A diary study and redesigning of the Fitbit Flex sleep monitoring application

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ABSTRACT

Aside from healthy eating and regular activity for healthy life, the quality of sleep is an important requirement for a healthy life. With the recent development of technology for wearable devices, many people can get help in efficiently managing their health. Among these health-related devices, the number of activity trackers is rapidly increasing. Of these, Fitbit is one of the most popular products and is a representative product of this market. This product monitors user's activity, calorie consumption, and sleep, and helps users to seek a healthier life.

Fitbit App has six functional categories in activity, food and sleep to promote a healthy life. However, not all functions provide specific information for the users to effectively manage their health. Especially, the sleep function only provides basic functions, which displays a pattern graph of the user's sleep; it monitored and checks the accumulated data. Also, there are UI issues in this part as well. In order to solve these issues, an evaluation of this App is first required.

As an evaluation method, online diary study and interviews are conducted to collect data. An online diary enables easier and faster access to online tools compared to the traditional paper diary. Using digital technology is a part of people's lives today. Also, all participants had sufficient online experiences, so an online approach was easier. Interviews were conducted on a face-to-face basis after the diary study was over. After this user research, the result analysis data is used, as a base to redesign the App and make it more suitable for improving the quality of sleep.

The purpose of this project is to improve the App for Fitbit Flex though user research, and redesign the sleep-monitoring App by applying the solutions to solve the issues, that Fitbit App has. The deliverable of this project is a POP interactive prototype. The contribution of this project is to solve the issues of Fitbit App, and furthermore help in promoting healthy sleep and habits, which is the ultimate object of this tracker, to people.
ACKNOWLEDGEMENT

The future has the potential for the development of technology that can really benefit people’s lives—this makes me really excited. In particular, this project has been a fantastic opportunity to learn about user experience design and wearable devices. I appreciate everyone who helped me out in carrying out this project. Particularly, I would like to thank Robin and my participants for supporting me.

A special token of appreciation goes to a person who gave me many insights: Dr. Ji-won Choi. Thank you for being interested in this project. I really enjoyed talking about wearable devices and this project with you.

I would like to extend my appreciation to my most dedicated supervisor, Dr. Martin Colbert, who was kind enough to offer his guidance throughout this project. I will never forget his advice during the supervisions and UX Design course. You are the best teacher that I have ever met.

I truly thank my loving family for their warm encouragement and for always supporting me. Last, but not least, I would like to thank my God, who has given me his never-ending support.
INTRODUCTION

1. INTRODUCTION

Healthy life and well being have been of interest to many people throughout history. A countless number of people have attempted to change their behaviour and improve their health though the use of different technologies [1]. And, in recent times, developments in computing technology have been a great help for people to attain good health and to maintain healthy lifestyle [2]. In particular, people are now able to monitor their health more effectively by checking their activities, such as their physical activities, sleep cycles and/or calorie intakes, on real-time data though developments in health-related wearable activity trackers. These digital devices along with the popularity of smartphones are one of the main areas where fast development and huge investments are made.

The recent explosion of work in health mobile Apps with activity monitoring devices has come from both the commercial sector and research in health and human-computer interaction [3]. In the rapidly growing commercial health fitness device area, there are many activity trackers such as Jabone UP24, Nike: Fuleband SE, Msfit Shine and so on. These are accelerating growth the health mobile applications. One the other hand, health researchers and Human Computer Interaction have developed these sectors such as users behavior change and health management [3]. The researches, which are finding methods to provide motivations for checking health conditions and managing a better life, has been inducing product upgrades day by day. Although increasing the popular activity trackers, there is concern about how meaningful and effective the contents from these devices are in helping people change their behaviours and achieve a healthier life.

The rising popularity of these health activity trackers, Fitbit has positioned itself as the market leader. It is the first wristband in the market that can synchronize via, Bluetooth 4.0 [4]. Wearable device Fitbit Flex, which is a wireless tracker in the market, is predicted to expand up to 169.5 million in 2017 [5]. The Fitbit has major three functions like other trackers; functions related to activities, foods and sleeping. Fitbit, however, has functions that need to be complemented. A function about sleep monitoring has a lack of information and independent feature compared to other functions. An assessment about value of information provided to users and how helpful the information is in changing users’ behaviors is required.

For health management, there are three important activities to support a healthy life eating nutritious food, regular exercises and quality of sleep. There are many health-related Apps that focus on supporting healthy eating and regular exercises [2]. Although sleep activity plays an important role, not just in the lives of patients but in the lives of ordinary people as well,
research in this area has mainly focused on treatment related to the medical field. Sufficient sleep can reduce exhaustion and stress, as well as the risk of all kinds of diseases. The development of health-related wearable technology through activity trackers is one method of support to allow for better sleep activity. This is the time to consider Apps that can monitor people’s activity patterns using activity tracker devices to promote healthy activity, and that can encourage people as a more effective method for a healthy lifestyle.

This project investigated the existing Fitbit App with device and redesigns it to improve the weak points through data analysis from user research. The evaluation method combines an online diary method with face-to-face interviews for collecting data. The diary study is one popular qualitative method designed to capture user activity and needs, and it is suitable for long-term studies. For example, in evaluating the mobile context though e-diary and data logging in a field trial, [6] Palen et al [7] used a new evaluation method of voice-mail diary. In another example, it was used as part of a combination research method that used online diary study with other research methods for remote workplace evaluation [8]. Traditional paper pen diary are augmented with signaling devices and the emergence of electronic means of data collection appeared as two major waves of change in diary research in the last two decades [9]. Therefore, this project will use the online diary study method with interview in order to capture users’ experiences effectively, collect this data and then consider how to redesign and improve the App.

The contributions that could be made from this project are to consider how to help people who want to manage their health effectively achieve a better quality of sleep, and how to develop motivation for a healthier sleep habit through the functional evaluation of the existing Fitbit App with wearable health devices.

In chapter two, the literature review will provide a brief history of wearable devices in order to help understand the Fitbit Flex device and App. It also includes user research techniques and competitor analysis. Chapter three presents the method of the online diary study for this project. Chapter four provides the result from the online diary study and interview. Chapter five considers design for the Fitbit new sleep-monitoring App with solution. Finally, the discussion in chapter six is about user research, user interface, prototyping tool and conclusion.
2. LITERATURE REVIEW

2.1. A brief History of Wearable Devices: Activity Trackers

“For the past several years, wearable devices have been receiving a lot of attention as the next-generation smart device from IT companies, resulting in their entry and the establishment of new market areas, one of which is "wearable devices." [10]

The definition of wearable technology has been changing for centuries. One of the recent definitions states, “a wearable computer is a digital device that is strapped to or carried on a user’s body” [11]. From the end of the 20th century to the beginning of the 21st century, fitness activity devices were manufactured. For example, devices such as a wristwatch-sized bicycle computer that can monitor speed, duration and distance were introduced around 1990, a wearable heart rate monitoring device in 1981, and wireless versions of heart rate monitoring devices in the beginning of the 2000s [12]. The Polar RS800sd Running Computer, launched in 2007 was a watch-type device with functions like planning, monitoring and analyzing data, and became the early model for activity trackers used today. However, the user manual was too complicated for the average user [13]. Afterwards, pedometers used accelerometers and altimeters to introduce Fitbit’s first product Fitbit Ultra™, which could measure activity, manage calories burnt and quality of sleep in 2011.

Since then, development of similar wearable devices has gained momentum. In January 2012, Nike Fuel Band, a smart band that is placed on the wrist with passometer and calorie calculation functions, became available through the Nike online store [14]. Nike’s next model, FuelBand SE, was redesigned to automatically aunchronize with the Nike tracker App via Bluetooth 4.0. Following Nike, Fitbit gained much attention when they released a wristband-type device called Fitbit Force™ with activity and sleep monitoring features that also functions as a watch in October 2013. However, the entire quantity was recalled in February 2014 due to safety concerns, with the material causing skin irritations [15]. Fitbit Flex is a subdivision model of the Force launched in May 2013.

In December 2013, John Sculley, the former CEO of Apple, released Misfit Shine, a wearable device with enhanced functions as an accessory [16]. The development of activity trackers such as Garmin Vivofit, Polar Loop, Sony smartBand and Samsung Gear Fit have shown a meteoric rise in the last two years. These gadgets have been rapidly improved and upgraded, resulting in a constant release of new activity trackers in the market by large and small corporations. Nevertheless, most of these have evolved to focus on functions related to users’ activities and workouts, and expending functions to offer better health benefits by upgrading functions that give their users motivations and tips to better manage their health. In SECTION 3.3. Competitor
Analysis, the pros and cons of these products will be covered more specifically in an analysis on competitors.

2.2. Understanding of Wristband Fitbit Flex

For this research to evaluate and redesign Fitbit App, it is necessary to understand what kind of device Flex is. This is because it is synced with the App in real time, and the device itself provides feedback with lighting and vibrations. This feedback reminds the users about their current status or motivates them to build a healthier habit. In order for the designer or developer to design a better user experience design, an accurate understanding of the process of synchronization between the device and the App is needed.

“Fitbit, the leading innovator and market leader in the growing Connected Health & Fitness category, introduces the Fitbit Flex Wireless Activity and Sleep Monitoring Wristband. Flex is the first and only wristband on the market to sync with Bluetooth 4.0—which means more flexibility when you want to check your stats.” [5]. Fitbit measures the steps taken, distance, calories burned, activity duration and sleep quality. It uses OLED display and the three-dimensional accelerometer and sense user movement. Besides the wrist-type Fitbit Flex™, there are four devices that offer various wearing methods: Fitbit One™, Ultra™, Zip™, and Aria™, which measure the activity [15].

The Fitbit App was launched for iPhone in October 2011, and the Android App was developed in March 2012. At first, it began as an App for Fitbit Ultra™, but the user can now use the interworking App by selecting any device in the intial setup page. When the App was first launched the user could retrieve their activity data from the user’s Fitbit account. However, since September 2012, the Fitbit One™ and Zip™ could synchronize with the mobile device via Bluetooth. Additionally, the Android Apps could be used in more devices such as LG G2, Galaxy S4, Nexus 4, HTC One, and Moto X from January 2014 [17].

FIGURE 1. Fitbit Flex wristband
2.2.1. Fitbit Flex Device

Fitbit Flex is a flexible rubber wristband type wearable device connected with the activity tracking and sleep monitoring made of flexible rubber. It is important to know the device for understanding the interaction between user and device because the Fitbit App wearable consists of four components (see: FIGURE 1): the Flex tracker (a) is placed in the wristband (d) during normal use. When charging is required, the sensor (a) is removed and clipped onto the charging cable and (b) connected to the USB port. Data can be synchronized with the desktop via wireless sync dongle (d) and viewed on the browser. Users highly value the option to exchange wristbands, available in different colours and sizes, especially when the wristband gets dirty or broken.

