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THE DEVELOPMENT OF A MOBILE MAP APPLICATION FOR PARK AND RIDE USERS

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ABSTRACT: User-centered design (UCD) has long been employed to enhance various map-based applications and GIS tools to ensure effective user interfaces. However, existing UCD guidelines cannot cover all relevant aspects, so the design process is becoming difficult; for example, a button should be located on the first page or not. This article presents the development of a mobile map application for park and rides users with user-centered design combined with the *user experience*. A brainstorming session was conducted gathering mobile application designers, programmer and commuters to generate ideas as to how people would use the application and how they would feel when using the application or *user experience*. All *user experience* findings were recorded with *user journey*. Several important aspects, such as a sequence of users' activities and information needed, were identified when *user experience* was considered during the design process. Additional features (e.g. reward points) were added at an appropriate place to enhance user engagement. The *user journey* helped me better organize functions, information, and the sequence of the mobile application.

Keywords: Map, mobile, User experience, User-centered design

1. INTRODUCTION

During the past ten years, the amount of smartphone users in Thailand has increased significantly. According to a report by Yozzo in 2015, the number of mobile subscribers grew from 71 million in 2010 to 97 million in 2014, of which 4.3 million are 4G subscribers. Seventy percent of internet users go online via smartphones more often than via computers or tablets [1]. According to a survey of smartphone behavior by Ericson, countries in Southeast Asia and Oceania consume about 1.2 GB of data per user, per month on smartphones, and the trend is increasing because of the increase in the percentage of internet package registers [2].

Similar to other mobile applications, map application usage also has seen its popularity rise, as demonstrated by the increase in the number of this type of application available in various mobile application marketplaces (such as Google Play and App Store). Some popular map applications include Google Maps, Apple, HERE map, Waze, and Nostra to name a few. Functions within those applications, at least, usually contain map display and navigation that suggest the best routes and the best modes of travel. With the availability of real-time information provided by various sources, such applications can serve as Advanced Traveler Information System (ATIS) to provide real-time information related to traveling (e.g. traffic congestion, road accidents, weather, and public transit time of arrival).

Sathorn Model project, supported by Toyota Mobility Foundation, aims to promote sustainability of transport systems in the Sathorn area of Bangkok, Thailand [3]. The project has experimented with various approaches, including park and ride service, shuttle bus service, adaptive signals, and a flexible working hours scheme to contribute to sustainable mobility in the Sathorn area. Because of a large number of smartphone users, the project tried to leverage the power of smartphone applications to encourage users to try to park and ride.

Park and ride is an alternative multimodal method of transit in which people use their personal vehicle for part of the journey, then park at an nearby area mass transit station in order to transfer to other modes of transport — in the case of Bangkok, these modes comprise the BTS Skytrain, MRT underground, or BRT bus rapid transit — for the remainder of the journey. The advantage of this method is that people can avoid traffic within the city even though they live far away from mass transit stations. As more people use the park and ride scheme, the amount of traffic congestion in the Sathorn area — the inner city of Bangkok — can also be reduced.

To ensure that the application is usable enough for users, a User-Centered Design (UCD) framework was adopted during the design process. UCD is a framework that emphasizes the requirements of users from the beginning to the end of the design process, which can ensure efficiency of interaction between humans and computers [4].

The UCD process normally consists of work domain analysis, conceptual development, prototyping, interaction and usability studies, and implementation [5]. UCD has been applied in many development processes for web maps, map-based applications, and GIS tools [6], [7].

In my case, some aspects were missing during the design, so that some components of the application could not be defined; for example, functions that should have been included, and the arrangement of pages or buttons. Therefore, UCD was applied to the user journey to record and identify users' thoughts and feelings when going through the steps of using the relevant applications.

This paper presents the development of the mobile map application for park and rides users, specifically reporting on how user-centered design processes and user experience concepts can be leveraged to improve the usability of my mobile applications. Several important aspects were identified when user experience was considered during the design. The contribution of the findings to the design decision will be discussed.

2. USER EXPERIENCE DESIGN

User experience (UX) can be defined as the feelings or reactions of people when using a product, a system, or an object, via user interface [8]. ISO gives the definition of UX is "a person 's perceptions and responses that result from the use or anticipated use of a product, system, or service"[9]. UX has its roots in Human-Computer-Interaction, a discipline related to the improvement of efficiency of interaction between humans and computers [4].

