International Journal of Multimedia and Ubiquitous Engineering
Vol.11, No.5 (2016), pp.65-74
http://dx.doi.org/10.14257/ijmue.2016.11.5.07

Types of Interactions and Feedbacks of Different Smart-Phone Contents

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Abstract

This study includes literature researches on interaction types for different contents in order to examine interaction and information perception among users. It turned out that information perception among users was in close relation with feedbacks. Repeated and lasting feedbacks result from touch events of fingers on the smart-phone screen, and these events maintain a series of rules. Touch events are most frequently used in a familiar user environment, and they are divided to several types: static feedbacks such as tap, double tap, and long tap; active feedbacks such as drag, flick, and multi-touch; and combinations of different types of feedbacks. Interaction types involve user tasks such as click, screen transition, zoon-in/out, and icon movement. UI elements include springboards, icons, navigations, controllers, table lists, etc. It turned out that the same interactions might be used among different UI elements. Most frequently used mobile internet service items include data and information acquisition, communication, leisure activity, GPS service, and economic activity in order. As contents were classified with corresponding UI elements based on these items, it turned out that the most frequently used elements were navigations and table lists, and that the corresponding interaction types were taps and drags. Since data and information acquisition was ranked first among goals of using smart-phones, tabs, an interaction type related to screen execution and hyperlink, were most frequently used. It also turned out that drag was often used for text-based contents, and this is because drag interaction was frequently necessary to scroll the screen upward or downward to read contents on a small smart-phone screen. Feedbacks result from interaction, and the most frequently used types of interaction are 'basic' and 'dynamic active' types. In addition, as UI elements were examined for different contents and interaction types, it turned out that the most frequently used UIs for contents were table lists, which involved interactions types such as 'tab,' 'drag,' and 'flick.'

Keywords*: smart-phone, smart-phone contents, interaction types*

1. Introduction

From smart-phones, tablets, and Smart TVs to glasses and watch type wearable devices, various forms of gadgets have come into the daily life of consumers. The advent of new devices and services has resulted in interface innovation, and 'touch-screen' is now the most familiar type of interface among users as smart-phones have been introduced. Since there are a wide range of formats, contents, and services, types of interfaces that function to connect devices and users also have repeated evolutions. Recently, for example, the 'multi-modal' interface has been firmly established as a mainstream. From keyboard and mouse touch for pen, voice, and motion controls, various interface types are applied to one device, which has contributed to more intuitive communication with devices. In

ISSN: 1975-0080 IJMUE

addition, interactions between humans and machines have advanced into a more natural type of communication.

The emergence of touch-screens made countless buttons for information manipulation disappear, and interactions through physical movements of fingers on the display are now dominant. Manipulation on a flat display, however, is inferior to physical manipulation in terms of sensibility, and makes it difficult to recognize the result of the operation. For this reason, there may be a gap between operation behaviors and cognitive thinking of users. Hence, artificial devices are necessary to help the cognitive process in a touch-screen environment.

The touch-screen interface is an active type of interface where the interactions between a user and the device are implemented through a direct physical contact on the screen. Since the touch-screen interface makes it possible to choose objects directly on the screen, learning it is easier than in the existing computer environment, and the decision-making process through manipulation is faster. Compared to other input devices such as mice and keyboards, the cooperative operation between hands and eyes is more efficient, and no separate physical space is necessary for input devices because the input and output devices are combined in this interface. In addition, it is possible to set up a user interface and buttons depending on the user classes and applications, which is more flexible than interfaces based on hardware keys.

Users are already familiar with these smart-phone interfaces, and the platform environment has already entered the step of maturity. Thus, no additional learning is necessary for using them. Accordingly, smart-phone contents approach users with a series of rules. The objective of this study, therefore, is to grasp specific rules of such contents, analyze existing interaction types, and provide new interaction types that will enhance the value of user experience.