FIGURE 2. Fitbit Flex component

1) Fitbit Flex: Features

The display of Flex consists of five LED indicator lights that provide the feedback on the user’s goal progress towards a goal, battery charging, and sleep mode. Each LED light represents 20% of the user’s goal completion. If the user touches the band display of the band twice, the progressed goal progress is shown as the number of lightings. When the band is tapped four times, the device converts to sleeping mode where two LED lights are shown in both sides together with vibration. The user can change the goal for steps, calories or distance in the Fitbit App. Furthermore, the user can set the goal for steps, distance, calories burned and active minutes for the daily exercise in the Fitbit account. Based on these data, the user can check and celebrate when he/she accomplishes the goal.

2) Motivational Support

Fitbit encourages the user to be continuously active with real-time information through LED lights, vibration, competitive ranking competition with friends, and encouraging messages through e-mail.
**Progress:** The increasing number of LED lights throughout the day and the final vibration of the Fitbit Flex™ upon reaching the goal motivates the user. The default setting for the number of daily steps is 10,000 steps. When the user walks 2000 steps, one light automatically turns on. When the device is tapped twice, the real-time progress can be seen. Particularly, upon reaching the desired goal of 10,000 steps, all five lights are animated, the lights switch on and the vibration alerts the user.

**Competition:** If the user enters the Friends button (see: FIGURE 3) on the App, they can register the friends who use the Fitbit Flex. The list of added friends is shown and their activity is represented as a numerical value, which can be used to rank oneself among friends. There are also Cheer, Taunt, and Message options that can be sent to the competitors.

![Dashboard](image)

**FIGURE 3.** Dashboard on Fitbit App

**Top Badges:** The user receives the badge through e-mail from Fitbit in every accomplishment of a goal as (see: FIGURE 4). The user can be reminded of his/her accumulated exercises to date.

![Badges](image)

**FIGURE 4.** Top badges by email

2.2.2. Fitbit App Dashboard on Desktop and Mobile

Fitbit provides a dashboard, which is an overview of user progress towards various goals, as well as graphs with historical data. The data are shown as a series of simple boxes each fulfillment and the daily real-time activity level. As shown in FIGURE 5 below, it shows the same data with the App. Individual boxes divided on a web dashboard for each option can be moved to the location the user prefers. It is an advantage of Fitbit to be able to track data both from the App and from the web browser at the same time. It might provide more options than other activity trackers. Additionally, it is effective because the user can see on a bigger screen than
the mobile version. However, the mobile App has higher accessibility when the user is working outside and moving. Therefore, the evaluating and redesigning for Fitbit App will concentrate on the mobile App with Flex device.

The data on the dashboard of the App is represented with simple and intuitive graphs. The user interface with functions displayed in the App can be rearranged according to the user’s taste. The activity and actigraph shows four colour changes according to the amount of activity represented by each bar. At first, the graph colour changes in the order of light blue, yellow, orange, and light green according to how near the user is to the goal.

![Fitbit Flex Dashboard on web (Left side) and mobile (Right side)](image)

**FIGURE 5.** Fitbit Flex Dashboard on web (Left side) and mobile (Right side)

### 2.2.3. Functions on Fitbit App

There are six-functional categories in Fitbit App. The functions seen in the Fitbit dashboard can be divided into Activity, Weight, Sleep, Food, and Water categories. An Exercise function is only provided in iOS and activity related measuring function. This section presents about the functions on Fitbit App. The activity function and food function are inter-related. When you put the name of foods into an App, calorie consumption and intake are automatically calculated according to active mass. In contrast, the sleeping function shows a graph by monitoring user’s sleeping independently. In this project the evaluation was conducted with the five cross-platform categories. Here is the overall information related with the evaluation form the project about each function and interaction with user in the functions.

1) **Activity category**

This part lets the user check their activity in real-time. It includes the following functions: steps taken (how long the user walked for the day); distance traveled (how long the user moved);
active minutes (how long the user worked); and calories burned 9 the calories intake and consumption) All these details are shown on the graph (See: FIGURE 6) It is the function that presents the user’s activity, and can be recognized by the real-time synchronization with the graph and value in the main dashboard of the App.

FIGURE 6. Activity category on Fitbit App

2) Weight category
The user can enter the actual weight and compare against the user-defined target weight. There is an arrow icon on the upper-right side of the weight function (see: FIGURE (a)). If the user taps on the icon, the accumulated information of changes is shown with the graph for every week, month, and year. The weight, Lean vs Fat, BMI options (see: FIGURE 7-(b) and (c)) can be displayed.
3) Exercise category

The function, only available in the iOS, helps the user to exercise effectively. As a function for track exercise and log activity, this option allows the user to select from Run, Walk, (see: FIGURE 8-(c)) or Hike, and it shows the distance traveled, time, and average pace on the map by tracking the current location with GPS. Users can check how their activity improves over time.
4) Food category
This function shows the calculated calories intake through food consumption compared to the activity amount as the user logs their food consumption throughout the day. If the user taps the calories eaten on the left function in the dashboard of the App (see: FIGURE 12-(a)), the data about the calories in vs out is shown as a bar graph. If the user taps on the plus icon on the upper-right corner, the food log is shown. If the user searches and adds the food eaten, the total calories are automatically calculated. The barcode scanning function, located on the top of right side on FIGURE 9-(b) is more convenient than manually searching and entering each food, but the device hardly recognizes any products in the UK. This function may be designed for the US-based users. There is also a function to manually enter the calorie value for each food for a precise measurement of calorie intake.

![FIGURE 9. Calories and food tracking Functions on Fitbit App](image)

5) Sleep pattern category
The sleep pattern function shows the time and quality of sleep by indicating time and frequency of restlessness and awake.

On the dashboard of the Fitbit App there is a function, ‘How did you sleep?’ (see: FIGURE 12-(a)) in which the sleep pattern can be checked. If the user enters the sleep time and wake time (The sleeping time and waking time can be entered automatically by synchronization as explained previously in Section 2.2.1 or entered manually if the device was not set in sleep mode before sleep) the device shows the number and duration of restlessness and period awake as patterns of coloured lines. If the user clicks the arrow in the upper-right corner (see: FIGURE 10-(a)), the accumulated data is shown for every day, week, month, and three months, or a year. (see: FIGURE 10-(a),(b))
6) Water category

The water function is the most intuitive and simple to use on the App. The user simply needs to enter the amount of water consumed, after which the total amount is then calculated and displayed as a human filled up to certain level (see: FIGURE 11-(a)). The amount of water can be entered in three ways: directly typing the amount or water, dragging the lever with a finger or by tapping the image of a suitable cup or a bottle.
2.2.4. Fitbit App on iOS and Android Platform

There is a small difference between the icons on the iOS and the Android platform (see: FIGURE 12-(a), (b)). However, these platforms have almost similar features. The five functions, Activity, Weight, Sleep, Food, and Water are the same across both platforms. iOS platform has the additional Exercise function. The Food Category in iOS is displayed as 'calories eaten' and 'calories left', and food can be logged when the user taps it to enter the log screen, in Dashboard in the Android platform, it has equal operational features except the graphic that displays the calories consumption.

Fitbit App on iOS is typically improved and released sooner than that for Android, an App redesigned based on iOS platform can also be equally applied for the Android platform. In addition, there are significantly more users who use Fitbit App on iOS. Therefore, this study presents redesigns based on the iOS platform. The FIGURES below shows the status of each dashboard in iOS and Android respectively.

![FIGURE 12. iOS (a) and Android (b)]

2.2.5. App Gallery for Fitbit

“Fitbit integrates with many popular health and fitness Apps, including Endomondo, LoseIT, MapMy Fitness, MyFitnessPal and Sparkpeople, to allow users to share data from their favorite apps.” [4]

According to the Fitbit homepage, about 40 different Apps can be interworked with the Fitbit device [17]. Most of these Apps measure activity, calculate the cholesterol level and provide the health information, motivate by the sharing data with others, and assist with the health management.
There is a sleep App for supporting Fitbit sleep function. ‘Sleep debt’ informs the user how much sleep they should have after calculating the amount of sleep the user has had. However, it does not provide direct information in terms of how it assists the change toward the healthy sleeping habit of the user.

![Applications for fitbit device](image)

**FIGURE 13. Applications for fitbit device**

### 2.3 User Research Techniques

“All research methods have advantages and limitations, with some particularly suited to undercover work.” [18]. There are many user research methods and it has disadvantages and advantages. The review of research techniques in this section is appropriate method for this project.

After reviewing the techniques, a combination of diary study and user interview were selected for the user research method to evaluate the Fitbit App. It is a useful technique for collecting data and capturing information from the users' environments in their real life. Therefore, it is the most appropriate method for this study. The goal of the diary study was to collect meaningful data for evaluation from participants in daily life.

The advantage is other techniques were offers to make up for the possibility of omitting events. An online diary enables the researcher to receive entries from the users every day, and the researcher can get the idea about the product beforehand. Here is briefly review the techniques for the project.
2.3.1. Surveys

Surveys have the clear closed questions, yes/no response, and Liker scale and open-ended questions. Surveys are quantitative method have the clear undercover advantages of easy to analyze. Surveys involve a series of well-defined questions targeted to a large audience. Unlike a quantitative research method collecting numerical data from consumers.

2.3.2. Focus Groups

“Focus groups involve bring together a variety of people within a target audience and facilitating a discussion with them.” [19] The research technique is qualitative method is performed to gather information through intensive dialogue with a small number of respondents. Focus Groups may bring out much insight however, it is not effective method for evaluation the App because sometimes participants’ statements can effect in the group setting.

2.3.3. Usability Test

A usability test is involves requesting participants to perform specific tasks during the test on application. Most usability tests are investigated as part of the design. For example, the time participants took and how they made errors could be confirmed while observing participants carrying out a task they were given. However, a usability test has limitations for evaluating the product, because it is more difficult to capture the users’ daily life than with a diary study.

2.3.4. User Interview

“The most obvious way to find out more about people is to talk with them. “[18] It is a qualitative research method. A user interview adopts an ethnography method that talks with current or potential users about products they want to talk about. It can use videos, phones, or camcorders when researchers meet participants. Through the interview, the interviewer can accumulate clear information on what the participants prefer or dislike.

2.3.5. Diary Keeping

Diary study is a popular field method designed to capture daily activities, user needs, and context information and others, and is particularly suitable for long-term studies [20] [21]. The diary method enables recording user experiences as they happen, capturing details and avoiding the risk of experiences with the tool being generalized in time. The Diary is requires the informants to record activities user throughout their daily life. Individuals write a diary about their experience of the product for certain duration of time, and the collected diaries are analyzed later.
3.1. Competitor Analysis

As seen in the preceding research, four Fitbit Flex products are competing in the current market. Learning how the basic specs, functional characteristics, motivational features, and features for activity, food and sleep interacted with users through analysis of competitors was important because it could provide insight for this study. The brief summary of each competitor is mentioned below.