The term UX is a broader term than usability, which only takes into account common benefit and the main functions of the user interface. In addition to the 5 common components of the ease-of-use interface of learnability, efficiency, memorability, errors, and satisfaction, UX emphasizes additional characteristics of the interface—namely, the user's pleasure with the interface [10] or look and feel [11]. For example, users may stop using an interface if they find no value (bad experience) in it even though the interface is easy to use and easy to learn (usable).

To document user experience while using a product, a service, or a system, *user journey*, (or customer journey)—which allows designers to record stages with details associated with user experience during using the application—was employed.

3. METHOD

The initial stage of the application development will be the focus, and only three steps—including work domain analysis, conceptual development, and prototyping—will be reported upon. My team improved the UCD process by incorporating *user journey* during the conceptual development phase.

My team consisted of a mobile application designer, a programmer, and three commuters who usually travel to work by car and by mass transit (Bangkok sky train and underground). The commuters are quite familiar with Sathorn area but their offices are not in Sathorn. In the first stage, my team reviewed related studies to identify the main user groups in the Sathorn area. Then, a brainstorming session was conducted for defining how people travel to work and how they use or will use the Park and Ride services. Next, *user journey* was created based on information developed from the brainstorming session. Rapid prototyping was then developed from the *user journey*.

The prototype was developed using Ninjamock (https://ninjamock.com), a prototyping software on the web that provides graphics elements of GUI components in a hand-drawn sketch style. The sketch style can have several advantages as [12] discussed. The software allows users to draw and test the graphic user interface (GUI) very quickly and efficiently.

4. RESULTS

Two main group of rush hour travelers in the Sathorn area were identified. The first group comprises individuals who regularly travel to the Sathorn area. Most of them are office workers, while others are parents who drop their children at school. The second group comprises individuals who are 'new' to the Sathorn area (non-residents); they just come to Sathorn for infrequent activities. My brainstorming team found that the first group plans their leaving time based on previous experience, but they rarely plan their travel routes because they are familiar with the area. In contrast, the members of the second group are more likely to plan their routes because they are not familiar with the area. In order to design an application to support both groups, my team further investigated how travelers would use the application, and recorded findings using *user journey*.

4.1 User Journey

To develop an understanding of how each group of travelers would use the application, a brainstorming session was organized. The result of that brainstorming session was depicted as a *user journey*. *User journey* is a diagram of steps with users' feelings and thoughts while using a product or an application. The brainstorming team recorded on what travelers would do and think during their travel to Sathorn. Possible feelings (both positive

and negative) and locations with required data for decision making during each step were also recorded. Ideas about additional functions (opportunities) that would improve possible negative feelings were also recorded in the *user journey*.

Our *user journeys* of frequent commuters and normal travelers are shown in Table 1 and Table 2.

Table1 User journey of frequent commuters

Time step	1	2	3	4	5	6	7	8
Doing		Wake up	Plan the trip	Leaving		Arrived park and ride service	Travel	Arrived the destination
Thinking			Is there road congestion?					
Feeling		Lazy		Worried				Relieved
Data			User's history					Trip summary
Opportunities	Rewarding		Show their experience					
Places	----------Home----------					On the way		Desti-nation

Table2 User journey of normal travelers

Time step	1	2	3	4	5	6	7	8
Doing	Plan the trip	Wake up	Plan the trip	Leaving	Looking for park and ride	Arrived park and ride service	Travel	Arrived the destination
Thinking	How to reach the destination? Is there a parking area available?		Is there road congestion ?					
Feeling			Frustrated		Worried			Relieved
Data	User's history		User's history		Park and ride information		Travel information	Trip summary
Opportunities			Show history, Travel modes, Rewarding					Rewarding
Places	----------Home----------					On the way		Destination

Based on the user journey, my brainstorming team found that the frequent commuters are not likely to use the application since they know their routes and suitable times to leave very well. In contrast, travelers who only visit the Sathorn area occasionally may use the application both before leaving and during their journey. The key information required for frequent commuters is the history of leaving times that can best avoid congestion. In addition, park and ride locations and modes of travel are needed for infrequent travelers.

