

UX Design Based on the Directional Nature of Smart-Phones

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Abstract

Recently, the internet access rates via mobile devices exceeded those via PCs, and in particular, smart-phones are most commonly utilized in this area especially for data and information searching. This study is to examine UX design patterns depending on touch gestures on smart-phones for mobile web service. Mobile UI design patterns are divided mainly to navigation for information management and screen movement, forms for entering texts and optional functions, tables for contents display, searching, invitation for functional control and attention, and feedbacks to handle responses depending on the situations. Characteristics of mobile web service include personalization, ubiquity, differentiation, and district-based nature. Due to the small screen environment, the information structure is different from that of PC web service. In addition, the screen transition through touch gestures is directional and thus involves certain UX design patterns. As for user experiences regarding touch gestures on a smart-phone, directional motions such as horizontal or vertical movements were more frequent than zoom-in/out and rotation, and such motions were often combined for navigation and invitation functions. Dragging was directional both horizontally and vertically while scrolling was directional basically vertically. Flick and swiping are two major touch gestures directional horizontally, and they are most frequently used for page transition in contents searching.

Keywords: *smart-phone, orientation, user experience, patterns, touch gesture*

1. Introduction

Smart-phones are no longer new to modern people. According to 2015 Social Indicators of Korea issued by the Korean National Statistical Office, the number of mobile phone service subscribers is 57,208,000, 40,560,000 of whom (70.9%) are smart-phone users [1]. The market of smart-phones entered the introductory stage as i-phones were released in 2009, and it entered the growth stage as smart-phones were released in 2012. During this period, the use of smart-phones started increasing not only among youths but also among those in their 50's and 60's. Around 2012, the market entered the Renaissance stage as more than half of the elderly started were already using smart-phones, and not it is in the maturity stage.

The smart-phone distribution rate in Korea is the highest around the globe. It is reported that the domestic use rates of smart-phones have already exceeded those of PCs. According to Nielsen, a market survey agency, the monthly hours of using mobile service among Koreans are 168 hours while those of using PCs are 24 hours, which indicates that the former is 7 times more than the latter [2].

According to 2014 survey of smart-phone use published by Korea Internet and Security Agency, the most frequently used function next to basic widget applications such as

calendar and alarm is mobile web service including information searching. The use rates of mobile web service by means of smart-phones exceeded those of PCs already in 2012, and accordingly, a number of web sites have been designed for mobile users.