3.1.1 Competitor Overview

Four activity trackers determined to be competitors are products currently drawing market’s attention, all of which are useful for health management. Materials used in these products are basically waterproof and light-weighted. Apps connecting to each product are synchronized real-time to show the history of user activities in graphs and numbers. Below is a table describing the features, advantages, disadvantages and motivation methods for each product.

Overall, all three products which have ostensibly the same functionality are focused mostly on activity-related functions rather than their food log and sleep pattern functions. In most cases displays, lighting, and vibration were connected and responded in real time to give visual and tactile feedback such as when to sleep (Jawbone), how much the user has attained their goal (Fitbit Flex and all) and showing weekly data reports, all of which are functions that give motivation for healthy living. Especially, as far as its sleep function is concerned, Jawbone is ahead of its competitors with various motivating factors as well as user feedback while Fitbit, Nike and Shine showed only simple information such as when to sleep, and how much you move during a sleep.

<table>
<thead>
<tr>
<th>Possible platform</th>
<th>Fitbit Flex App</th>
<th>Jawbone UP 24 App</th>
<th>Misfit Shine App</th>
<th>Nike: Fuel Band SE App</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>iOS</td>
<td>iOS</td>
<td>iOS</td>
<td>iOS</td>
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<td></td>
<td>Android</td>
<td>Android</td>
<td>Limited model</td>
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<td></td>
<td>for Android</td>
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<td>Functions</td>
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<td>Activity</td>
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<td></td>
<td>Food and Calorie</td>
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<td></td>
<td>burn</td>
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<td>Sleep</td>
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<td>Sleep monitoring</td>
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<td>Motivational</td>
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<td>Feedback</td>
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</tbody>
</table>

TABLE 1. Competitor basic specs and functions overview
To propose the activity tracker App, it was necessary to understand each device and its Apps. Below we will review the activity trackers and Apps from each competitor in detail.

3.1.2. Jawbone UP24

The Jawbone UP24 Activity Tracker [22], which was upgraded in December 2013, is designed to compete against Fitbit Flex years. Both Jawbone and Flex are made of textured rubber and deliver the feedback to the user through lights and vibration. They both have similar functions such as daily activity, calories burnt and sleep patterns and but, aesthetically, Jawbone 24UP is a more stylish device than Fitbit Flex.

The strong points of 24UP App among other activity trackers are its sleep-monitoring feature. People repeat the deep and light sleeps, so Jawbone App wakes up the user with the vibration alarm system when the sleep of the user was changed to the light sleep. By investigating the quality of sleep, the App avoids the deep sleep and reminds the user to wake up by the vibration in light sleep. UP24 shows more systemic and scientific data and goal value according to the user’s change in behaviour. A measure of how close you are to the goal is shown with graph and numerical values about activity and sleeping function in the main window. When recording the food eaten, the calories intake is also shown, and it contains the nutrition facts and the recommendations about the healthy food. Information about how to live healthily is also provided in the main window every day with the question of ‘Did you know?’

24UP has a well-established motivational feature as well as a feedback feature. The user sets their goal and the progress of the goal is displayed in various visual methods. The real-time feedback and motivation for the activity of the user are the strong points of Up24. When the device is not used for a long time, or the activity is not sensed, the vibration and mobile message is activated to inform the existence of the device.

This product has reinforced motivation function, information on healthy life, and feedback function compared to other trackers. It provides information on healthy life and habits. Especially, the sleep function not only provides segmented information to the users, but also leads the users to have sleep time feedback by setting the bed time and target rising time as vibration alarms. This feedback function can promote motivation in the user to aim for a healthier life.

**Strengths**

- It displays data trace information in different, easy to understand visuals
- Improvement of feedback: UP24 allows the user to remind his own status through real-time feedback messages regarding Activity and Sleep.
- Providing information: it provides information and comments for healthy habits regarding consumption of food, sleeping hour and activities.
Weaknesses

- It is more expensive than other similar devices.
- Impossible to replace the band: the sensor is part of the band, so if a bright coloured band is purchase, although the band gets dirty, the user still has to use it, regardless of the band’s condition.
- It might be distracting when typing or doing other activities due to its thickness.

3.1.3. Misfit Shine

Misfit Shine [23] was developed by John Sculley, a former CEO of Apple and Pepsi With built-in low-power Bluetooth device. The user turns on the designed App to sync with iPhone or iPad, and then just touches the Shine once on the sync screen. The most significant advantage of Shine is its wide range of accessories. Its design is strengthened around the fashion feature, which is he most important feature for a wearable device. Its main sensor provides nine different colour options, and bands are available in various different types for wearing. The sport band and clasp are basically provided, and the coin-sized sensor in the centre is collected with the
activity data. This product can also provide an aesthetic accessory effect, as the user can wear it anywhere such as on their shoes, trousers, wrist, neck or hair, etc.

Shine’s synchronizing method requires the Shine sensor to be placed near the phone without activating Bluetooth. Various workout option activity tags, which can be checked in the Shine App, can be activated by just tapping the Shine sensor three times. There are 12 LED holes in Shine, and they are switched on when they accumulate points. If the user achieved their goal, then all 12 LED holes are lit. If the user chooses the Time option, then the user can check his/her time with 12 LED lights.

The Shine App is available for iOS 6.1.3 and Android 4.3. It can gain feedback on their own progress towards their goal. Its strong feature is that the user can choose from a selection of sports and exercises: Yoga, Stationary, Elliptical, Cardio, Pilates, Dance, Cycling, Swimming, Tennis, Basketball and Soccer. However, the response from some taps on the device does not register immediately. And these options are hard to find compared to Fitbit Flex.

This product is popular among users for providing variety to the ways of putting the device on. However, there are limitations on the applicable mobile models. The synchronizing process between the App and device is an interesting factor that arouses users’ interest. If the initial synchronization between sleeping App and device is easy and fun, it may provide the user with positive experience.

**Strengths**
- It has a long battery life
- The method of synchronizing process easy and interesting
- It can be worn anywhere, and features an attractive design
- There are various activity selections and options on App

**Weaknesses**
- Sleep monitoring feature does not recorded the bedtime
- There is less insight into users sleep patterns
- Sometimes the LED lighting is inaccurate
3.1.4. Nike: Fuel Band SE

Nike SE [14] is second generation, which is updated from the first model [24]. Nike SE improved the accuracy of the accelerometer SE from the earlier Nike model. Users can also check the Fuel usage every day, week, or month just like Fitbit. It has a different style than Fitbit, but it can also check the measured data with the device in real-time and share the activity data with friends. The user can also compete with others who use Fuelband.

Plastic and silicon rubber makes the first look of the device, which was launched in 2013, so it is light. The best benefit of SE is that information is shown on the LED display. This information tells the user about Progress, Fuel point, calories burnt, number of walks and time. Like other trackers, it announces achievement when the set target is achieved and an image of a trophy is given after achievement for additional motivation. Another advantage is that Fuelband can measure activity according to different types of exercises by selecting various exercises. However, it only provides basic information for sleep monitoring and calories burnt.

The 100 LEDs in the device are an effective feedback factor. In terms of activity-related functions, the Actigraph, which displays the data of real-time monitoring, is visually attractive.
However, in comparison to the activity function, the sleep function is similar to Fitbit, which simply provides sleeping hours and patterns.

**Strengths**
- Check user option by text or number in LED display
- There are many exercise options for the user to select according to the different activity options the user wants to measure
- Ergonomic design and a simple, sporty design in both device and the App

**Weaknesses**
- Only works with iphone and ipod touch
- Sleep function provide about sleep duration and poor information

![Nike Fuelband SE Device and App](image-url)

**FIGURE 16. Nike Fuelband SE Device and App**
3. DIARY STUDY

This study is conducted through an Online Diary Study and interview for gaining real user experiences. It was an important aim of this study was to collect data meaningful for longitudinal usage and user feedback.

Although the traditional diary study adopts a paper method, there are two reasons for selecting the online diary. First, digital technology is a part of everyday lives these days. People check e-mails every day or search the Internet to look for information. Secondly, the participants in this research all ranked highly in terms of their online use. The easiest approach for all of them was e-mail. Therefore, an online diary was selected as a research method.

Diary study is useful in capturing the user experience in daily life. For this project, the investigator had to obtain the experiences and feedbacks in the users’ daily lives from the details of device and App uses. Therefore, a diary study was chosen because it is a proper method in learning how the user interacts with the product in daily life, how the user learns about the product, and what kind of interaction the user has in certain environments.

As a practice method, an online diary was selected. Right now, the digital technology is an integral part of people’s daily lives. People check e-mails every day and surf the web using computers and mobile phones. An online diary is useful for being easy to access and familiar to the users. Also, in order to obtain evaluation data on the App that allows real-time monitoring, an online method where the user interaction can be traced in real-time and feedbacks received every day; an online method was the most useful.

3.1 Aims

The study evaluates what issues are affecting the Fitbit App, the extent to which is meets users’ expectations, and the specific redesigns required to improve the user experience. It is carried out through an online diary study and interview. This study addresses the following research questions below.

- **Usability**: What is the overall user experience of the six functions in Fitbit App with Flex?
- **Satisfaction**: With what function do users feel the most satisfaction or dissatisfaction?
- **Motivation**: What motivation do users need to keep using Apps?
- **Redesign**: What would be helpful to include in a future design criteria for the Fitbit Flex App?
3.2. Preliminary Pilot Study

Before starting the diary study, there were a few concerns about the Fitbit App that had been discovered through a one-month pilot study.

The first concern was the sleep monitoring function. Sleep has a very close connection to health. The sleep graph is not very accurate. Users might find it difficult to recognize the moving action during the sleep time because it does not show the time exactly. It seems to show the graph ineffectually. Moreover, it might be more efficient if it can give the user some advice to fix the user's unhealthy sleeping patterns or habits, based on the user's data. If it gave the user meaningful information related to their sleep, it might be much more beneficial for their health.

The second concern was that log food consumptions were complicated and took a long time. The Food Database Search seems quite complicated and inconvenient to search everything, such as their calories on the Internet and then type in the data on the Fitbit App.

The third concern was about the motivation supported on Fitbit App. There are several methods for giving people motivation, from awards and feedback. However, it is focused on the activity function. The viewing progress toward the user goal was motivating, but the social function that enables users make friends in order to motivate and encourage each other seem questionable, for how much could strangers influence each other? The badge awarded at the completion of the goal is also questionable, for how much could it affect users to change their behaviours?