4.2 The Design of the Graphic User Interface (GUI)

Based on the brainstorming session, it was found that the two group of users required information at different times. The local commuters do not want to plan their routes as they usually rely on past experiences when choosing the best departure time. In contrast, infrequent travelers may want to plan their routes as well as their departure time to avoid traffic congestion. Therefore, the first page of the application (Fig.1) was designed to include a *'record your trip'* button and *'just plan your trip'* button to support both groups of users. Users can skip the planning function if their preference is just recording their trips. In order to use recording function, users need to sign up so that the system can recognize them.

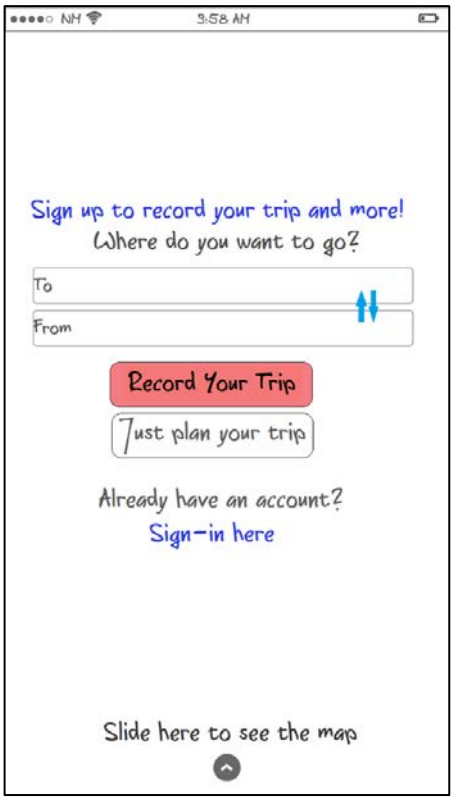

Fig. 1 The first page which consists of 'record your trip' button and 'Just plan your trip' buttons

4.2.1 Recording trips

During the brainstorming session, it was found that frequent users might want to recall their experiences traveling to Sathon area, so a recording function is provided allowing users to record their trip in the system for their own history. Once the user signs in, he can use the record function by pressing *'Record your trip'* on the first page after inputting the origin and the destination of the trip for trip reference. The screen will change to the '*tracking'* page (Fig.2) in which the *stop* button and *elapsed time* are displayed. The map showing the current location is also displayed on the page. At the end of the trip, when the users press the stop button, a pop-up window appears, displaying a short questionnaire asking about comfort, level of crowd density (in case of using public transport) and mode of travel, and a comment textbox appears (Fig.3). The results of the questionnaire will be summarized in the '*report*' page (Fig.4). Reward points gained is also shown in the report in order to encourage users to use the application.

