User Experience Design of Smart Headwear for Bike User

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***Abstract*—With the recent development of technology for wearable devices, user experience design is considered as the important design strategy. The purpose of this study is to conduct practical user experience design for smart headwear for bike user. To find smart headwear contents, the user needs and pain points were extracted from the user research. In developing the user experience (UX) design elements, persona and user journey map were created to provide differentiated experience contents for bicycle user. In this study, smart headwear through UX design process could provide the guidance for route during the cycling, coping with accidents, and bicycle trip. The smart headwear development with UX design process could suggest the UX content direction and the business success model. This study could be helpful to establish the UX strategy for smart devices for bicycle users.**

Keywords-user experience; smart headwear; wearable device; bicycle user; user interface.

I. INTRODUCTION

The technologies of wearable devices and digital life have been developed last decade. Smart glasses gained interests since the Google Glass was launched in 2013 and other manufacturers put various models on the market. However, it is difficult to find examples of effective usage on everyday life or profitable cases.

Recently, the services and contents for cycle users were developed with the smartphone and wearable device. Volvo and Strava introduced new alert system to reduce chances of collisions between cars and cyclists using global positioning system (GPS) information data [1]. Moreover, increase of the cycle users and success on cycle tourist could boost the wearable device industry. Jung reported the usage of cycle increased sharply in nine cities in North America and the transportation rate of cycle increased to 5.8% in 2009 from 1.1% in 1990 [2]. Successful cycle tour business could be found in France. In 2007, 7.3 million people, 3.5% of tourists who visited France, used bicycle tour and 0.8 million people, 3.0% of tourists who visited Paris, used bicycle tour [3].

The aim of this study is to introduce practical user experience design process from exploiting user experiences to applying the user experience (UX) concepts to wearable device. Focus group discussion and in-depth interview to exploit users' needs and pain points were described in Section 2. Development of personas and journey map and workshop in order to provide a differentiated service were described in Section 3. In Section 4, all findings were applied to wearable device for bicycle users.

II. USER EXPERIENCE RESEARCH

A. Methods

Focus group discussion and in-depth interview are good methods to collect broad and clear user experiences. Nine bicycle users separately recruited from three groups, such as daily leisure bicycle users, expert road bike users, and wearable device users. Daily and expert users participated in focus group discussion and wearable device users participated in in-depth interview.

Awareness and behavioral characteristics of bicycling, bicycle usage experience and objects of bicycle usage were collected from daily and expert user groups. And behavioral characteristics related with smart devices and smartphone during bike-touring were collected through an interview with the wearable device users (Figure 1).

B. Results

Needs and pain points were categorized into three riding tour phases. First, few information on difficulties on the riding course, and issues related with safety likes maintenance and protection of robbery were raised during preparation phase of riding tour. Second, problems on safety and accident were main concerns including communication with riding members during phase of riding tour. Lastly, after riding, major interests were riding photos and data related with riding likes riding distance and average velocity.

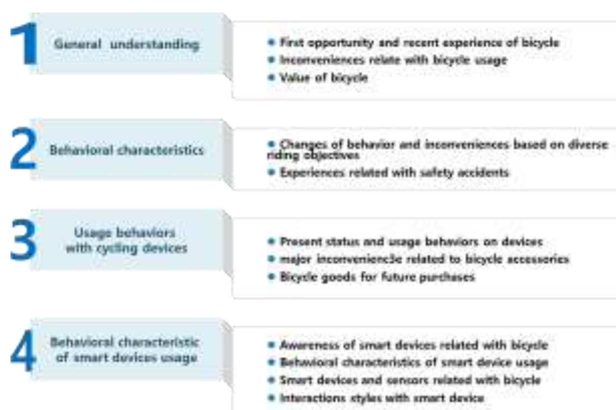

Figure 1. Major interview contents for bicycle users

Cycle users hoped the wearable device for cycling could provide the precise information on riding and exercise, information on riding course and surroundings and cautions on risky conditions. However, the short battery time of device and interference of calling and listening music caused by a wind were major concerns.

Consequently, the concepts of wearable device for cycling could be summarized into "safety motivation", "social activities with self-motivation", "tour assistant" and "health monitoring".

III. Building UX Concept

A. Persona and User Journey

Collected user opinions and comments were refined and used for creation of personas and journey map that were suggested by Alan Cooper [4], software designer and programmer. These methods could be effective and give easier way for understanding users. For creating personas, democratic variables, objectives of bicycle riding, inherent tendency of bicycle usage were considered and classified into similar personal characteristics.

