A Study of Usability on Internet Map Website

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Abstract. This study assesses a Taiwan Internet Map website by adopting the three commonly used means in usability assessment, namely Coaching method, Interview, and Observation. For determining the problems involving Interface Design and usage, thirty individuals with no prior experience with the website were recruited and underwent a usability assessment for each of the two typical tasks set by the focus groups. The results showed that: (1) Excessive information has been displayed on the homepage, and the ways of categorizing and naming are distinct from public cognition. Base on the principle of minimizing user memory loading, simplifying user interface to the full extent is suggested. (2) The names of options on the user interface should be more in conformity with common language used, and avoid bias that users may associate with. Thus each name of the options shall be amended accordingly. (3) Considering users' reading convenience, the visual design of the web page shall be revised to exhibit simple and consistent text for enhancing reading comprehension. (4) Results of this research provide guidance to website designers to better meet users' needs and preferences.

Keywords: Internet Map website · Usability · Interface design · Map design

1 Introduction

Since the 1980s, the rapid development of computer networking has unfolded a new Internet era that is dominated by transmission and application of graphic messages, notably in the form of maps. Under the Internet environment, the easy and fast upload and download of messages has led to a new species of maps- Internet Map, and created novel scenarios of map cartography and applications. Based on the above background, this research takes the "Taiwan Map", a mobile e-map, as an example to discuss the query design of Internet maps, and uses usability engineering's Focus Groups and Coaching Method to look into the problems users may face with the query interface. Hopefully, the results can be useful reference in the interface design of Internet maps. This research Objectives are following:

(1) With usability engineering, examine the user interface design of a representative Internet map and evaluate its usability.

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(2) Discuss the problems with the use of Internet maps, and analyze the complexity of typical work steps and related user satisfaction; the results hopefully will provide useful reference for future interface design of Internet maps.

2 Literatures

2.1 Internet Map Characteristics

Shi Qingde and Wen Zhuda (2002) suggested the following Internet map characteristics: (1) more convenient map application: the exponential growth of Internet map data sources will make the application pervasive, reaching the so-called evolution of cartographic democratization; (2) ever faster cartography and message delivery: Internet is advantaged in high speed and unrestricted space, allowing conduction of cartography and relevant applications whenever needed; (3) rapid growth of map users: due largely to the constant growth of Internet users; (4) map diversification: map resources are versatile and comprehensive; although current queries are mainly based on the names of streets and venues, more query criteria are expected in the near future; (5) quick updates of map data: constant data updates assure of up-to-date map information; (6) easy processing: the map data are easy to copy and process, greatly reducing the data processing time; (7) personalization and practicality for daily use: the cartography process can be decided by users, fulfilling the so-called user-defined, on-demand maps that satisfy professional and daily needs of individuals and small groups, such as coffee shop maps; (8) dynamic analysis and mobile applications: implementation of geographic visualizations (GVIS).

2.2 Related Studies on Map Information Design

Text labels in map are used for explanation purposes. The place and direction of the texts will also determine whether the user will understand it or not. Phillips (1978) found 5 matters of concern while seeking and studying name of places: 1. Texts with the first letter in capital were easier to be read as compared with texts in all capital letters. 2. Bold fonts did not produce better readability. On the contrary, they made the map looked messy and produced a bad visual effect. 3. There was no close correlation between the choice of font and readability. 4. Texts should be placed in spacious and clear locations. 5. Grades and levels can be differentiated with colors and font size to minimize search time. However, unrelated differentiation will increase search time. Chang Chun-Lan (1993) showed that "lettering" is a general name for texts and numbers on a map, and is one of the cartographic languages. Lettering on a map is made out of 5 elements; the font, font size, text spacing and direction of text, location, and colors. Objects are differentiated by various fonts and colors. The size of the lettering reveals the grade or level of the object and its importance on the map. The location of the lettering and the difference in text spacing and direction of text showed the location, extended direction, and range of distribution of the object. Not long after, Robinson (1995) proposed in the principles of text labeling in map designs that: font size may be used to reflect the grades of a system but must be limited to 3 grades of size only.