Fig. 2 Tracking page

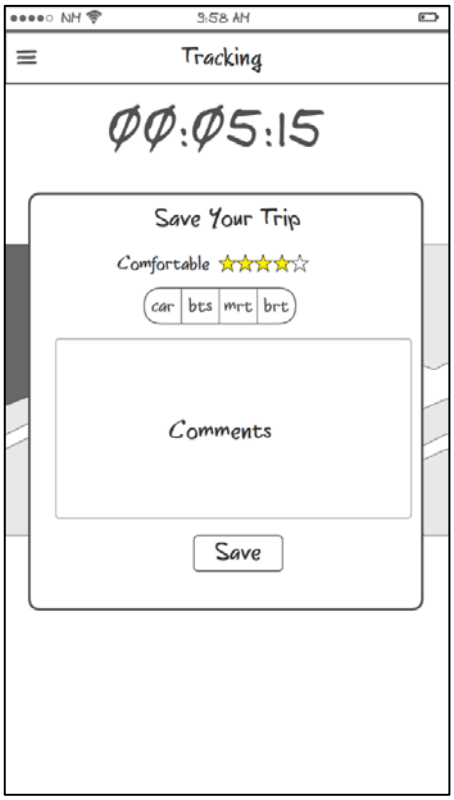

Fig. 3 Pop-up window showing several questions about the trip

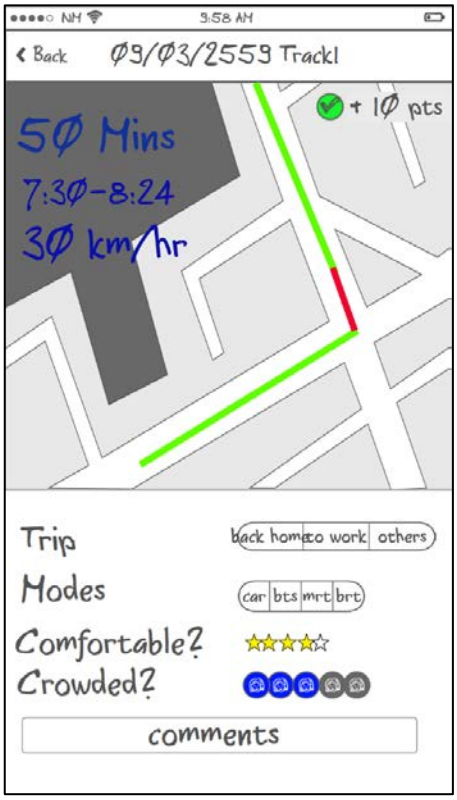

Fig. 4 Report page

4.2.2 Trip records

Every type of users may gain some benefits from their history especially for local commuters who can compare their travels on different days. Therefore, we provide *Trip Records page* as shown in Fig. 5. The detail of a trip (as shown in Fig. 4) can be seen by clicking on one of the lists.

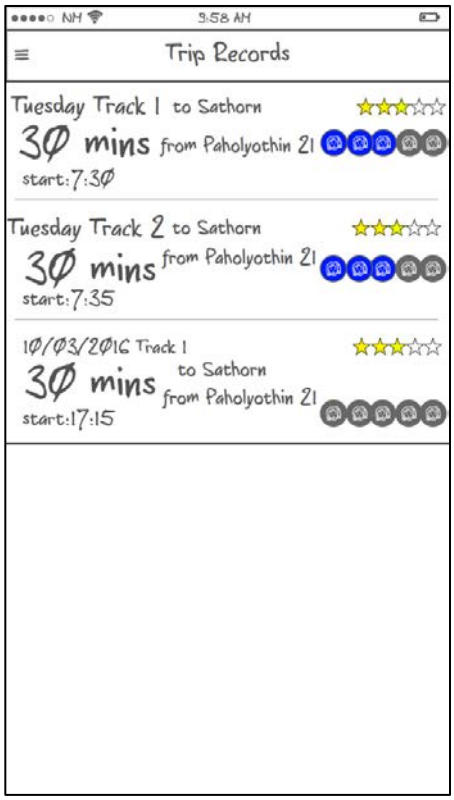

Fig. 5 Trip Records page

4.2.3 Trip planning

A *trip planning* function is provided in case the user wants to plan the trip before traveling. It is aimed to support commuters who are new to Sathorn area. A map is available but hidden from view on the first page. Users can scroll to the bottom of the screen to view the map to see available parking areas in this project (Fig.6). Users can then click on the park and ride icon to see the details about the parking including a photo of the parking, parking name, cost, hours of operation, and a short description of its entrance (Fig.7). Once the user presses '*Just plan your trip*', the system will display all the possible ways to travel to the destination, with estimated travel time included, so that the user can compare different modes of travel (Fig.8). The number of reward points is also shown to encourage users to travel via an alternative mode rather than the use of personal cars. The user can investigate his/her history by clicking '*See Stat*'

button. After the user chooses an option on '*Travel options*' page, '*Tracking*' page will appear.

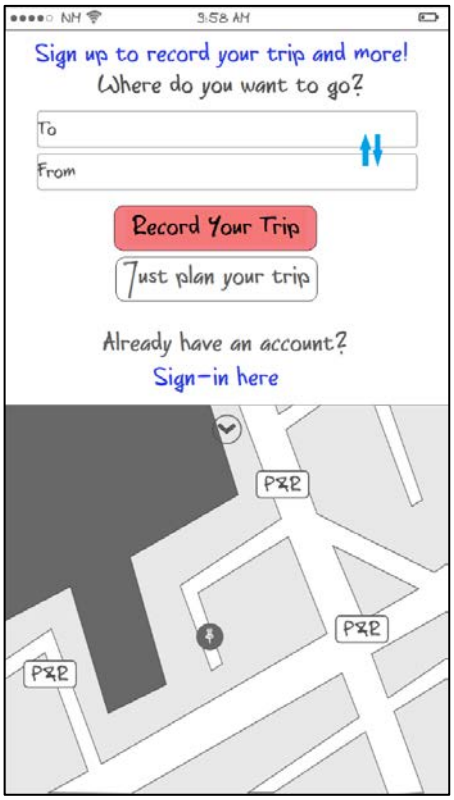

Fig. 6 The map is hidden underneath the first page.