There were two common negative emotions on four personas. The bike user concerns about safety and accidents took great portion during cycling. The expert bike rider who is more than six road bikes a week, and the persona needs for riding courses, objective riding data, and navigation functions. When riding for travel, there were requirements for movement such as navigation and route information. In the case of commuting bike rider had the needs for contemplating about accidents and requirements on crossway in urban area. For a riding bicycles for health care, the main focus has been on the need for information on living conditions, exercise and personal training functions, and achievement of goals, mainly on track records and on compensation and motivation.

The user journey map was developed based upon characteristics shown in Table 1. Journey map was composed after each persona's bicycle usage phase was settled and was defined behavioral criteria for each phase, such as emotional variance, needs, and user requirements.

TABLE I. GOAL FOR PERSONA

Persona	Goal
Expert bike rider	To renewal own record for preparing competition
Traveling bike rider	To find a bicycle course for traveling
commuting bike rider	To commute and use bike as a form of transportation
Bike rider for healthcare	To care about health from cycling

Four personas were consequently created, such as expert bike rider, Traveling bike rider, commuting bike rider, Bike rider for healthcare. Figure 2 present the hallmarks, pain-points and needs of each persona and the output example.

Figure 2. Persona & User Journey map

B. User Experience Concept

The workshop was carried out for extracting the UX concept, shown in Figure 3. Collected data were classified into safe riding, bicycle information, navigation, sharing route and information, bike accessory, record and feedback. Idea generating process was discussed in order to solve the pain points and needs of each persona. UX concept and strategy were drawn during idea workshop.

Finally, values and experiences that a wearable device could provide to bicycle users were summarized into four key UX contents: safety, tour, social, and health. Figure 4 displays key UX contents.

Figure 3. Idea workshop and affinity diagram

Figure 4. Key UX contents

This study drew concrete ideas to enhance the user experience through the headwear with four main contents drawn. First of all, the safety function is that prevents dangerous accident and helps cope with it after an accident, which helps the users ride safely by providing alarms for speeding bumps and places where accidents occur frequently so that the users can let others know that through emergency call and quickly cope with it.

Secondly, the social feature makes the user experience of riding the bicycle more pleasant by the function of saving and sharing own driving records and routes and the function of motivating for riding through competitions and games.

Thirdly, the features for tours are to provide the information and navigation about the area where the user is cycling. Users can easily get the information about the area and can find the correct tour route even if the user is not familiar with the area.

Last, the health care function provides exercise state information while driving such as exercise status monitoring, exercise goal-setting and achievement rate display, so that the user can effectively control user pace, monitor the physical condition through body temperature and heart rate measurement, and prevent Glycogen depletion by informing the user of time for food and water intake.

IV. APPLICATION TO SMART DEVICE

A. *User Interface Design*

With the derived key contents, an application for mobile and headwear was designed. Each function was defined, and a screen considering the user's gaze was designed. Experiment was conducted for inspecting the relationships between eye dominance and the user's cognitive performance before user interface design. A total of 36 bicycle riders who have been cycling consistently were recruited and participated in the experiment. Recognition time, error rate and user preference scores were measured during riding a bicycle on a stationary stand for safety reasons. As a results, quantitative experiment with eye tracker showed that recognition time had 20% delay and error ratio increased almost 10% when the device was located on non-dominant eye. The interaction effect of ocular dominance and age group was significant with respect to recognition time and error ratio. The recognition time of the users in their 40s was significantly longer than the other age groups when the display was placed on the non-dominant eye, while no difference was observed on the dominant eye. Error ratio also showed the same pattern. Although no difference was observed for the main effect of ocular dominance and bike usage, the interaction effect between the two variables was significant with respect to preference score.

Headwear display screen connected to a mobile device is divided broadly into Event Area and Information Area as Figure 5. The part of the screen which is most noticeable visually was assigned to the Event Area and it was designed so that information checked continuously such as current speed and mileage would be positioned in the Information Area.

Figure 5. Smart Headwear display layout

In order to seek interaction to provide the users with an emotional new experience while they are riding the bicycle, four visual concepts were proposed and this study went through a user verification process. Like shown in Figure 6, designs were provided as follows: the design that forms honeycomb-shape in which multiple contents are connected based on the hexagon shape, the design in which each content has a bubble-shaped module and each information appears like soap bubble spreads, and the past information disappears as the bubble bursts, the design of sunflower concept in which contents appear round and turn like petals, which provides interaction centered around directions contents; and design of Bi-Circle, which embodies circle shape in bicycle mode, and provide visual information simply using two big circles.

In the detailed visual design, it was embodied by choosing Bi-circle as the most highly preference from the survey about four concepts corresponding to the headwear display.