3.3. Method

“Traditionally user diaries are paper based, but research has been done with use of digital diaries or mobile phones” [25]. Qualitative research of the diary study conducted in this research confirmed for two weeks for context usage period by the user since the first usage of the Fitbit app was able to achieve this outcome.

The online Diary method used in this study is applied to the two weeks from the moment users download Fitbit App and sync with its device. An induction is given to familiarize the new user with the device before actively using it.

3.3.1. Participants

Five participants were selected for the diary study. The criteria for selecting participants include people who were interested in new gadgets but with no previous experience with Fitbit Flex. They were required to write the diary every day while wearing the device, and they should be involved in the experiment.
The participants were recruited by verbal contact and e-mail. After the intention of the experiment participation was confirmed the five participants were chosen from among the applicants who responded. All of the selected participants were highly interested in the sleeping pattern function of the product. Two of the participants were interested in losing weight for health by the activity monitoring, and the other three were interested in the motivation of the health management, increase in activities and improving quality of sleep.

The age of the selected five participants ranged were from the mid twenties to the early fifties, and the two were female and three were male. Three were employed in full-time, one of them self-employed, and one was graduate student. During the experiment, the participants were required to inform the indoor activity and outdoor activity. All the participants were experienced with the Internet and smart-phone and had a high level of interest in using new gadgets.

The reason for choosing this method is that digital tools can be accessed more conveniently by participants who are proficient for online experiences and it is a convenient way to convey real-time experience.

All participants had extensive online experiences and were very interested in health management. For such participants, digital tools like online diary were easier to access. All participants were positive about this e-mail diary feedback. Participants not only were interested in the new device, but also were also concerned about health management. Some who were planning to purchase this device supported very actively in this study.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Gender</th>
<th>Age Range</th>
<th>Occupation</th>
<th>Using platform</th>
<th>Online Experience</th>
<th>Product Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>M</td>
<td>35-44</td>
<td>Director</td>
<td>Android</td>
<td>High</td>
<td>No</td>
</tr>
<tr>
<td>P2</td>
<td>F</td>
<td>18-24</td>
<td>Worker</td>
<td>Android</td>
<td>High</td>
<td>No</td>
</tr>
<tr>
<td>P3</td>
<td>M</td>
<td>25-34</td>
<td>Worker</td>
<td>iOS</td>
<td>High</td>
<td>No</td>
</tr>
<tr>
<td>P4</td>
<td>F</td>
<td>45-54</td>
<td>Online business</td>
<td>iOS</td>
<td>High</td>
<td>No</td>
</tr>
<tr>
<td>P5</td>
<td>M</td>
<td>25-34</td>
<td>Graduate student</td>
<td>Android</td>
<td>High</td>
<td>No</td>
</tr>
</tbody>
</table>

TABLE 2. Characteristics and capabilities of participants.

3.3.2 Setting

There are many kinds of online tools that are easy to access with the Internet. The additional online tools were provided to collect real-time feedback and were deemed a convenient way for each user to choose an accessible tool. It is not obligated optional tools and it is not obligated, according to the activity condition of each participant, the problems or feelings from the use of could be recorded and sent. Examples of these methods are Email, Blogger and Evernote. The
participants sent the feedback to the researchers through their selected method and also sent the diary every day via e-mail.

**E-mail.** It is the most accessible tool for computer, mobile phone and any digital device with access to the Internet. The participants could send their idea or feeling anytime to the researcher via e-mail, in addition to the end-of-the-day diary. Sending feedback via e-mail was the most common online method among the participants in this project.

**Google Blogger.** This site is the blog site developed by Google, which can be used anywhere that has web access and mobile app. Participants could write the feedback on the ‘group blog’. One participant shared the idea though accessing the blog. For example, one of the participants said, “I am thinking it should be possible to implement another function using the five lights through a single tap. For example, stopwatch which is all lights on, one blinking light moving steadily progressing from left to right.”

**Evernote.** This is a free online service equipped with functions of camera, recording, and writing, available on many platforms such as MAC, Windows, Android, and iOS. One participant sent half of the diaries in two weeks through Evernote.

**Supports for remembering**

During the diary study, it was important to encourage the participants to write the diaries continuously. At the first meeting, several participants suggested that it would be better if the guide questions were provided. For example, after the first day of using the device, the questions such as “How was the synchronizing procedure for the first using of product? How do you feel about the one-day wearing? What is your comment about the first using of the app and UI?” were included in the diary form.

In the diary form sent for the users, two to three questions were included to encourage them such as what was your expectations with each function, how many times have you checked the App? For example, the e-mail containing the questions reminded them of diary writing and diary study procedure. The participants gave this positive feedback because it was helpful as a guide to write the diary. About the continuous encouraging messages, one participant said, “I was reminded due to the daily diary form.”

3.3.3. Materials

**1) Fitbit Flex device**

This is blue gray colour and all includes charge, sensor and bend.
2) Profile form

Participants completed a background questionnaire. The background questionnaire requested demographic data such as age, gender, occupation as well as Internet use. It also included demographics questions, scales assessing their perceptions etc. (see: APPENDIX A)

3) Consent form

Before starting the diary study, participant signed the consent for gathering data to be used in this report. (see: APPENDIX B)

4) Satisfaction questionnaire

This questionnaire (see: Appendix C) is usage feedback about the product satisfaction in a Liker scale after finishing the diary study. This was done in one-to-one interviews after finishing the diary study and the questions were about general layout, navigation, and presentation about Fitbit application. The result from these questions are discussed in CHAPTER 6.2

5) Interview questionnaire

“Questions that imply a specific answer or the correct response or that influences participants to answer in a certain way. Ideally, questions are simple, neutral, and open ended.” [22] The questions were simple and also related to using Fitbit app and device. (see: APPENDIX D)

3.3.4. Ethics

The diary study was carried out in accordance with the Ethics: Guidance and procedures for undertaking research involving human subjects [26]. “Every research project involving human subjects should be preceded by a careful assessment of the predictable risks in comparison with foreseeable benefits to the subject or to others. Concern for the interests of the subject must always prevail over the interests of science and society”. [26] Therefore, all subject in this study met these criteria.

All participants were requested about their physical problems, risk for wellbeing and other issues during investigation before starting the study. All participants’ anonymity in study and their name were omitted from the research. Regarding privacy, anonymity, and confidentiality.

Information sheets about this research were offered to participants in meetings before diary studies and all participants signed a consent form. Include the research materials were used only for the goal of this study and all datas was stored by participant number.
3.3.5. Data Collection Procedures

The participants had the first group meeting before the diary experiment started, in order to understand about the experiment. After the experiment began, the participants were wrote and sent diaries every day.

1) Kickoff meeting

Before the beginning of the study, the participants were invited for the understanding of the Fitbit Flex product. The study was investigated of the participants’ profile, and signing of the informed consent from for the data to be used in this report.

1. The diary study overview was explained by the researcher to ensure participants could invold the study.

2. The Participants were informed of the objective, risk, and benefits about the study procedure, signed on the consent form and wrote the participant profile questionnaire (see: APPENDIX A).

3. Fitbit flex devices of the same color (gray) were delivered to the participants.

4. The participants downloaded the Fitbit app and were told about how to use the product.

5. All participants were requested what were their expectations, what was their porpoes of using Fitbit App?

2) During the online diary study

The diary study was carried out for two weeks. During each day by the participant, the researcher obtained each participant's diary. The online diary collected data on user experience with Fitbit App.

The participants wrote about their goal after being informed what the product is. The function of most interest was the monitoring function of sleeping pattern that is a new function, in which the restless and awake during the sleep or sleeping time were measured. Users with previous experience were excluded in order to collect feedback from the users in the same condition. Motivation from seeing more LED lights can remind the user how much he/she worked and to congratulate on the achievements.

3) One to one interview

After the diary, the participants were interviewed one to one interview. All the contents of the interview were recorded after the participants’ agreement. The interview was prepared in a way where users can naturally talk about their experience. (see: APPENDIX D) One to one interview was held with the user in a comfortable place after finishing diary study. Details from the interviews had many recurring points so analyzed details are presented and discussed in Chapter 4.
4. RESULT

4.1. Summary of overall findings

For general evaluation, users were satisfied with the UI part of the application’s main dashboard. Colour changing according to activity level and activity graph and tracking using numbers showed satisfactory results but there was a mention of the lack of general feedback functions.

The result from the post-diary entry questionnaire was generally positive feedback; Activity a category and UI on the main page was intuitive and clean. However, sleep and food categories were considered the negative sides of the App. Particularly, sleep monitoring was overall the most unsatisfactory function which needed improvement visually and to provide feedbacks for a better sleep.

The project is evaluated each functions of existing Fitbit App. There are overall findings was about wristband device and the App from the user research. It is not only important to concern about the Fitbit App experience but also think about the wristband device for evaluating the Fitbit App because they are related each other to give user unique experiences.

4.1.1 Wristband device

Most participants had favourable opinions on the wristband device. One of them said, “It is very light and is good that it is waterproof.” However, one participant stated that “the more I use it, sometimes it is uncomfortable”. Vibration and lights that increase every time the user achieves every 20% of the target goal were deemed positive by all participants were positive about this new experience. Particularly, all participants provided the same feedback that this motivates their activity. Moreover, when the morning alarm is set in Fitbit App, the wristband vibrates three times at the set time, which all the participants were greatly satisfied with. Because the vibration alarm is coming from the sensor wrapped under the rubber material, it was quiet and this did not disturb the person sleeping next to the user like the users’ wife or husband and etc. Therefore, the vibration alarm received positive feedback.

4.1.2. Data Analysis.

The data from online diary entries and the face-to-face interviews were analyzed. The analyzed data are summarised below TABLES with the issues of usability from the diary study and interview. Each issue was classified to positive and negative and how many participants had the same experiences and quality of use were represented. The following is the table
Usability Issues about six functions on the app

The following is the summary of the comprehensive review from the diary study and interview.

- **Positive and Negative**: This indicate what kind of feedback from the participants
- **Number of participants** (N.P): How many participants agree with the issue
- **Quality of use**: What kinds of issues are there

**Activity Category**: All the participants were satisfied with the function. “Because the activity part consisted of number and graph, I could understand my work easily.” However, the detailed contents and accumulated data of the activity did not increase the value. Even though participants were satisfied with the function, there are some issues in terms of how present the graphs and usabilities. A user using iPhone said, “It is seen as not optimized to the phone screen. There is too huge space though the phone screen is not so huge.” In addition, when the user feels difference of the step played the app and actual movement, the reliability of app data decreases.