Fig. 7 Parking map on the first page.

Parking map showing in Fig.7 indicates that, when the parking icon is selected, parking information page will be shown.

4.2.4 The menu

The application includes the menu hiding on the side of the screen. The menu includes user's history, collected rewards, user's profile, help & feedback and log out button as shown in Fig. 9. Badges that the user received are shown on the top with the user's name. The badges represent users' achievement that is accompanied with the reward points. In this paper, the details of the rewarding system will not be described since it's out of this paper's scope.

Fig. 8 The menu showing user's history *(your places* and *trip records*, *your summary*), with *help & feedback* and *log out* button. Badges are also shown on top of the menu.

5. CONCLUSIONS

In this paper, the development of mobile phone application prototype using a User-Centered Design framework combined with *user journey* was described. *User journey* can help understand users' activities before, during, and after using the application, which can consequently help designers to identify the sequence of functions in the application. In this case, both '*Record your trip*' and '*Just plan*

your trip' are included on the first page in order to support two distinct user groups. In the case of commuters who are familiar with the area, they can just skip to the tracking page.

User journey can also help us identify information needed for each function. This can prevent 'information overloaded' on each page by just providing only crucial information to users. In the developed application, a parking map is hiding on the first page for users who want to see parking locations and information before using other functions. Travel history is shown in the *travel options* page as the information might be necessary when they choose their travel modes. Users can also recall their history at any time from the menu.

The *user journey* also informs me the best time to add additional functions (opportunities) in order to encourage users to modify their travel behaviors. For example, reward points are included on '*travel options*' page to encourage users to choose other modes rather than driving their own personal cars.

The design of the application is currently in progress. To ensure the usability of the design, a prototype will be developed and evaluated its usability with different groups of potential users, who regularly travel to Sathorn area and who are very new to the area. As suggested in many user-centered design guidelines, an iterative process including prototyping and redesigning will be used. More strategies to encourage users to use the application will be incorporated. The detail of the rewarding system will be defined to improve user engagement.

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7. REFERENCES

[1] Yozzo, Thailand's Telecom Market end of 2015, 2015, Available at https://www.slideshare.net/ yozzo1/thailands-telecom-market-end-of-2015.

[2] Ericson, Mobility Report: Southeast Asia and Oceania 2016.

[3] Sathorn Model Team, WBCSD SMP2.0 Sathorn Model Project — Final Report, 2016.

[4] Haklay M. and Tobón C., Usability Evaluation and PPGIS: Towards a User-Centred Design Approach, International Journal of Geographical Information Science, vol. 17, no. 6, 2003 pp. 577-592.

[5] Robinson A.C., Chen J., Lengerich E.J., Meyer H.G., and MacEachren A.M., Combining Usability Techniques to Design Geovisualization Tools for Epidemiology, Cartography, and geographic information science, vol. 32, no. 4, 2005, pp. 243-255.

[6] Roth R., Ross K., and MacEachren A., User-Centered Design for Interactive Maps: A Case Study in Crime Analysis, ISPRS International Journal of Geo-Information, vol. 4, no. 1, pp. 262, 2015.

[7] Siricharoen W.V., Experiencing User-Centered Design (UCD) Practice (Case Study: Interactive Route Navigation Map of Bangkok Underground and Sky Train), in Human-Computer Interaction*:* Second IFIP TC 13 Symposium, 2010, pp. 70-79.

[8] Law E.L.C., Roto V., Hassenzahl M., Vermeeren A.P.O.S., and Kort J., Understanding, scoping and defining user experience: a survey approach, in Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 2009.

[9] ISO, FDIS 9241-210, in Ergonomics of human-system interaction –Part 210*:* Human-centered for interactive systems, 2009.

[10]Bevan N., What is the difference between the purpose of usability and user experience evaluation methods, presented at the Workshop UXEM, 2009.

[11]Lipp K., User Experience beyond Usability, in Media Informatics Advanced Seminar 'User Behavior', 2012.

[12]Wood J., Isenberg P., Isenberg T., Dykes J., Boukhelifa N., and Slingsby A., Sketchy Rendering for Information Visualization, IEEE Transactions on Visualization and Computer Graphics, vol. 18, no. 12, 2012, pp. 2749-2758.