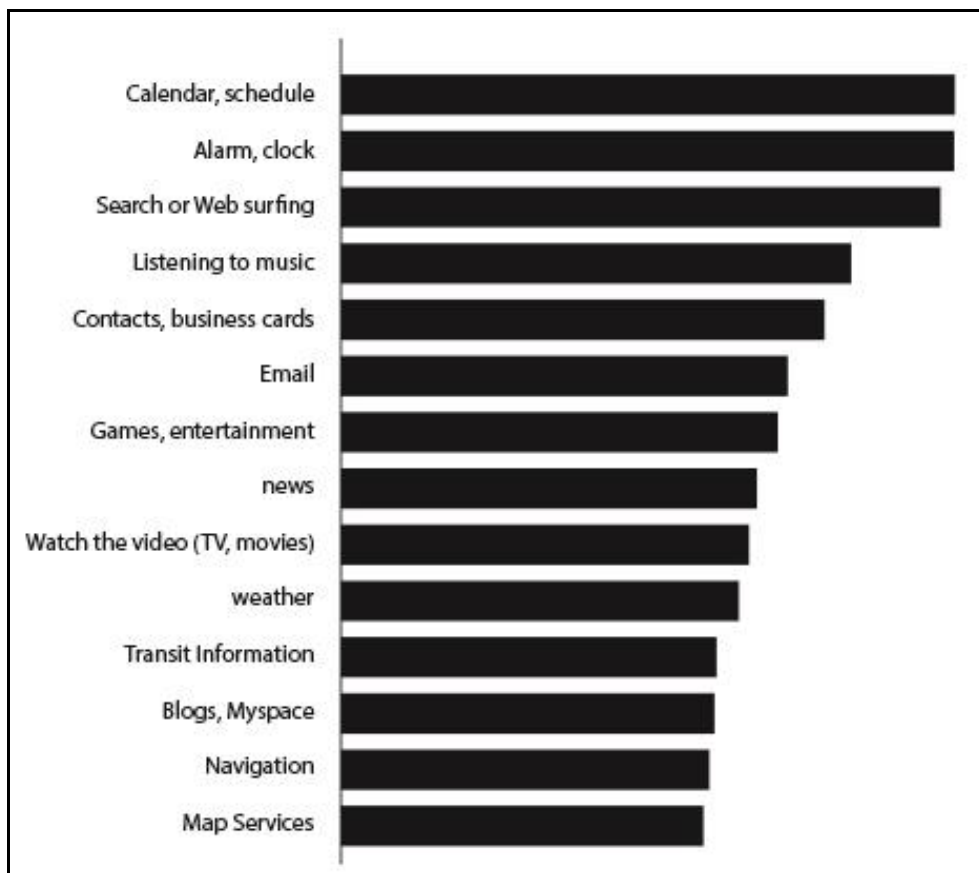


Figure 1. Survey of Smart-Phone Use

In addition, as many scholars have conducted researches on smart-phone characteristics and UXs, most domestic websites have upgraded UXs of their mobile versions after trials and errors, not providing stable design formats and UXs. However, as for touch gestures, the most important feature for mobile web service, UXs do not provide consistent experiences among users who surf over various web sites although they are designed for characteristics of a specific web site.

Hence, this study aims to analyze UX design patterns of screen transition with touch gestures involved. In addition, related user experiences are analyzed to present touch gesture UXs in harmony with design patterns for better user experience.

2. Theoretical Background

2.1. Characteristics of Mobile Web Service

Existing PC-based web services were supported by input devices such as mouse and keyboard through which accurate positioning is possible on a relatively large screen. In contrast, smart-phones are based on screen touch and the use of small screens. Since mobile web service utilizes small screens and finger touches, the information system and GUIs are basically different from those of PC-based web service. The most outstanding difference from PC web service is the interaction method: Various sensors such as GPS and touch gestures are utilized for interaction

with the interface, and the operation system is optimized for mobile environments [3]. For this reason, it is challenging to operate existing PC-based web services on the small screen of a smart-phone as they are, and thus the roles and functions of smart-phone UXs have become more precise and complicated.

As for information composition as well, a simple top-down sequential structure is preferred because of the small size of the screen. The contents displayed on the screen are also limited. To show a large quantity of information, items need to be grouped and classified more specifically so that they can be displayed as a category. To this end, UXs specifically designed for mobile web service such as the drawer type need to be adopted [4]. Characteristics of contents in such mobile environments are as follows:

- 1) Contents are presented according to specific characteristics and mobile device settings of each user. Personalization for enhanced security is another feature of personal terminals.
- 2) Mobility of mobile devices overcomes the spatial limit and contributes to ubiquity for information searching and communication regardless of the time and place.
- 3) Owing to the improvement of hardware features and transmission rates as well as software aspects such as killer app development, information searching and communication have become more convenient than before.
- 4) Differentiated service for each individual is provided based on the analysis of use patterns.
- 5) Users can access desired services anytime anywhere by means of a mobile device. Lastly, location-based GPS service provides useful information of surroundings and regional features.

2.2. PC Web and Mobile Web Services

As mobile web services are operated on a small screen, the information structure is different from that of PC web services. With the advancement of the ultra high speed Internet access, many are familiar with PC web service and make good use of Explorer browser that is based on Flash or Active X functions. As for layouts, the menu structure is centered on the Header and Left sections while the layout of the contents section is opened. Interaction with inputs/outputs by means of a mouse or a keyboard is another feature.