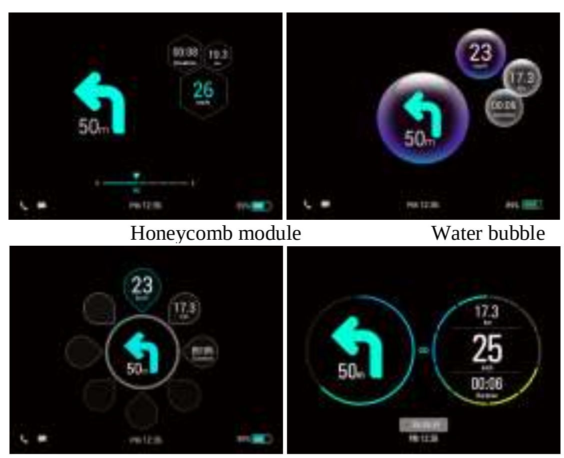

Figure 6. Visual design concept

B. Visual Design

When the headwear device is turned on, the first screen is displayed in the wearable device. Figure 7 shows the connection attempt screen.

Figure 7. Connecting screen on Headwear display

The main feature is that the contents are not arranged on the left part during ordinary bicycling so that the sight could be less disturb. When navigation shows in the screen that the direction is indicated on the left side, the state of battery is displayed with rounded shape and the POI (point of interest) information is displayed on the center (Figure 8).

Figure 8. Riding Screen on Headwear display

This application provides the state on the display and rings a warning sound if the user's body temperature gets out of the normal range, through the body temperature sensor on the headwear while on the bicycle (Figure 9). In addition, it alerts a dangerous situation by blinking the translucent red background and automatically sends an SOS message to a preset acquaintance, if such a situation lasts for over 3 seconds.

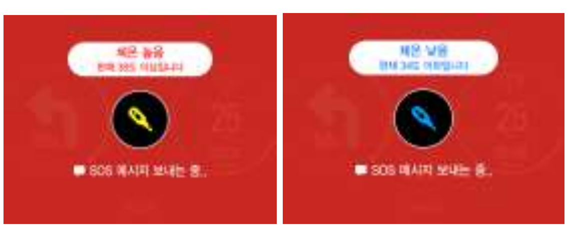

Figure 9. Warming Screen on Headwear display

C. Prototype Creation

Prototype was made as a video type for verifying design of Headwear in detailed visual design. The background animation provided real situation for cycling as the Figure 10.

Figure 10. Video prototype screen

V. DISCUSSION

This study introduced the practical UX process with single-lens wearable device for cycle users.

Overall, the expectation was met from the output for the new headwear application. Despite the project interest in the UX design process, it was not easy to analysis the large amount of collected data from user because it was needed to be concerned about the related interaction between the App and device. It was not easy to analyze the data of cycle users during FGD and to extract the most needed contents for wearable device. First, numerous concept meeting was placed to resolve the needs and pain points during cycling. Smart headwear could give limited functions technically, so there were a lot of troubles how to enhance the user experience during cycling. Especially, safe cycling to prevent accidents and information on route and local area were discussed intensively. In addition, there were many suggestions how to give natural interaction between headwear and smartphone and how to offer emotional experience. In order to clearly define target user, major grouped needs and pain points were classified, and personas were created.

This study considered the effect of ocular dominance when the user gazed the display of wearable device. Most popular single-lens smart device, Google glass, were recommended to locate on user's dominant eye. Moreover, this study empirically identified that cognitive performance could be decreased when the device was placed on non-dominant eye, cognitive performance could be decreased. Results showed that the recognition time and error ratio increased significantly. This study developed the smart device for the right-eye dominant only, however, experiment results proposed the necessity of device for left-dominant eye users for safe cycling.

Besides ocular dominance, small display size was also a problem to address. Optimized contents and layout of information were determined not to disturb user's front view.

Another problem was that the user wearing the device could not see the information on the display of device in sunny day condition. This problem should be settled down, considering the cycling condition.

This study is progressing. The central concern has been for personal device associated with information on safe

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cycling and navigation for more emotional experience. There are some aspects tour and social network service that it can be concerned about future works.

VI. Conclusion

This study tried to apply UX approach to develop the headwear that could enhance the bicycle user experience. In order to achieve the goal, massive data were collected from many cycle users, then persona and journey map were created for more understanding users. Working prototype was developed and was tested in laboratory experiment.

For further research, specific feature should be implemented on Smart Headwear to build a new business model. It is significant that this study can provide insight as a UX design approach about new wearable services for cycling user. It is necessary to embody the function development implementation and related services provided from the extension of this study which is ongoing. Results of the study could provide the UX approach and apply to wearable device.

Acknowledgment

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