<table>
<thead>
<tr>
<th>No</th>
<th>Positive and Negative</th>
<th>N.P</th>
<th>Quality of use</th>
<th>Findings and Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Negative</td>
<td>3/5</td>
<td>Reliability</td>
<td>Sometimes, the step count is not accurate on main dashboard For example, “When checking the amount of activity in the app, “I want to know about the criteria of measurement on the step count.”</td>
</tr>
<tr>
<td>2</td>
<td>Negative</td>
<td>3/5</td>
<td>Learnability</td>
<td>There is no information on the difference between steps and active minutes. For example “ I would like to know the measuring criteria. It is ambiguous “</td>
</tr>
<tr>
<td>3</td>
<td>Negative</td>
<td>3/5</td>
<td>Flexibility</td>
<td>There is empty space in the detail page. (See FIGURE 6-(a))</td>
</tr>
<tr>
<td>4</td>
<td>Positive</td>
<td>2/5</td>
<td>Simplicity</td>
<td>It shows that the visual on the main dashboard are easy to understand. (See FIGURE 5)</td>
</tr>
</tbody>
</table>

**Weight Category**: Most participants did not often use the ‘weight’ function. The feature contained terms, graph, and numbers that were hard to understand because of options like
Weight, Lean vs Fat, BMI. Even when a user selected one of them, the user could not understand the information and did not know how to use the information. Two participants said, "I cannot understand what it means precisely on the graph." Another opinion from participant was that: "I don’t measure the weight due to not having a scale and if I do, it bring me down, and I don’t get motivated." Although the weight function is useful for managing health, it might be depressings information to people who are sensitive about weight information.

<table>
<thead>
<tr>
<th>No</th>
<th>Positive and Negative</th>
<th>N.P</th>
<th>Quality of use</th>
<th>Findings and Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Negative</td>
<td>2/5</td>
<td>Learnability</td>
<td>The graphs are not easy to understand because the numbers on the function are unclear the numbers on the function and there is no information on how to interpret the chart (See FIGURE 7-(b))</td>
</tr>
</tbody>
</table>

TABLE 4. Finding issues of Weight category

**Exercise Category:** This function can only be used in iOS, so only two participants who had the platform could use it. Both participants gave the researcher positive feedback in that they can see the distance on the map by GPS. However, the options for the exercise can only be set as running, walking, and hiking, so there is a limitation of selection. One of the two participants who use iPhone said during the interview, "I could select neither Run nor Walk when I walked fast." Because there is no information on how the active minute function is measured, the understanding of measured data was different to the users’ expectations.

<table>
<thead>
<tr>
<th>No</th>
<th>Positive and Negative</th>
<th>N.P</th>
<th>Quality of use</th>
<th>Findings and Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Negative</td>
<td>1/5</td>
<td>Flexibility</td>
<td>Although users might want to measure their exercise such as yoga, swimming and cycling, there are just three options for exercise, so the user cannot exactly measure exactly their exercise.</td>
</tr>
<tr>
<td>2</td>
<td>Negative</td>
<td>2/5</td>
<td>Learnability</td>
<td>At the first use after downloading, the meaning of colour and button is vague due to the absence of basic using instruction. (See FIGURE 8-(a))</td>
</tr>
<tr>
<td>3</td>
<td>Positive</td>
<td>2/5</td>
<td>Compatibility</td>
<td>It is a useful for finding locations on the map</td>
</tr>
</tbody>
</table>

TABLE 5. Finding issues of Exercise category

**Food Category:** This was another area where most of the participants have complained about because the database is insufficient. Since there is a lot of data, the participants needed to check their activity lists. According to a man who is managing his weight, it takes time to find a
food list. Also, another participant said that he does not have any idea on cookies and it turns out to be awkward to enter data. Another participant said that he was really confused when he tried to cook other cultures food at home. Since I do not know how to type new food names and their calories directly, it was uncomfortable.

**Suggestion:** Users suggested ideas for Food function, as they felt uncomfortable whilst using it. For example, “There is the ion drink that has high calories. So it’s better to include different drinks in the app." One of participants said, “I hope there can be a function where automatic calories calculation is possible when food and its weight are entered. I ate one pack of strawberries 400g and tried to record it but found that I had to record manually which made me to search for its packing again and checked it is written as 100g=30kal so I recorded with my own calculation”

<table>
<thead>
<tr>
<th>No</th>
<th>Positive and Negative</th>
<th>N.P</th>
<th>Quality of use</th>
<th>Findings and Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Negative</td>
<td>5/5</td>
<td>Simplicity</td>
<td>It is complex to find and enter the food to be eaten for the calculation of daily calories consumption.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>“Entering food data is difficult. It is good way of making simple about function.”</td>
</tr>
<tr>
<td>2</td>
<td>Negative</td>
<td>3/5</td>
<td>Compatibility</td>
<td>In the log food function, It is a difficult to find new food or unique food. There are only food databases for a few countries in ‘Log Food.’ It is hard to find other foods besides the four countries. <em>(See FIGURE 9-(b))</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>“When I ate unusual food, it is not searched and I should enter the data by myself, but I don’t know how to find it which is frustrating.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>“When finding food, there is a limitation to find the food actually eaten because there is food whose calories are fixed for each famous restaurant.”</td>
</tr>
<tr>
<td>3</td>
<td>Negative</td>
<td>1/5</td>
<td>Compatibility</td>
<td>The bar code is not working properly. It is useless because it cannot find food. <em>(See FIGURE 9-(a))</em></td>
</tr>
<tr>
<td>4</td>
<td>Negative</td>
<td>1/5</td>
<td>Compatibility</td>
<td>When the midnight is passed, the user cannot record the food, that is eaten earlier in the day.</td>
</tr>
</tbody>
</table>

**TABLE 6. Finding issues of Food category**

**Water Category:** It received positive feedback from three users. The entering method of the water consumed was convenient and interesting. One participant said, “The amount of water filled in the image graph according to the water drunk was interesting and simple.”
<table>
<thead>
<tr>
<th>No</th>
<th>Positive and Negative</th>
<th>N.P</th>
<th>Quality of use</th>
<th>Findings and Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Positive</td>
<td>3/5</td>
<td>Simplicity</td>
<td>The navigation is easy and simple. (See: FIGURE 11)</td>
</tr>
</tbody>
</table>

**TABLE 7. Finding issues of Water category**

**Sleep Category:** All participants said that the sleep function is novel and interesting. One participant described the feeling of the first use in their diary, saying, “I was excited that could check my sleeping state after waking and I was satisfied with it.” Another participant said, “The data of the sleeping state is interesting and new as I did not have experience before.” However, participants wanted to gain more valuable information and feedback about their real conditions. In the diary study, one participant complained about sleep monitoring, “I had 2 awakes and 11 restless. What now? Is it good or bad? How can I improve it?”

**Suggestion:** Most participant suggested ideas for the sleep function, they need to gain some information for improving their sleep pattern from the monitoring data. One of participant said, “it is a more efficient to recognize the time that the partten graph on the Fitbit App looks like watch time like dashboard on PC version.”

<table>
<thead>
<tr>
<th>SLEEP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>

| 31 |
4.2. Post Questionnaire Results

It is the Liker scale result about the participants’ experience about Fitbit app after the use of Fitbit Flex. This question means the measurement of the overall expectation about the product use. The questionnaire was used a Likert scale point 1 to 7, disagree to agree.

Participants generally responded that they enjoyed using the Fitbit app. They were mostly satisfied with the main dashboard actigraphic, activities information displayed, and intaken of water. Based on the results from numbers 6 and 7, the satisfaction of participants about UI was high.

Looking at the satisfaction of each function, the satisfaction about activity, weight, and water function were higher, but the sleeping pattern and food category function were lower. Considering the feedbacks of participants on the two functions from the diary study and interview, the sleeping function had no information influencing the users behavior than the expectation and only provided the basic pattern, and this resulted in the decrease of the users satisfaction. Food function can be the result of successive inconvenient experience to search the food eaten due to the absence of a satisfactory food database.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Mean</th>
<th>Mdi</th>
<th>Mod</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I enjoyed using Fitbit App</td>
<td>4.6</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>2. The application was easy to navigate</td>
<td>4.6</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>3. It was easy to find the information that I needed</td>
<td>4.2</td>
<td>4</td>
<td>4,5</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>4. I was satisfied with the information displayed</td>
<td>4.2</td>
<td>4</td>
<td>4,5</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>5. The date on the application was easy to understand</td>
<td>5.0</td>
<td>5</td>
<td>5,6</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>6. The application was visually well laid out</td>
<td>5.2</td>
<td>5</td>
<td>5,6</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>7. Each icon was clear and understandable</td>
<td>5.0</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>8. I was motivated by the results displayed in the application</td>
<td>5.6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>9. I was satisfied with the information displayed under the ‘Activity’ category</td>
<td>6.2</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>10. I was satisfied with the information displayed under the ‘Weight’ category</td>
<td>4.2</td>
<td>4</td>
<td>4,5</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Questions</td>
<td>Mean</td>
<td>Md</td>
<td>Mod</td>
<td>Max</td>
<td>Min</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>------</td>
<td>----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>11. I was satisfied with the information displayed under the 'Sleep Pattern' category</td>
<td>2.4</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>12. I was satisfied with the information displayed under the 'Food' category</td>
<td>2.6</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>13. I was satisfied with the information displayed under the 'Water' category</td>
<td>6.0</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>14. I would recommend this application to others</td>
<td>5.0</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

TABLE 9. Participat data for user experience using scale 1 to 7

The following graph represents the mean value of the satisfaction about the five functions shown in the table based on the as a result of the satisfaction questionnarire. Apparently, the graph shows the Activity function received the highest satisfaction, closely followed by the Water function. The function to receive the lowest satisfaction was The Sleep function, although this was only considered marginally worse than the Food function.

FIGURE 17. The mean value of the satisfaction on Fitbit App

The result of yes and no questions about the change of expectation is shown below. All participants showed high levels of expectation at the interview before using the product. After using the Fitbit App, four participants responded that the expectation decreased at the question of “Has your expectation changed since using Fitbit App?” and only one participant responded ‘No’. As the participants who had high expectation experienced the inconveniences (e.g. sleeping and food function) while using the device, they responded that their expectation had changed. The main reason for this is that, although expectation from new products was high, it lowered as time passed due to the lack of feedback and motivation from the products. A participant, who was filling up satisfaction questionnaire during an interview, said that it was
disappointing to see that the sleep function merely showed vague pattern graphs. This led to the user losing much of his expectancy of that app.

<table>
<thead>
<tr>
<th>Expectation</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has your expectation changed since using Fitbit App?</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

TABLE 10. Expectation Questionnaire after using Fitbit app

To the question ‘After using the Fitbit App, which is the most satisfactory function?’ all participants responded that they were the most satisfied with the function on the activity. The reason was because the graph on the main board is simple, and can be readily verified as numbers. They were able to check their activities in real-time using the App, and it was accurate.