Mobile web service designed for smart-phones presents the menu centering on the header and contents sections, and movement between menu items is through page transition. The layout is limited due to the narrow width. Various sensors such as cameras and GPS are utilized, and hybrid applications of device functions are adopted. Interaction is implemented through finger touches. These can be summarized as follows:

Table 1. PC Web and Mobile Web

Class		PC Web	Mobile Web
User		All ages, including mobile users	75% of the mobile user (Age 20~40)
UI	Layout	The menu structure of Header Left and center area Contents area layout freedom	Menu Structure and Contents of the Header area center Go through the page transitions between menu The layout is restricted to a narrow horizontal width
	Event	Mouse(One Click, Over) Keyboard	Touch Screen Equipped with QWERTY keyboard
Browser		firefox, Explorer-driven Flash, ActiveX Available HTML5+CC Not valid	Opera Mini, Safari-driven Flash, ActiveX Not valid HTML5+CC Available
Device, Infra		High-speed Internet Independent development of Device	3G, Wifi Cameras, GPS, etc. applied to the capabilities of the Device hybrid types

2.3. Mobile Design Patterns

Upon facing a certain problem for the first time, people go through various trials and errors before finally solving it. When a similar trouble occurs later, it may be successfully addressed by applying the former solution. Design patterns of smart-phones are a type of empirical solution after various trials and errors. To solve design problems that are repeated in an object-oriented system, enterprises are motivated to analyze them and present detailed explanations [5]. Repeatedly used designs are grasped after countless trials and errors, systematically classified, and collected as design patterns.

Mobile UI design patterns are divided mainly to navigation for information management and screen movement, forms for entering texts and optional functions, tables for contents display, searching, invitation for functional control and attention, and feedbacks to handle responses depending on the situations. Characteristics of each are as follows:

Navigation: Navigation UIs are designed for screen movement and different depending on the OS. Navigation UIs should be designed in reflection of the information structure settings and indicate the attributes clearly depending on the usability or importance.

- Tab Bar: UI that forms tab buttons
- List Menu: UI for list items in a table
- Springboard: a collection of icons that can be used to open an application
- Dashboard: UI that visualizes the result of information analysis
- Mega Menu: A pop-up type of temporary menu
- Metaphor: An icon type of menu
- Sliding Menu: Top-to-bottom or left-to-right menu type
- Rotating Menu: Menu of a circular orbit

- Sliding Tab Bar: Tab menu that moves horizontally or vertically

Forms are a component to enter texts or data and implement functions. The number of letters that can be typed in may be either limited or opened. Certain text fields and input devices may have to be activated for inputs or standardized frames may be utilized. In addition, forms may be utilized for operations or certain functions. It is desirable to inform the user of the way of entering or tips for contents to be entered.

- Text Field: space to enter texts in
- Comment View: Screen on which opinions are written
- Place Holder Text: Text provided in advance in the text field
- Instant Input Field: a text field and input devices are activated for inputs
- Calculation Form: Data input form with a calculation formula
- Execution Button: Button directly linked with user behaviors
- Completion Button: Button through which a certain task is completed or an open screen is closed
- Setting Button: Button to set up options or statuses
- Radio Button: Button to select one of the given options
- Check Button: Button for selection of multiple options
- Toggle Switch: Control to select one of two options

Table List: Mostly, the text and image are arranged in the middle of the screen or the total page area is presented except the navigation and tab menu. Information segments may be classified and grouped depending on their relations or a list of them may be presented. this is the most frequently used type of UI. In consideration of the touch area, the 44-pixel height is recommended, and the screen is not divided. Scrolling is recommended for movement. It is desirable to insert an index or give a notice of change.