2. Theoretical Background

2.1. Interaction and Information Perception

The dictionary definition of 'interaction' is a behavior, influence, or action between two. It is a combination of the two words - 'inter' which means two parts or interactive subjects and 'action' which means a behavior [1]. In terms of HCI, interaction indicates a series of procedures between computers and humans in the process that a person makes use of computers. According to Sharma (1998), humans recognize environments by means of senses such as sight, hearing, smell, and taste, and communicate through external elements such as hands, bodies, faces, and voices [2]. This is basically an interaction between humans, and interaction at the interface between a human and a system emphasizes cognitive aspects of a user with the focus on the behavior that a human utilizes computers. In this respect, designing an interaction involves not only elements visible on the screen such as simple buttons and images but also elements that are invisible on the screen but affect behaviors of humans and devices. The interaction between computers and users have been implemented by means of keyboards and mice in a single modal format, and the keyboard-based interaction is mainly through text inputs. Recently, voice commands or gestures on or over touch-screens are commonly used for interaction.

Information processing of humans includes perception, processing, and behavior in order. Stimulations from outside are recognized by sensory organs, and the information is sent to and processed by the central nervous system. Kantowitz (1989) [3] presents a human information processing model, which is also divided to the steps of perception, central processing, and behavior. This model is designed to grasp interactions among decision-making devices while they are carrying out tasks. The MHP (Model Human Processor) of Card, Moran & Newell (1983) [4] consists of three sub-systems - Perceptual Subsystem, Cognitive Subsystem, and Motor Subsystem. This represents the order of sensing certain stimulation by means of sensory organs, recognizing it in the brain, and reacting by moving hand muscles. A human consists of the input system, output system, and cognitive system, and each of these three systems has its own memory and processing devices: The cognitive processor accepts information from outside and then keeps the memory in visual or auditory image storage. The information in storage is processed by the cognitive processor, stored in the long-term memory, and lastly, the motor processor processes the memory unit or information stored in the long-term memory, which leads to human behavior shown externally.

2.2. Feedback

The term, 'feedback,' is widely used as a concept of stimulation or reaction after a user takes a certain action. A feedback provides the user with information of how the task has been carried out and what has been the result [5]. In other words, a feedback presents a reaction to a certain action taken, information of a successful task implementation, and whether a certain behavior may continue [6]. When a feedback is provided, a proper combination of audio, tactile, verbal, and visual behaviors are selectively used in consideration of the user environment or situation. As a user is provided with appropriate feedbacks on the given situation, he can learn the results of his behavior and what should follow thereafter. Thus, this is a very important concept in terms of usability and sensibility, and it includes all types of reactions while a user communicates with devices or media.

Feedbacks through smart-phones are divided into three: visual feedbacks with graphic effects, auditory feedbacks with sound effects, and tactile feedbacks with vibration. Visual feedbacks utilize basic visual and formative elements such as color, shape, layout, typography, graphic, and so forth. These include motion effects and changes in object colors, sizes, and shapes of icons and buttons as well as transitions. Auditory feedbacks consist of sound and voice. In general, humans respond to auditory stimulations such as sound and voice more quickly than to visual elements [7]. Tactile interfaces accept information through skin senses upon vibrations on a device. Vibration-based tactile feedbacks may utilize various elements such as vibration intensity, frequency, duration, *etc.* Compared to visual and auditory senses, the tactile sense is difficult to be informationized, and tactile feedbacks are not of great help in shortening the task time. When they are well harmonized with other types of feedbacks, however, positive effects in sensory aspects may be brought in such as reduction of the running time and psychological burden [8].

A multi modal indicates an interface environment where humans communicate with systems such as machines and computers by means of multiple senses. When two or more senses are combined, the effects can be enhanced with lacks of a single sense complemented [9]. However, this is not absolute: Senses are subjective nervous elements, and the understanding and use of interfaces are decided exclusively by the user. Unlike an analogue keypad, a smart-phone has no physical separation through which a user can sense the border between buttons unconsciously. Thus, feedbacks play an important role in terms of interaction as a clue that indicates whether a certain action is successful in a smart-phone environment. In this type of environments, multi modal feedbacks can be effectively utilized to enhance the usability in a user experience of interaction. However, it is not always necessary to provide multi modal feedbacks in every task: Users may have different preferences in feedback elements depending on the touch events, and the level of satisfaction also may be different depending on the situations [10]. Furthermore, multi modal feedbacks may decrease the level of satisfaction. In the process of examining feedback elements, therefore, it is vital to analyze user preferences and take into account the given situations. In a touch-screen environment with physical characteristics little involved, smart-phones pursue user-centered designs of visual perception.