However, in response to the question ‘After using the Fitbit App, which is the most unsatisfactory function?’ two participants stated that they were the most unsatisfied with the Food function, and three stated the Sleep function. They were unsatisfied with the Sleep function’s such simple pattern, which did not meet their high expectation of the Sleep function and the purpose of using Fitbit. For example, “it was fun in the beginning when the Sleep function was checking my sleep state while I am sleeping, but I lost interest as I continued to use it, because I was not able to analyze the data on whether my sleep state is healthy or not.”

FIGURE 18. Result of Satisfaction Questionnaire

4.3. Issue: Sleep Function

Complaints were the highest for the sleep function and the next thing is the food function according to the result. For the food function, the main complaint was the insufficient database,
which did not recognize certain foods when users entered them, while the sleep function was considered to be poorly designed as it had only limited information. Most participants want to gain valuable feedbacks and informations from the App.

The sitemap (see: FIGURE 19) is a visual representation of a screen structure in Fitbit App for sleep monitoring. The navigation is simple. However, it does not navigate efficiently for presenting sleep-monitoring data. For example, even though there is information about one week one month, three month and one year, it needs to consider that users want to check their previous data. This is a sitemap for sleep monitoring on existing Fitbit App.

![FIGURE 19. Sitemap for existing Fitbit App sleep function](image)

4.3.1 User interface Issues
Participant's entries in their online diaries and their feedback in the face to face interviews brought to light six main issues with regards to the sleep function. The flowing from the (see: FIGURE 19). The six issues are as follows:

1. The graph is unclear.
2. Although it is possible to add a sleep log, there is no capacity to show the graph for a second time. The gray background is no meaning.
3. It does not show information effectively. It is an almost same information previous page.
4. The time is unclear on the sleep pattern graph.
5. It is unclear to check the detailed information the number of right side on the page.
6. The colour of the time asleep is confuse because the bar color is Restless in main sleep page.

![FIGURE 20. Issues of Sleep monitoring function](image)

4.3.2. Functional Requirements

From the diary study it was evident that all participants wanted to know details about their sleep pattern, such as whether it was good or bad and how to improve their quality of sleep. The participants suggested that want to know information about healthy sleep. Therefore, the new design App will add a Feedback and a coaching function, with attention to effective visualization on the Fitbit sleep pattern App.

4.4. Design Recommendations
Design problems and solutions based on user feedback provided in the diary study and interview will be discussed in this section to address the design problems. As seen in previous result, in the Sleep function, which is the weakest function in Fitbit App, there were following UI issues, feedbacks to improve sleep quality, and user needs on sleep-related information. In this section, detailed application plans to design the App will be discussed.

4.4.1. Navigation

The sleep function is not complicated structure. However, it is not efficient in finding data that shows the restless and awake stages during the sleeping time as a bar graph. The issues related to the navigation of the Fitbit App.

4.4.2. Presentation

Fitbit’s sleep monitoring function just shows the user’s sleep pattern and track-accumulated data. As seen in the result, the sleep monitoring function in existing App had the most issues with the graphs. For example, some of them were, how easy the user acknowledges the information on the graph, how easy the user can find the desired information on the graph, or how effectively the graph displays the accumulated data. Therefore, the presentation of pattern graphs should change to a more effective method for redesign.

4.4.3. Motivational Support

This function considered the information provision to improve the quality of sleep based on the feedbacks from the participants in the diary study, and the support in motivation to create health sleep pattern. By referring to the user motivation function in research competition section, it provides feedback function and sleep-related information to remind users of better sleep habit.

- Provide options to select and make target for when and how much sleep will be taken
- Give messages and feedback to motivate target sleep goals
- Provide information about health sleep.
- Sleep coach for improving quality of sleep

4.5 Persona
“A persona is a representation of the goals and behaviors of an actual group of users. They are derived from research with real users, so they have a strong grounding in fact. A set of detailed understanding of real people.” [27]

A persona is a typical target users based on research. When designing user experience, these personas were basic models of actual target users based on user research. Persona is valuable in deciding the priority in the new function or the design of the App to be designed. For example, things like whether the function is useful for the target user group or what is the most needed function can be considered.

The target user for the Fitbit ‘ZZ’ App has a Fitbit device were all interested in using new digital devices and sleep monitoring. They wanted constant motivation to manage their healthy sleep an important aspect of health management. The personas for Fitbit ‘ZZ’ App are represented target users based on the diary study and interview gathered datas from the participants. There are potential users such as Light user (see: FIGURE 21), Middle user (see: FIGURE 22) and Heavy user (see: FIGURE 23) for using Fitbit App ‘ZZ’

**FIGURE 21. Persona light user for Fitbit ‘ZZ’ App**

Jane

Potential personal type:
Light user

Gender: Female
Occupation: Marketer
Age: 29

“I am curious about my sleep pattern during the sleep time”

Jane has worked IT company as marketer. She is very interested in new goals and enjoys new challenges. She is skilled at using digital devices. The IT Company she works for has allowed her to get used to recent new technology and to read articles about wearables devices. She is worried about not exercising as much as she would like, so thinks it would be great if she could be motivated while using the device.

Recently, she met a best friend. Her friend mentioned using the Fitbit device and, hearing feedback about it, she was interested in the sleep monitoring aspect. She is influenced by her sleep environment easily. She could not sleep very well, when stressed, or when she has a lot on her mind, and since she occasionally suffers from the insomnia, she wanted to try using the sleep-related applications. She also thinks it would be nice to get feedback or coaching on how to increase the quality of her sleep.

Motivations:
- Curious about the her sleep monitoring
- Wants to manage her sleep pattern
- Needs to have some feedback about her sleep

Health condition:
- She is sensitive about her sleep environment
- She get stressed easily

Education Background:
- BA, MBA degree, Studied Marketing

Fitbit Flex Device: Has one

Technology

[Graph showing technology features]
FIGURE 22. Persona middle user for Fitbit ‘ZZ’ App

David
Middle user

Potential personal type:
Middle user
Gender: Male
Occupation: Director
Age: 38

“He needs to get motivated toward healthy sleep behaviour”

As well, lately he has often thought that he needs to manage his health better. This is because on many days he sits at his desk at the office without moving much while working, so he always feels tired. However, he knows he is not managing it properly, so he would like to be more motivated. He thinks he can be motivated toward healthy sleep behaviour by checking to see precisely how deeply he sleeps and how many times he wakes and being able to set times to go to bed and wake up to keep reminding him while helping him manage his sleep.

Motivations:
• Wants to improve his weak body condition
• Wants to improve his quality of sleep patterns
• Needs to check his different sleep patterns

FIGURE 23. Persona heavy user for Fitbit ‘ZZ’ App

Susan
Heavy user

Potential personal type:
Heavy user
Gender: Female
Occupation: Businesswoman
Age: 50

“I would like to overcome my irregular sleep habits for a healthy life”

The first day she has had Fitbit, she downloaded and used the device’s sleep app. For several days she was very tired and did not wake up refreshed, and she noticed from the sleep log that she had almost never fallen into a deep sleep. She often woke during the night, and when checking data accumulated over several days, she saw that the difference between the time she was in bed and the time she slept was significantly different every day. She feels she needs to put more effort into keeping set sleeping hours in order to achieve healthy, regular sleep.

Motivations:
• Wants to manage her weak body condition
• Wants to manage her irregular sleep habits
• Needs to have advice when she cannot sleep well
5. DESIGN

5.1 iOS design style guide

Before designing, this design pattern guideline provided the basic patterns to consider the general direction in how the UI will be designed and how the layout and navigation will be designed. iOS and Android in fitbit App are the same touch screen based interaction such as App icons, gestures and functions on section 2.2.4. Fitbit App on iOS and Android platform. The designing the prototype was created based on the most recent iPhone five models iOS style guide [28].

5.1.1 Navigation

The user experience can be provided in three navigation methods in iOS. Such as Hierarchical, Flat, Content or experience driven. Overall, the structure in Fitbit App is used most Hierarchical method. The structure is helpful in designing mails or setting options. However, if the design requires multiple pages, the increased interactions for input may bore the users. As finding from result, it was inconvenient to users. Therefore, the new sleep App will use Flat information structure. As seen in the previous result, providing information in multiple pages bored the users. Thus, a flat structure was used so the activity can be done in one screen.

The Status Bar

The status bar displays base information about battery, times, signal the device and the current environment. It always appears at the upper edge of the screen.

![Carrier](Carrier.jpg)

FIGURE 24. The status Bar

Notifications

The Notifications view displays recent notification items from Apps that users are interested in. It is useful function for Fitbit App.

5.1.2. Interactivity and Feedback

Gestures need to be understood for the interaction with the new App on a screen. Users try already-experienced gestures after looking at the App icons or page format, even before they think of what kind of gesture to make.

- Tap: To press
5.2. Redesigning of the Fitbit Sleep Monitor

The design was created based on the insights from the previously reviewed research that looked at the sleep monitoring function and motivation function, user feedbacks from design evaluation, and suggestions.

People need varying amounts of sleep, but most sleep professionals, as well as NHS, recommend that adults need eight hours of sleep each night to feel rested and have full cognitive functioning during the day, with younger individuals tending to need more [30]. A new trend uses more sophisticated alarm clocks that wake users when they are in the light sleep phase, which is presumed to be a more restful way of waking.

The goal of the UI was ease of use without the need for a special manual for users in order to resolve the issues discovered, and the app was designed with easy navigation and an intuitive interface using icons. Therefore, users can effectively monitor sleep, and the app can guide their changes in behavior to develop healthy sleep habits through its feedback and coach functions.

5.2.1. Designing the Logo

Since the logo is an image representing the brand, the most effective type of logo will be one that is easy for users to recognize and remember.

The name of this new App is Fitbit ‘ZZ’. It represents the sound people make when they are sleeping soundly. People write these letters when they want to express sleep, and they are familiar to people as something that instantly reminds them of sleep. This name makes it quick and easy for people to recognize this as a type of Fitbit App for sleep monitoring.

This is the Logo page screen when user downloads and opens the sleep App. The background with its gradations of dark blue and the dot pattern in the shape of a star symbolize the night sky. The App's logo is shown in the middle. The Fitbit logo is at the bottom to show that it is a Fitbit App. This screen is displayed for about 1-2 seconds, and then the App moves to the next screen.
FIGURE 25. Sleep Monitoring App Logo ‘ZZ’

5.2.2. Designing the Structure and Navigation
Fitbit ‘ZZ’ has features to increase the quality of sleep through an App that links with Fitbit Flex. After swiping on the main screen, it shows another screen with a features list. The menu list consists of eight features appearing on the main screen (see Figure 27-(3.0)), which shows an actigraph of the user’s sleep status.

