Buying vs. Using: User Segmentation & UI Optimization through Mobile Phone Log Analysis

구매 vs. 사용: 휴대폰 Log 분석을 통한 사용자 재분류 및 UI 최적화

Myoung Hoon Jeon 전명훈*, Dae Yol Na 나대열*, Jung Hee Ahn 안정희*

Abstract To improve and optimize user interfaces of the system, the accurate understanding of users' behavior is an essential prerequisite. Direct questions depend on user's ambiguous memory and usability tests depend on the researchers' intention instead of users'. Furthermore, they do not provide with natural context of use. In this paper we described the work which examined users' behavior through log analysis in their own environment. 50 users were recruited by consumer segmentation and they were downloaded logging-software in their mobile phone. After two weeks, logged data were gathered and analyzed. The complementary methods such as a user diary and an interview were conducted. The result of the analysis showed the frequency of menu and key access, used time, data storage and several usage patterns. Also, it was found that users could be segmented into new groups by their usage patterns. The improvement of the mobile phone user interface was proposed based on the result of this study.

요약 제품의 사용자 인터페이스를 개선하고 최적화하기 위해서는 실제 사용자들이 그 제품을 어떻게 사용하는지에 대한 정확한 이해가 선행되어야 한다. 지금까지 사용자의 행동을 이해하기 위한 방법으로 주로 사용되어 온 면접이나 질문지는 사용자의 기억에 의존해야만 한다는 단점이 있으며, 사용자에게 특정한 과제를 부여하고 행태를 관찰하거나 실험을 진행하는 usability test, 사용자의 실제 환경이 아닌 주어진 환경에서 실험자의 의도에 따라 정해진 과제를 수행해야 한다는 제약이 있다. 본 연구에서는 이러한 단점들을 보완하고 실제 사용 환경에서 자연스러운 사용자 행태를 추출하기 위하여 사용자의 사용 로그를 저장하고 분석하는 방법을 활용하였다. 연구 대상 폰을 사용하고 있는 실사용자들을 마켓 세그멘테이션에 따라 선발한 후, 로깅 소프트웨어를 이용하여 약 2 주간 사용한 휴대폰 로그 데이터를 수집하였다. 또한, 로그 분석이라는 방법이 실제 관찰을 포함하지 않았다는 점을 보완하기 위하여 사용자들에게 같은 기간 동안 시간대별 일기 형식의 기록을 하도록 요청하였고, 추후 간단한 면접을 실시하였다. 수집된 데이터를 분석하여 주요 기능의 사용 빈도 및 사용 행태를 추출해내고 사용자의 세그멘테이션을 재분류할 수 있었다. 또한, 이를 바탕으로 새로운 형태의 사용자 인터페이스의 방향 또한 도출해 낼 수 있었다.

핵심어: User Behavior Analysis, User Segmentation, UI Optimization, Log Analysis

* LG Electronics UXD Gr.

전명훈 philart@gmail.com

Introduction

Machinery and systems get smarter and smarter. Literally we meet the rise of the smart machine [9]. They speak to their masters and suggest their favorite songs. For this, the system has to collect the user's selection history and to analyze her/his taste. Prior to this perfect personalization of the system, designers can divide users into several groups and customize the products for the tastes and needs of each group. Moreover, customization also needs to analyze user groups' behaviors. If it is so, do consumer segmentation group and user segmentation group coincide? It is a fundamental question of this study.

In the field of interaction design, methods for understanding of users' behavior include face to face interviews and task-based usability tests. The former has a weakness that it is fully dependent on user's memory while the latter has a weakness that it gives participants unnatural atmosphere of the given environment and tasks. This study adopts user log analysis to extract users' natural activities and to improve the usability of the mobile phone user interface complementing those demerits.

Related Works

The log analysis is often used in the studies for human behavior. Among them, the actively applied area of log is web site analysis. Web server logs can be used to glean a certain amount of quantitative usage information. Log information provides a baseline of statistics that indicates use levels and supports use and growth comparisons among parts of a site or over time [3]. It covers wide range of domains. Researches on user activity in the digital library through log analysis are easily found [5, 7]. Log Analysis is also shown in the analysis of internet shopping mall [6] and electronic newspapers [8]. These studies report not only some implications for the development of several services [5, 6], but also present the findings can be used to improve effectiveness of electronic systems and identify areas for improvement, ranging from user interface and functionality to documentation and product training [5, 7, 8]. However, it is not easy to find studies on the electronic devices using log analysis. There is a paper discusses the distinguished characteristics of mobile phone-based Internet users [10]. But it is also about web log not the mobile phone itself. A prior work successfully demonstrated the effectiveness of log analysis on the improvement of the user interface of digital TV [2]. The research founded frequency of main functions and a remote controller and other usage patterns of a TV through a month logging. They tested the accuracy of the result of log analysis comparing to result of the interviews. Unlike in web log analysis, in the study of electronic devices, it was impossible to analyze anonymous users, so 40 families were selected across Korea. In the case of large products like TVs or refrigerators, direct observation such as ethnography or contextual inquiry can be used. However, mobile phone has some constraints such as a small screen and private contents. Therefore, tracking user' activities can be an alternative.