- Simple Table: The simplest format of table lists
- Visualization Table: List with visual elements in a table
- Group List: Table groups under certain categories
- Index List: Table list classified according to the items
- Card Index: A folder type of list
- Data Table: Table that is configured to present data sets

Invitation: A type of icon within a list or a table that leads to detailed information. The most fundamental role is to help using the service functions as intended. It may also be utilized for permission such as authentication within a page or for movement to another page.

- Dialogue Box: Alarming pop-up that responds to a certain situation
- Help: Help with descriptions of functions
- Tour: Statement on the screen or functions with longer sentences than in Help
- Prompt: Pop-up for inputs
- Toast Message: Message that appears instantly and disappears
- Alarming Bar: Area with alarming information
- Play Control: Control for music and video clips
- Keyboard Tool: Tool that appears above the keyboard
- Scroll: Control for vertical or horizontal movement on the screen

Because of the intrinsic limitation of a small screen size, the quantity of information that can be displayed in a mobile device is inevitably limited: It is challenging to display all information in a single page on the mobile screen, and even if it is possible, containing too much information in one page may be rather disadvantageous. It is vital to display necessary results of searching only. In addition, it is recommended to provide a series of procedures through which a list of related results is provided for selection because the method of touch inputs is adopted. The arrangement types of searching results also need to be optional depending on the quantity of data.

- Searching Bar: Area of searching elements such as the searching window and buttons.

- Searching Result: Display and arrangement of searching results
- Filter: Presentation of searching results with certain items excluded
- Searching Field with Inputs: Searching field filled with search words.
- Automatic Completion: Sentences or words are automatically completed when a word or part of it is entered in the searching window
- Tag Cloud: A cloud of tags or key words
- Tools: a set of buttons with the control over certain tasks in a mobile display. Buttons may be arranged within a fixed area or as a pop-op menu depending on the situations.
- Menu Tool: A menu type functional control
- Situational Tool: A pop-up type tool for additional functions
- Inline Action: Tool within a table line

Feedbacks are a type of UIs that indicate a page error or status. They may indicate certain actions that a user takes in a mobile display or provide information that the user has not noticed. Feedbacks are essential because the app may fail to be registered according to the app store's review policy if it does not provide feedbacks on error-involving situations.

- Error: Error indication
- Progress: Indication of the current progress

3. Analysis of the Directional Nature of Touch Gestures

In the context of HCI, interaction is defined as a unit of processes, conversations, and behaviors of humans for interaction with computers and a series of procedures between humans and computers. Interaction in smart-phones is based on finger touches of a user on the device [5]. 'Touch gestures' are touches of a finger or multiple fingers on the screen for various manipulations [6]. Most mobile devices except certain PCs or smart-phones apply touch functions to web service. Because of the small size, interaction through finger touches is specifically for web service through smart-phones, not PCs. In particular, touch events of user motions are closely linked to screen transition and need to secure affordance that reflects realistic motions that are probable in real life [7].

Screen transition seems to be similar among different operation systems of smart-phones although the specific motion functions might be somewhat different. The most frequently used touch gestures in smart-phones include selecting an item by tapping on the screen with one finger lightly for a moment (Tab), zoom-in/out by tapping the screen twice quickly (double Tab), dragging on the screen with a finger (Drag), moving over a certain distance with one finger on the screen (Swipe), scrolling vertically or horizontally (Scroll), and flicking with quick scrolling motions vertically or horizontally to move around the screen or to another page (Flick).