There is a registration process (see: Figure 27-(1.0), (1.1), (1.2)) when Fitbit ‘ZZ’ is first downloaded. It was designed so users could enter their personal information to register or simply sign in quickly and easily using Facebook. Since one of this App’s characteristics is its sleep monitoring by linking with Flex, a synchronization process is needed to start using it. This process only takes place the first time the App is used, and when registration and synchronization are complete, the logo screen is displayed starting the second time the App is opened and users are taken directly to the main screen (See: Figure 27-(3.0)). As mentioned above-, this navigation is selected Flat navigation that is an efficient structure to find data for the new App. The navigation design major concerned how easy it is for the user to navigate when they find their monitoring data or are using any functions.

FIGURE 26. Sitemap of Sleep Monitoring Fitbit ‘ZZ’ App

5.2.3. Designing Presentation of sleep patterns
From the result that there were problem the monitoring graph was redesigned in this section to display information more effectively to the user. Also, these newly designed functions are explained.

To resolve issues that had been problems with previous Apps, a new App was proposed. Functions included in this App were designed based on all issues discovered as well as users' needs.

This App was redesigned to use a method more recognizable to users than the monitoring pattern graph from the previous app to better monitor sleep and support sleep activities.

As well, the App was designed to give coaching information and set sleep time goals for more regular, healthy sleep activity, and users can receive feedback.

The existing App only provided the sleeping pattern of restless and awake states in graphs, and a review of accumulated data. As seen in the research result, the sleep function called for user needs in UI usability issues, and feedbacks and coaching functions for healthy sleep activity. Therefore, the proposals for a redesigned App included a new UI and functions to solve these issues. We will now consider each function and user-interaction.

By swiping to the right on the main screen, (a) appears, and by swiping left, (b) appears. Features includin are Trends, Power Nap, Sleep Mode and Coaching. First, if "Goal" is selected from the list, the selected area changes color while the page over the right side of the list spreads out toward the left. The sleep target can be set above the clock on this page. The recommended sleep quantity and time slot are set at first. Users can move the settings bar above the screen using a finger. This settings feature lets users set goals to suit their own condition and schedule, and there is an individually tailored motivation feature so users can compare their target with their actual sleep. Users can move toward a more regular lifestyle by using this function.
FIGURE 27. Interaction on main page
1) The Sleep monitoring pattern Data on the Main Screen
The Major problem is the pattern graph on existing Fitbit App. The target sleep time and actual sleep time appear together on the main screen. Participants in the diary studies suggested that it would be easier to understand sleep patterns shown on an actual clock form instead of in a line or bar graph. Using a clock may be a more familiar method to users as this method allows them to quickly recognize time. Time slots and amount of sleep, difficult to see in previous Apps which showed sleep patterns, were more effectively understood using this method, and so a clock shape able to intuitively show them was designed.

In other Fitbit Apps, only information on restlessness during sleep and waking was provided, but in this new App, sleep goals can be set to motivate users and the recommended basic default sleeping time of eight hours can be compared with actual sleeping time. According to Dr. Verma, it is not just the amount of sleep that matters for healthy sleeping habits, but also regular times for going to bed and rising [8]. Users can set their target sleep times, but can also compare their sleeping patterns according to recommended amounts.

**PROBLEMS:** The sleep-pattern graphs in the Fitbit App are not very effective for recognizing the time when the user was restless or awake.
Checking the collected data is also not an effective method for comparing the data.

**SOLUTIONS:** Changing the pattern graphs more effectively.
A. The quick Menu: It contains the most features from the participants in the diary study. Tapping on the quick menu unfolds the Menu list.

B. This shape displays the target sleep time slot to inform users of their set waking and sleeping times.

C. These numbers show a percentage to make it easy for users to know whether or not they have reached the target sleep quantity they have set.

D. Like B, this is a display indicating the target waking time.

E. The user can see how many hours they have spent in deep sleep. They can check that sleep quantity through a circular clock.

F. This lets users know how much they have awakened during sleep.

G. If the left arrow is tapped, it shows sleep patterns on past days and the present day. The right arrow can be tapped to return to the present, when checking past data.
H. Dark blue represents sleep, light blue represents light sleep, and pink represents waking patterns. The centre shows the total sleeping time.

2) The Sleep pattern collecting Data

Accumulated sleeping data displayed for awake/restless time was not effectively displayed in the current Fitbit App’s graph. For example, if asleep and awake data options were selected on the same day, each was displayed on a different screen. If a user wanted to know how much they had slept or been awake the previous day, they needed to go back and forth between the two pages to check. However, in this new App, accumulated data appears simultaneously on the same screen, so it can easily be checked all data.

A. This feature can be used to check past sleep data. If sleep trends are tapped on the menu list, each daily sleep pattern from among the collected data is displayed. Users can check by week or month.
B. Previous apps showed restless and awake periods for dates and days, and the graph size was increased to make it easier to recognize data for each day by bringing it to the centre of a sequence of days with a left-right swipe.

C. Shows the detail, such as Deep sleep, Light sleep and Awake

D. The graph presents three of information

E. If the graph is started center. The graph show detail information

5.2.4. Designing Motivational Support

1) The feature of Sleep Coach
This feature contains information about how users can improve the quality of their sleep. The user can click on the information category they want to see. The NHS developed this information with reference to the recommended qualities of healthy sleep [29].

![Image of Sleep Coach on Fitbit 'ZZ']

FIGURE 30. Sleep coach on Fitbit ‘ZZ’
A. Information title
B. Sleep information is continually updated in the app.
C. This is sleep-related information. It is information that anyone can easily understand about how to sleep, healthy sleep habits, sleep environment management, etc.
D. This icon allows users to share information related to their sleep on Facebook or via email through the sharing function.

2) The feature of Target goals
The newly added features can provide motivation toward healthy sleep habits. Target sleep quantity and times to go to sleep and wake up can be set. These target values are initially set as the recommended eight hours of sleep and recommended times. Users can set their own values, while information about recommended sleep quantity and times is on this page. Furthermore, if the healthy sleep behavior button is activated within the Sleep Coach function, a text message about recommended sleep times is sent.

Users can use a finger to drag the target values above the clock to move the bar indicating the time. The red point represents the time to go to bed and the blue point represents the time to wake up. While the user drags to set the time, the set time appears below the clock. The numbers displayed for this time change according to the value set by the user. When users set their goals, they can use with one finger. Drag the point of the indicator and the amount of the graph colour changes.

FIGURE 31. Interaction on the taget Goals Screen on Fitbit ‘ZZ’
A. Cancel button: Users can tap to cancel if they have incorrect entered settings or do not want their target settings.

B. Users can touch and drag this small bead to set target sleep time. D and H automatically change to reflect these movements.

C. Users can drag this bead to set target waking time.

D. It shows wake-up time.

E. If this feature is activated, the device vibrates when it is time to wake up.

F. If target time setting is complete; tap the F icon to save set targets.

G. It shows a sleeping time.

H. Taget sleeping time.

I. Sleeping time.

J. Save the taget goals.

FIGURE 32. Taget goals screen on Fitbit ‘ZZ’
FIGURE 33. Redesign Screens
Other features on new sleep monitoring ‘ZZ’ App

Home
The Home feature returns to the App's main page. Users can view the App's functions on the left by tapping the menu list on the upper left of the main screen. Users can tap their desired function and be taken to the appropriate page and can and can tap the home button to return to the main screen. Users can navigate between pages by swiping, but returning to the main screen after using a function from the menu list by tapping the button is faster and more intuitive.

Sleep Mode
This function is used when setting Sleep Mode in the Fitbit App. To set Sleep Mode, users can tap the settings button on the Fitbit App or tap the device display several times to set Sleep Mode automatically. The fitbit ‘ZZ’ Sleep Mode settings can be set using the similar interactions as those used for the device. However, when setting it in the App, there was no Sleep Mode setting method on the device, which was confusing to users; thus, it was added to the previous page.

The same two methods are used to set Sleep Mode in this App. If the device is tapped a few times, it is set along with lighting feedback and vibrations, and when setting the App, the Sleep Mode button can be tapped to set Sleep Mode with accompanying vibration feedback. Information on methods to set Sleep Mode using the device is specified on the Sleep Mode setting page in the App so users can clearly understand how to do it.

Power Nap
The need for a Nap feature was suggested in user feedback. In the current App, users could continue to add nap time, but no patterns were displayed or information provided for the second recorded sleep. Thus, a Nap function was added to the new App to record nap time so users could check those patterns as well.

This feature analyzes sleep patterns related to napping and has the same settings as sleep mode. Users can drag with their finger to set the times indicating when they sleep and awaken. If the alarm function is activated, the alarm goes off at the set wakeup time through vibrations in the device. Afterward, analysis data for that sleep scrolls on the screen in a bar graph and users can check accumulated data.

Silent Alarm
The vibrating wake-up alarm function received positive responses from all participants.
DISCUSSION AND CONCLUSION

6. DISCUSSION AND CONCLUSION

6.1. Reflection

Overall, the expectation was met from the results for the redesigning. It was a suitable research method to find valuable information and practical use issues for the redesign. Participants liked to experience the new device. They provided feedbacks from the diaries and interviews. It includes contents on activities, food and sleep to help users to manage their health more effectively. There might be a function to focus on each user’s aim. Availability depends on how much a user focuses on it.

Despite the project interest in the redesign process, it was not easy to analyse the large amount of collected data. Participants gave a lot of feedback during the research period. Researchers needed to organize the more valuable contents for redesigning in their diaries. It is not only effective presenting all data, but also adapting all feedback from participants and applying it for the new design. It was a key role of researcher ability. However, as it was a novel product, the researcher needed to be concerned about the related interaction between the App and device. It was a very time consuming process.

6.1.1. Critical Review of the User Research

The diary study was a significantly interesting study to find out the users’ needs. The participants selected for this study were all voluntary applicants, and although it was two weeks, they were very much interested in this new device so they participated very actively. After the two-weeks study period, they continued to provide feedback along with their daily events, thoughts on the product and ideas they shared. It was quite helpful for redesigning. This proceeded in a very similar participatory to the research process of working with the participants in the redesign. In this sense, the redesign is similar to participatory design works.

Diary study is a research method that can derive detailed and significant information, but due to its long research period, risks may occur during the period. For example, out of five participants in this study, one dropped out after one week, for the reason that the participant was unable to focus on the diary study due to a sudden busy work schedule, business trip, and personal reasons. From the experience, it would be better for the next research that requires a long period; such risks should be considered and confirmed before proceeding with the research. However, any unexpected event that may occur to anyone is the limitation of a long-term research.
Five devices were prepared for this study, and considering that one more feedback would result in additional information (and reach the suggested number of five participants), another person was found to join the diary study. Therefore, the overall study period was extended by one week, to a total three-week period. What was interesting was that the replacement participant went through the same procedure and sent feedback on the two-weeks of use, and although they began one week later than the others, the replacement participant still displayed similar experiences. For example, in terms of the sleep function, the feedback stated that although it was very interesting in the beginning, it provided no help in sleep play because of the ineffective pattern graph. If there are real problems in a product, any users’ might have same complaints. It is a natural situation and designer need to solve the problems.

