user's DTC genetic test and acquired body data, and is placed on the home screen to help the user set goals first when accessing the smart mirror. 3)My DNA provides essential information on genes, effects on the body, and TIP for management to help understand genetic test results and actively utilize them in real life. 4) The Nutrition page displays nutrients that are likely to be deficient based on their genetic testing. Users can compare themselves with the nutrients they are currently taking and review their shortcomings. Additionally, a notification widget is displayed on the home screen to help continuous management. 5) On the Reports page, the user can objectively grasp the level of satisfaction process and body changes within a month by visualizing the user's service usage history.

6) In Body scan, the user's body change is measured. It provides immediate feedback based on body change data. 7) My body visualizes changes in body composition and circumference and 3D body model changes by accumulating body data obtained through body scans. It rotates the 3D model 360 degrees, observes one's body, narrows the gap between cognitive and actual body type recognition, and increases user convenience by automatically recording body changes. 8) The Fitness page provides physical activity content. In the group mode and the Live exercise, the user may invite another user or share their respective screens in real-time to exercise together. In addition, we guarantee users' privacy by granting a live exercise AR filter function.

The 3D modeling of the smart mirror interface is depicted in Figure 5. We conducted offline service staging by making service prototypes for stakeholders and weight management performers. From October 29 to

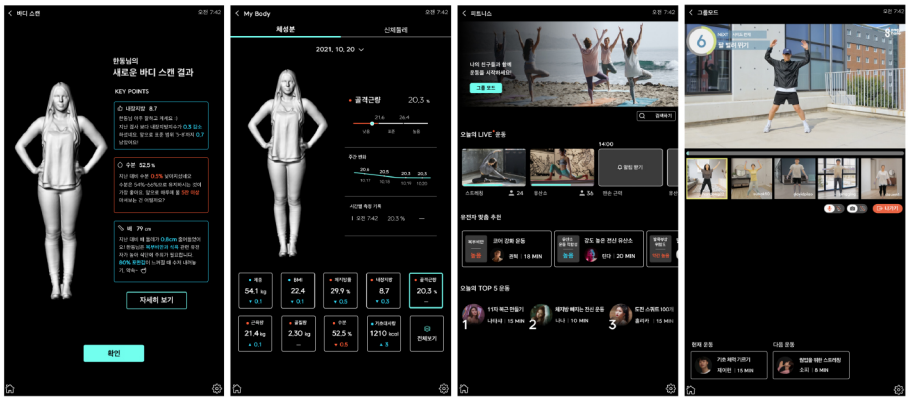

Figure 4: Smart mirror GUI (6-8).

Figure 5: 3D model of the smart mirror & service staging.

November 3, 2021, about 320 people experienced it by the following order. 1) service background and service flow description 2) performing the smart mirror prototype, including six main functions. The service staging allowed us to obtain feedback on body change data visualization, non-face-to-face exercise platforms, and future research directions. Participants were delighted with grasping their innate information through DTC genetic testing and weight management function based on precise information. Additionally, they predicted that the visual data utilization of the 3D model would be highly performed.

CONCLUSION

This study analyzed insights by applying the service design methodology and proposed the service design of individual weight management healthcare services based on the research in the implementation of healthy weight management. We utilized DTC genetic testing, body composition analysis, and 3D body scan to combine innate body data and acquired data for service contents and used a smart mirror to strengthen users' experiences through digital and non-face-to-face platforms. This study, user behavior inducement and habituation based on the study of psychological factors and user type, and visualizing body data, differentiates from existing services in the healthcare industry. Moreover, it has the potential to expand the service by combining them with other smart devices and smart mirrors based on IoT. Future study

will develop the service design by reflecting user behavior gained from the service staging of 320 people and analyzing user behavior based on heuristic evaluation standards.

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