In log analysis, the information on user behavior can be culled automatically and manually [5]. This study adopts not only quantitative analysis through calculation of summary statistics but also qualitative analysis examining semantic clues on usage flows. As prior work points out [3], log analysis is not the perfect and needs to be accompanied with other methods. We asked users to keep a diary by time and had short interviews with participants.

Marketers generally have segmented consumers based on diverse standards such as their age, sex, location, occupation, life style, key buying factors, and objective of the product. However, these standards are constructed not to analyze users using products but to analyze customers buying products. For user Interface designers, the standards of segmentation must be user behavior. User behavior includes frequency of use, importance of functions, and usage flow, etc.

In this aspect, personas theory suggests an effective method to interaction designers. Personas are hypothetical archetypes of actual users. Personas method has shown the wide range of successful case studies which include an entertainment system in flight, a tool making web site, scanners [1]. The important point is to make user personas not customer personas. User personas must be constructed based on the end users considering their real environment. The result of this study can be used to construct mobile phone user personas.

Group	A	B	C	D	E
Characteristics	Luxury The most Frequent Call	Fashionable Trendy	Fun Trend Follower	Focus on Voice Call	Sensitive to price Thrifty
Key Buying Factors	Function Brand	Design Function	Price Brand	Price Usability	Price Robustness
N	7	11	12	10	11

Table 1. Market segmentation of LGE's mobile phone

Method & Process

We used a specific model of LGE's mobile phone (KH-1300). The model was turned out in early 2007 and it was 3G phone which incorporated high-speed internet access and video telephony. It had an mp3 player and a camera.

50 users who bought and used the KH-1300 phones over a month participated in the study. They were recruited by market segmentation and consisted of five groups (see table 1).

Participants were asked to visit our laboratory two times. In the first visit, a starting session proceeded. Above all, the goal and process of the study were explained. After agreement on the experiment condition, they signed the confidentiality contract. Then, logging software was downloaded in their mobile phone and the setting values were checked by the coordinator. Meanwhile, a short interview was carried out. After two weeks, each participant visited our laboratory again. Stored log data were downloaded and logging software was removed from their phones. For two weeks, participants kept their diary by time and the diary data were used for contextual analysis of use.

Logged data were extracted as text file format. Logged data were analyzed by Microsoft office excel 2007 and Microsoft office access 2007. First, descriptive statistics of each item presented usage frequency. Next, we analyzed line by line to obtain a specific usage flow.

Figure 1. Sample of accumulated log data

Results and Discussion

As a result of the analysis of logged data, we gained frequency of menu access and key press, the changed setting values, used time and storage, and context analysis. Based on these usage analyses, users were regrouped into three segmentations.

Total frequency of menu access of 50 participants for 14 days was 109,747. Average frequency of a subject for a day was 156. Only the numbers of module change were counted. Thus, for example, from in time of message mode to out time of message mode was calculated just one. Among them the most frequently accessed menu was multimedia menu (57.5%), and next was message (27%) (see Figure 2). The most rarely accessed menu is sound (0.29%). In the case of hot key access, right navigation key is the most frequently accessed (5404, function: message) and is followed by send key (4789) and soft1 key (3782, function: menu). Menu structure is not merely decided by one element, but these frequencies can affect menu order.

Over half participants turned off the button feedback sound (60%). We cannot remove feedback sound from the phones but need to consider this phenomenon carefully and think alternative like various vibrating patterns. 49% of participants preferred normal font size to large font size (18%). This might show people prioritized aesthetic to visibility if it guaranteed above a certain level of usability. When the storage of message box was full, people chose automatic deletion of received messages instead of denial of new reception (86%). Data connection was changed from 115kb to USB (98%).
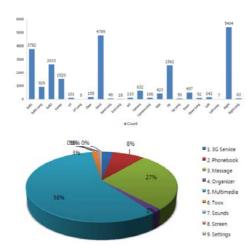
Figure 2. Reorder of 2nd depth menu by use frequency

The most important fact of the setting values was that most of participants registered some items in 'my menu' (98%). My menu is a kind of short cut to favorite functions. Alarm / morning call (72.55%) was the most frequently registered items in 'my menu'. Subway map (41.18%) and memo (33.33%) followed it. Several improvements are possible. We can include these functions in 'my menu' as default values or put these functions into hotkeys. Through more studies, we can make these functions accessible from the idle screen.