Overall, for a smooth progress of the diary study, it was important to approach participants in a more friendly way and to get close to them. If this research were for their families or close friends, participants would be likely to pay closer attention to it. As such, understanding about their lives and getting to know them better, besides the information on product usage, helped engage more openly with the process. Some examples of the effort were friendly phone calls and messages before the meeting and during the process or friendly e-mails to remind them about the product review. These may have affected positively with the participants expressing their thoughts more actively and focus on the study for the two-week study period.

In general, the process of diary study to redesign Fitbit App overcame the mere acquisition of meaningful information, and was the time to understand them better and get to know them more for two weeks. Their thoughts, lifestyle, and their emotions while using the products could be learned more realistically. Understanding who the real users were and what they experienced were important in comprehending the user needs.

6.1.2. Critical Review of the UI and Prototype Tool

The UI design process that solves the issues found in existing App was very interesting. Designing the UI, which was the solutions to solve the issues that resulted from the App evaluation, was not an easy process because the interaction with the device also had to be considered. While considering how to solve each issue, it was chosen to suggest a new App. However, as a new App is proposed, a design with more developed functions added was needed. For example, a verification on the added function in setting a goal for sleep time and rising time was needed if dragging action to set up was useful to the user. Therefore, although the function is created based on user feedback, the instruction of use demands a usability evaluation.
In general, apps for products monitored in real time are mostly shown as actigraph that is a moving type. Although this App has partially moving graph forms, there is a limit for emboding because the device is a prototype based on paper with POP tools by using Photoshop and illustration. It is, nevertheless, effective to use POP tools to easy explain interaction. It was useful to realize actual interaction on touch screen of the phone.

6.2. Future Works

In this project, the central concern has been for personal trackers associated with health and wellbeing there are some aspects that it can be concerned about future works.

First of all, for the next step, usability evaluation is required for the Fitbit 'ZZ' App. The App needs to evaluate from users whether it provides them motivation, easy to use or not, although reassessment and supplementation by solving problems that appeared on the assessment. It would also be great to repeat this study with redesign suggestions incorporated.

Secondly, there are issues on Fitbit App. Although the sleep function was deemed the most unsatisfactory feature, there are several issues on most features that need to be improved. The actigraphs on the main page of the app look simple and attractive, but some parts are complicated when the user wants to find information and the weight feature graph is not easy to understand.

Thirdly, it is necessary to study more about the motivational method to change users’ behaviour; this is the case for not only for the Fitbit App but also the current activity trackers on the market, all of which have same functions. More studies need to be performed to give more values to users. For example, psychological studies on how a user can remain consistently motivated to stay healthy and how the App can help the user to change habits that have a detrimental effect on their health would be useful in providing information that can be applied to further develop the functions of the App.

Last, but not least, the target audience was composed of ordinary people who had concerns about their healthcare, and who were also particularly interested in the sleep monitoring in this study. However, it is also possible to take another target user group, such as patients who have sleep diseases. The sleep-monitoring App has tremendous potential to support patient care outside the hospital and can therefore help health professionals teach patients how to manage their conditions successfully.
6.3. Conclusion

The project study aims were to evaluate the Fitbit app and to redesign the app according to the results of the evaluation. Before the assessment, an introduction to the background of the Fitbit device and design was provided, and competitors were analysed. For the enhance using the Fitbit App, the Diary study and face-to-face interviews to evaluate the Fitbit App was an suitable research method to discover user problems with the App. The online diary study enabled feedback through by email. Meaningful and significant feedback was obtained through diary and interview.

Results of collected data evaluation after the diary study were already considered on pilot concern. The results of the data showed that, in terms of the six functions on the Fitbit App, most of the participants were satisfied with the activity and water functions and unsatisfied with the food and sleep functions which was the lowest. Especially, the sleep function was deemed the least satisfactory function. Although it was initially the most interesting function for users, as it offered only basic information, users were quickly dissatisfied with the function. A new sleep-monitoring App was suggested to solve the problems based on user feedback from the results and UI issues, and to supplement the motivation function. This App was designed to help users to make healthier sleep habits and to monitor their sleep status.

UI for sleep monitoring was designed by iOS platform. Since this study aimed to redesign sleep function of Fitbit App, the App was designed to be in harmony with the flat UI and efficient design for quality of sleep the former App had. In particular, between bright blue and blue color the Fitbit uses were chosen for the new App. Easy navigation, usability, communication and motivational support were considered to design the new App. Simulation of the designed App was a prototype, paper base, to interact. A comprehensive interactive prototype with the screens and functionalities were described. All in all, the new sleep-monitoring App aims to keep and set healthy sleep behaviors.

In the wearable activity tracker market, newer models have been rapidly improved and updated. Although the technology to monitor people's current state in real time is still in its infancy, it is clear that there are issues on the extent to which the App is effective in changing a user's behaviour towards a healthier habit, and how the App keeps motivating the user to enter the long-term market. Particularly, health applications with wearable technologies like activity trackers will be developed in-line with the technical improvements continually in the future. These developments are likely to have a considerable affect on people's lifestyles. In that sense, the project is a small step for supporting the users' who really want to improve their health and wellbeing now and in the future.
REFERENCES


APPENDIX A: Screening Questionnaire

Personal Information Questionnaire

1. Have you participated in a Diary study before? □ Yes □ No

2. What is your age?
   □ 18-24 □ 25-34 □ 35-44 □ 45-54 □ Over 54

3. What is your employment status?
   □ Full-time □ Part-time □ Self-employed □ Unemployed □ Retired

4. What is your main occupation or job title?

5. How long have you been using the Internet?
   □ Over 10 years □ 10-7 years □ 4-7 years □ 1-4 years □ About a year

6. How long have you been using the Smart Phone?

7. What is your Smart phone model? (E.g. iPhone 5S)

8. Have you ever used a Health care App before? □ Yes □ No

9. If "Yes" in question 8 please answer this question.
   Which Health care App have you used? .................................................................

10. How often have you used the Health care app since 2 years?

11. Have you heard about Fitbit before you join this project?

12. What is your main purpose of using a Fitbit?
APPENDIX B: Participant Consent Form

**Information Sheet about Diary study**

**Purpose:** The purpose of this project is to examine the E-diary study of the app through the diary study and, with the obtained information, this project intended to provide the better user experience and improve the user interface of Fitbit app.

**Duration:** You will be asked to:
- Tell us a little about yourself as a user, and how you like to work;
- Perform everyday using this device and the App;
- Give me some feedback about your experience of use, and help us design a better version.
The period will be 2 weeks.

**Data being collected:** Everyday diary and feedback form using online tool that you send me. After diary study, an interview will record all your feedback about using the app

**Right to withdraw:** You may withdraw from the diary study at any time without prejudice or you need not answer specific questions if you choose. Should you withdraw, the data already collected will be stored until you cancel your permission to use it.

Right to cancel: You may cancel your permission to use your data in writing at any time by sending a written request to the investigators below. The investigators may use and disclose information that was gathered before we received the cancellation. Should you cancel, all data that can be associated with you personally will be securely destroyed. Once data has been anonymised, however, your personal data cannot be identified, so we will continue to use it.

**Potential of risk or discomfort:** This study has no side effects and will not impose any harm to you physically or mentally.

**Data storage/Anonymity/confidentiality:** Your identity will be anonymous. All data will be stored using a participant number, and will only be used for the purposes of the research. All data that might identify individuals will be destroyed by the end of the project (December this year), when we anticipate that the project and its publications will reach its completion. In the reporting of the project, no information will be released which will enable a reader to identify who our participants were.

**Research Sponsor:** none/the student

**Further information:** You may request further information about this study at any time by contacting the investigators below.

Do you have any questions? If you agree to participate, please read and sign this consent form.
Participation in Evaluation of Fitbit App project

Informed Consent

Statement by participant #..................

- I confirm that I have read and understood this information sheet and the invitation to participate.
- I understand:
  - The purpose, risks, and benefits of taking part in this project.
  - What my involvement will entail and any questions have been answered to my satisfaction.
  - That my participation is entirely voluntary, and that I can withdraw at any time without prejudice.
  - That all information obtained will be confidential.
  - That research data gathered for the study may be published provided that I cannot be identified.
- Contact information has been provided should I wish to seek further information from the investigator at any time for purposes of clarification.

Participant’s Signature ……………………………………… Date ……………………………….  

Statement by investigator

- I have explained this study and the implications of participation in it to this Participant without bias and I believe that the consent is informed and that he/she understands the implications of participation.

Name of investigator ………………………………………………………………………………………………..

Investigator’s Signature ………………………………….. Date …………………………………..

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APPENDIX C: User Satisfaction Questionnaire

Satisfaction Questionnaire

Please circle the number, on a scale of 7 being the highest and 1 being the lowest, that best describes how much you agree with the following statements based on your personal experience with Fitbit App.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Disagree</th>
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<tbody>
<tr>
<td>15. I enjoyed using Fitbit App</td>
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<td>16. The application was easy to navigate</td>
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<td>17. It was easy to find the information that I needed</td>
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<td>18. I was satisfied with the information displayed</td>
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<td>19. The date on the application was easy to understand</td>
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<td>20. The application was visually well laid out</td>
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<td>21. Each icon was clear and understandable</td>
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<td>22. I was motivated by the results displayed in the application</td>
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<td>23. I was satisfied with the information displayed under the ‘Activity’ category</td>
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<td>24. I was satisfied with the information displayed under the ‘Weight’ category</td>
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<td>25. I was satisfied with the information displayed under the ‘Sleep Pattern’ category</td>
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<td>26. I was satisfied with the information displayed under the ‘Food’ category</td>
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<td>27. I was satisfied with the information displayed under the ‘Water’ category</td>
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<td>28. I would recommend this application to others</td>
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1. What was your expectation of Fitbit App prior to its use?
   Very poor 1  2  3  4  5  6  7 very high

2. Has your expectations changed since using the Fitbit App?
   YES   NO

2-1. If your answered ‘yes’, the previous question, please explain the reason.

........................................................................................................................................
........................................................................................................................................

3. After using the Fitbit app, which is the most satisfactory function?

3-1. What are the reasons for your selection?

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4. After using the Fitbit app, which is the most unsatisfactory function?

4-1. What are the reasons for your selection?

.................................................................................................................................................. 
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5. Any additional comments relating to the Fitbit app:

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.................................................................................................................................................. 
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APPENDIX D: Interview Questionnaire
1. What do you like about Fitbit App?

2. What do you dislike about Fitbit App?

3. Does Fitbit App meet your expectations?

4. How was your experience with each function?