In her book, "Information Design (2004)", Tanaka Izumi defines 6 different interaction design processes [11]. Among these, feedbacks are defined as an essential element to be examined in the process of visual and element designs. In this regard, feedbacks are expected to induce behaviors in the process of design examination. Feedbacks need to make the flow of user tasks efficient, save manpower, and prevent errors. Since smart-phones provide settings for individual users' use preferences with mobility maximized, it is difficult for all users to experience the same feedback. In the smart-phone environment that has entered the step of maturity, however, feedbacks seem to show regularity, and the corresponding tasks on the part of users are already decided. This is a type of interaction.

3. Analysis of Interaction Types

3.1. Interaction Types Depending on Touch Events

As for touch events through fingering, a user's finger functions as a pointing device instead of a mouse or a keyboard. Just as a mouse has basic interaction types such as pointing, click (double click), and dragging, finger touching on a touch-screen has interaction types that are embodied on the screen.

Touch events may be classified a bit differently depending on the mobile devices: Dan Saffer (2008) [12] classifies types of touch interface events depending on the user behavior and the purpose. His method of classification organizes events that may occur not on certain devices but on general touch-screen devices. Even the same events are subdivided and classified further depending on the types. On the other hand, events utilized in mobile device touch interfaces such as double tap and long tap are excluded.

In input interactions through finger gestures, such functions as screen movement, zoom-in, and zoom-out are readily implemented through multi-touching, which enhances the usability of mobile devices as well as satisfies sensuous aspects as users find touch-based direct manipulation interesting. Since fingers are often used, however, the accuracy of manipulation might be inferior with the risk of malfunction increasing if the touching area is too small. For accuracy, users may need to learn and practice gestures, and thus the way of interaction should not be overly complicated with the consistence secured throughout the system.

Basically, touch events result from tap inputs. Dragging over an object or the entire plane is another way. Other expressions such as flick also may be utilized in application of the base technology such as accelerating sensors. Touch events are divided mainly to basic and active events although there are various combinations of inputs in addition to them. Interaction types depending on touch events are summarized in the following table:

Table 1. Interaction Types Depending on Touch Events

Class	Interaction	Description
Basic	Tap	Briefly touch surface with fingertip.
	Double Tap	Rapidly touch surface twice with fingertip
	Long tap	Keep on touching the screen for a while

Active	Drag	Move fingertip over surface without losing contact
	Flick	Quickly brush surface with fingertip
	Multi-touch	Push two touching spots simultaneously
Combination	Hold&drag	Hold a certain coordinate while moving the target in four directions
	Hold&Flick	Hold it while moving fast in four directions and let the motion continue in the direction of progress even after letting go of it
	Hold&Rotate	Symmetrical displacement from the input coordinate or rotation after multi touching
	Hold&Free	Free movement with no fixing axis in four directions
	Drag&Stop	While moving along the fixed axis in four directions, it suddenly stops on the coordinate in the 'Hold & Drag' status
	Flick&Hold	Hold the screen in the middle of 'Hold & Flict' motion to stop it

'Basic' interaction shows static feedbacks with no drastic change on the screen while 'active' interaction shows dynamic feedbacks such as zoon-in and movement. Combinations provide dynamic feedbacks mainly of screen movement or rotation. Input styles relying on visual feedbacks such as touch events may lead to usability inferiority unless an event gives tactile feedbacks. To address this problem, multi modal feedbacks of visual, auditive, and tactile senses in a multi modal interface are taken into account.

3.2. Interaction Types and UI Elements

Users rely mainly on the visual sense to obtain information. According to psychological researches, the visual sense of humans is not a passive sense that accepts simply what is seen mechanically; rather, selective perception based on visual feedbacks includes both consciousness and unconsciousness. In a conscious state, visual feedbacks become the most important indicator of a task success or failure, but in an unconscious state, it is unable even to recognize the execution of a task. However, auditive and tactile senses can inform the user of task execution even in an unconscious state through physical sensory organs, and it is possible to predict or present the next behavior of the user. Thus, feedbacks need to be provided in reflection of the use context. A user is likely to have a regular pattern of use, and related US elements include such items as spring board, icon, navigation, searching, table list, feedback, controller, sliding menu, *etc.* Most frequently used interaction types are 'basic' and 'active.' User tasks and UI elements depending on the 6 types of touch events are summarized in the following table:

Table 2. User Tasks Depending on Interaction Types

Interaction	User Task	UI Element
Tap	Menu selection, hyperlink, reading, number key, input, screen movement	Springboard, icon, navigation, keyboard, searching, table list
Double Tap	Image zoon-in/out, exit from the current screen	Photo image
Long tap	Moving to a new tap, pop-up menu, area selection	Springboard, icon, photo, navigation, hyperlink
Drag	Movement on the screen, phone call receiving	Springboard, icon, content screen, controller, keyboard
Flick	Screen turnover, item movement	Springboard, content screen, slide menu
Multi-touch	Rotation, zoom-in/out	Game, icon, photo image, content screen

3.3. Interaction Types Depending on Contents

According to 2014 Survey of Mobile Internet Use conducted by the Ministry of Science, ICT, and Future Planning, the main purposes of using smart-phones include acquisition of data and information, communication, leisure activity, GPS service, and economic activity. The most frequently used types of service are messaging service, news, games, photos, and videos in order. The goals of using mobile internet service include 'data and information acquisition'(99.0%), ‘communication’ (97.5%), and ‘leisure activity’ (89.0%) in order. The goals of using smart pads include 'data and information acquisition’ (84.0%), ‘leisure activity’ (75.0%), and ‘communication’ (69.2%) in order.

Data and information acquisition includes interest-arousing articles such as news and life information, and most contents are text-based. Communication includes basic functions of communication devices such as phone calls and e-mail. Messaging service and web communities that provide chat window or user list services are utilized. Leisure activity includes hobbies and interest-arousing contents including multimedia elements such as games, movies, and music. GPS service includes mapping, path-finding, and spot locating. Economic activity includes shopping and banking. Based on UI elements used for different contents, interaction types may be classified as follows:

Table 3. Interaction Types Depending on Contents

Class	Contents	UI Elements	Interaction Types
Data and information acquisition	News, life info., other information searching, web surfing	Navigation, keyboard, searching, table list	Tap, Double Tap, Drag, Flick
Communication	E-mail, messaging service, community, phone calling	Icon, navigation, keyboard, searching, table list	Tap, Long tap, Multi-touch, Flick
Leisure activity	Game, movie, music	Icon, controller	Tap, Double Tap, Long tap, Drag, Multi-touch
GPS service	Map, path-finding, spot locating	Map, path-finding, Icon, mapping, searching, table list	Tap, Drag
Economic activity	Banking, shopping, social commerce, omni-channel	Icon, table list, navigation	Tap, Drag, Flick

4. Conclusion & Suggestion

Unlike analogue keypads, smart-phones have no physical borders between buttons that can be unconsciously recognized. Because of the touch-screen environment with few physical characteristics, smart-phones pursue user-centered design of visual perception. A major clue of indicating the success or failure of a task action in a smart-phone environment is feedbacks. Repeated and lasting feedbacks result from touch events of fingers on the smart-phone screen, and these events maintain a series of rules. Touch events are most frequently used in a familiar user environment, and they are divided to several types: static feedbacks such as tap, double tap, and long tap; active feedbacks such as drag, flick, and multi-touch; and combinations of different types of feedbacks. Interaction types involve user tasks such as click, screen transition, zoon-in/out, and icon movement. UI elements include springboards, icons, navigations, controllers, table lists, *etc.* It turned out that the same interactions might be used among different UI elements.

Most frequently used mobile internet service items include data and information acquisition, communication, leisure activity, GPS service, and economic activity in order. As contents were classified with corresponding UI elements based on these items, it turned out that the most frequently used elements were navigations and table lists, and that the corresponding interaction types were taps and drags. Since data and information acquisition was ranked first among goals of using smart-phones, tabs, an interaction type related to screen execution and hyperlink, were most frequently used. It also turned out that drag was often used for text-based contents, and this is because drag interaction was frequently necessary to scroll the screen upward or downward to read contents on a small smart-phone screen. Flick interaction was often used mainly for table list elements probably because it was useful for screen transition when a user had to find target contents.

This study includes literature researches on interaction types for different contents in order to examine interaction and information perception among users. It turned out that information perception among users was in close relation with feedbacks. Feedbacks result from interaction, and the most frequently used types of interaction are 'basic' and 'dynamic active' types. In addition, as UI elements were examined for different contents and interaction types, it turned out that the most frequently used UIs for contents were table lists, which involved interactions types such as 'tab,' 'drag,' and 'flick.‘

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