Specific scenarios composed by queries from user interface designers were analyzed. The rate of cancellation in 5 seconds after key press showed above 10%. These might mean key press without reason was higher than expected. The meaning was followed later of this paper. The frequency of hot key cancellation appeared in direct proportion to the frequency of hot key press. Right navigation key (450, function: message) is the most frequently cancelled. Soft1 key (400, function: menu) and send key (350) followed it (see Figure 3). Calling pathways were analyzed. The first was from the call history (45.99%), the second was by auto completion (27.74%), and the phonebook search was next (17.47%).

When they input numbers on messages, most of them preferred changing into numeric mode (97%). The fact that segment D (100%) and E (23%) used long keys relatively more to input numbers was intriguing. Mode change still seemed to be difficult task to rare-use groups. When scrolling (a page is displayed over a screen), many of users unexpectedly used side hot key

(46%). These taught us that if convenient function was once learned, users did use it.
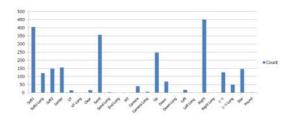

Figure 3. Frequency of hotkey cancellation

Use of end key (66%) on ending call was higher two times than slide down (34%) though the KH-1300 phone was slide type. This might be also affected by prior learning. Multi-tasking usage was beyond our expectations. When they wrote messages, the number of access to camera album was a few and the rate was 0%. Similarly, while playing mp3, their use of other menus did not occur frequently (8.77%). Especially, segment A (3%) and D (3%) hardly used other functions while listening to music.

We described used time and storage by segmentation. Segment A showed the highest calling and answering number (No.318, 14days average) and just used a few functions registered in 'my menu'. Segment B showed the highest rate in composing messages (9 hours), sending and receiving messages (No.1160), taking photos (No.99), and photo storage in a phonebook (541KB). Segment C was very much interested in using media such as mobile viewer (42792KB), mp3 storage (267MB), playing mp3 (7 hours), and playing games (4 hours). Segment D held a dominant position in message box storage (68367 byte) and downloaded image storage (380 KB). The highest tendency of voice memo storage (12846 KB) of segment E coincided with the lowest in use of text message.

Based on the above analyses, users of mobile phones were reorganized into three types, communication type, entertainment type, and restriction type. Just segment A was regrouped as communication type. They used the phone for business and they sent and received the call the most frequently as mentioned. For communication type, calling-centered user interface design might be needed. We could improve the search type or raise the accessibility to frequent partners.

Entertainment type included segment B and C. They looked the highest involvement in mobile phones. Above 50~60% of most of the items were occupied by this type.

They could be called "Thumb-Generation" [4] who used short message service whenever and wherever. They loved to use multimedia such as game, camera, and mp3 player. For them, a mobile phone was a necessity beyond the way of communication. In context analysis, their rate of hot key cancellation was the highest. We could infer that they always gripped the phone as a fingering or toying object. Brand new user experience elements could be studied for this new generation, for example, application of unique material (e.g. rubber or wool), affective use of vibration, etc.

Finally, restriction type showed the lowest involvement in mobile phone. The participants in this group used more storage in voice memo and message box. Since this type people were relatively older than other group people, they seemed to seek significance in those message data. The other possibility might be that they did not learn to use short message service. They often used 'my menu' in the same ratio of communication type. It meant that they used a few restricted functions. Therefore, in the aspect of user interface, the operation of 'my menu' could be improved. In the aspect of service, their favorite functions or services could be revealed more accurately through FGI and depth interviews. Moreover, accessibility to them could be raised and more storage could be provided with.

Conclusions and Future Work

Through gathered log data from users' mobile phones, users' behavior patterns were tracked. Based on these results, five consumer segments were regrouped into three segments. Implications for user interface optimization have been still extracted. It is possible to compose personas in mobile phones based on these characteristics of user groups. Furthermore, the result of these works would be applied to successfully design the user interface of mobile phones.

We are planning to carry out similar researches in Europe and America. Perhaps, difference by nationality and culture could affect users' behavior pattern and these factors might be added. In the future work, we could raise the reliability of log analysis conducting FGI and usability test integratedly.

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