To design touch gestures in a mobile environment, it is vital to taken into consideration sensor areas as well as visual elements. Ergonomical aspects also need to be considered for user motions that interact with the device. Such touch gestures are in close relation with screen transition that is likely to be directional. Features and directions of different touch gestures are presented in the following table:

Table 2. Touch Gesture and Direction of Screen Transition

Touch Gesture	Feature	Direction of Screen Transition
Tab	Tapping with one finger lightly for a moment	Reloading
Double-tab	Tapping the screen twice quickly	Zoom-in/out
Drag	Dragging on the screen with a finger	Vertical/horizontal movement
Swipe	Moving over a certain distance with one finger on the screen	Horizontal movement
Scroll	Scrolling vertically or horizontally	Vertical movement
Flick	Quick scrolling vertically or horizontally	Horizontal movement

Screen transition aims to create cognitive distinction between sequential scenes. For better understanding of information arrangement, it maintains the sequence of gaze shifting and motions and enhances attention to the screen by creating senses of tension and rhythm. Especially in interfaces, screen transition is effective in drawing user attention to the extent of dynamics, creating unique experience of that information. As a result, a user develops visual perception in response to dynamic feedbacks to his behaviors, and the accumulated experience requires the same perception for similar patterns, as the same perception is repeated, the level of presence is enhanced.

4. Analysis of Touch Gesture and UX Design Patterns

Mobile patterns that are most closely related to screen transition are navigation and invitation. Navigation shows a list of the most important items on the screen, and tab touch gestures are most frequently utilized. Tab gestures are for reloading and vertical or horizontal screen transition. Mostly, screen transition results from tapping on a menu list in the navigation that leads to a page of contents. Navigation is presented mainly in a form of table list or with tab UIs.

Tab UIs of navigation may be arranged on the top or bottom of the smart-phone OS or on both. They are usually hidden but appear from the bottom only upon certain touch gestures such as scroll-up or clicking an 'UP' button icon. This type of screen transition is commonly used in most mobile interest services with a format of UXs that users are familiar with. The list icon normally located with the tab UI on the top contains a navigation list that cannot be arranged on the same screen simultaneously. This displays the top-level menu or a collection of additional functions. This type of list is hidden normally but when the list icon is clicked on, it comes out, sliding either from left to right or from right to left. It slides toward the opposite depending on the location, but recently, some pages are reloaded for a complete transition into a new page. In this case, users might be confused with the proper touch gesture for screen transition that would lead to the original page. Thus, navigation items arranged on the top need to induce reloading through a tab gesture while a list of icons in the left or right side should induce horizontal

movement with left or right sliding depending on the location of the icon list. As for tab UI menus at the bottom, vertical sliding-up patterns are required in use of tab gestures.

Invitation is another type of UP pattern that is likely to involve errors in screen transition. Since it is located mostly in a line within a table, checking specific information may lead to transition of the entire page or opening/closing a part of the clicked cell in a format of a left/right slide. Some patterns are of an accordion format that opens or closes it toward the bottom. Even the same type of invitation may involve different patterns depending on the web sites. Thus, providing standardized patterns will minimize errors among users. In addition, invitation needs to provide feedbacks regarding horizontal or vertical movement upon screen transition for a specific cell. A pop-up type of invitation as well is required to provide feedbacks on closing a window or moving to another page. As for UX design patterns of invitation, tab gestures for left-side contents will have to result in sliding toward the right side to show the detailed information, and tab gestures for right-side contents will have to result in sliding toward the left side or the bottom.

5. Conclusion

Recently, the internet access rates via mobile devices exceeded those via PCs, and in particular, smart-phones are most commonly utilized in this area especially for data and information searching. The objective of this study is to provide consistent experiences to users who are already familiar with smart-phones, and the findings are as follows: First, basic characteristics of web contents presented in a mobile environment include personalization, ubiquity, convenience, differentiation, and district-based nature. Second, the information structure of mobile web service is different from that of PC web service because of the small screen size, and a unique feature of mobile environments is touch gestures that create specific UX design patterns. Third, touch gestures play the most important role in screen transition that is directional depending on the touch method. Lastly, because of the directional nature of screen transition, regular UX patterns need to be provided depending on the mobile design patterns. This study examines user experience of smart-phone touch gestures based on mobile design UX patterns, and as a result, it turned out that screen transition is a vital element in relation to user experience especially for navigation and invitation. In this respect, this study is of significance in that it provides consistent UX patterns.

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