2.3 Usability Engineering

In his book "Usability Engineering", Nielsen defines usability as related to all kinds of problems users may have in using products or systems. For the term "usability" comprehensively used in the concept of human-machine domains, Nielsen (1993) argued that evaluation of systems or user interface was not unidimensional; instead, it was composed of 5 criteria: (1) learnability; (2) efficiency; (3) memorability; (4) error rate; and (5) satisfaction. In addition, he also proposed quite a few methods to evaluate usability engineering. Herewith, only the methods used in this research are discussed. They are: (1) Focus Groups: it is a group of people - the users, who discuss a specific problem or interface, from the user perspective, in a more liberal and unstructured approach; (2) Coaching Method: this is an empirical approach with experts providing instant instructions when the testees encounter obstacles in the process of an experiment, so that the experiment can keep going; (3) Interview: recorded data only show what users have done, without elaboration of the causes; therefore, recorded data coupled with subsequent interviews can better display what was happening when the users were using the systems, and elaborately explain interesting phenomena.

3 Research Methods

This research comes with 5 phases: (1) selection of websites for tests: Internet maps that are representative are picked; (2) setup of typical tasks: the Focus Group discusses the queries steps of Internet maps and establishes typical query tasks; (3) implementation of experiments: the testees are asked to execute the typical query tasks and the process flow is recorded; after the queries are finished, a seven-layer subjective satisfaction evaluation and brief interviews are given; (4) decoding the browsing steps: analyze the recorded data of the testees' execution of the typical query tasks, including the steps and time used for the queries and the usability obstacles encountered; (5) comprehensive analysis: after the experiment and interviews, the query modes and evaluation data are integrated and compiled, in search for usability problems.

3.1 Research Scope

Limited to the resources and time, this research only takes the more representative Taiwan Map website (www.map.com.tw) for the experiment. It was a two-week online experiment, from June 22 to July 7 of 2013. This research aims to discuss the usability of the query interface only, not involving the framework and technical aspect of the Internet map itself.

3.2 Experiment Planning

The experiment was conducted in an research office of the Department of Visual Communication Design, National Yunlin University of Science and Technology. The lighting conditions were unified. The tools used include PCs, Hypercam5.0 capture

recording software, memorandum, and Microsoft IE V5.0 browser. The 20 testees both males and females, were college students, who are frequent Internet goers (averaged 8 h a week) but had never used this test website before - novice users in terms of this website.

3.3 Typical Tasks

The typical tasks are designed based on the literature information. Five Internet goers with both usability and website design backgrounds were invited to make up a focus group for discussion and setup of the tasks. The group discussion focuses on two aspects: (1) general user motives of querying e-maps and problems they may encounter; (2) most commonly used functions and operations of the target website, and its Internet connectivity allowing users to link through different paths to reach the same destination. Therefore, the principle of setting up typical tasks is to describe the jobs executed, imposing no specific process flow, and the purpose is to observe users' actual query behavior, so that their web browsing patterns can be examined for analysis of the website's usability. This research uses the following two typical tasks:

(1) Search for the location of Yilan County's Dongshan River Water Park and relevant road conditions, and then print out the result and send it out via an email.
(2) Search for the closest path from Taipei City Museum of Art to Printemps Department Store.

3.4 Research Process

See (Table 1).

Table 1. Research steps and relevant contents

Work steps	Description of contents
(1) Experiment preparation	Explains to the testees of the test workflow and things to note
(2) Execution of typical tasks	Prepares a list of typical tasks for the testees to execute, and allows them to, during and after the experiment, raise questions and express comments, which are recorded by the Hypercam software
(3) Likert Scale assessment	After the two typical tasks are finished, uses a Likert Scale (7 layers) to assess the testees' feel about the interface design and their satisfaction
(4) Post-experiment interviews	The interviews are aimed at the browsing behavior, by asking the testees about their hesitation in the workflow as well as questions and suggestions
(5) Data transcoding and analysis	1. The recorded data are transcoded into pure text format for analysis, and then the data of work steps and time spent by each testee in execution of the typical tasks are extracted 2. The ticks made on the Likert Scale by the 20 testees are summed, averaged and converted into percentage to spotlight things to improve
(6) Proposal on interface design	All the test data are compiled and analyzed to determine the website's usability problems, and then interface design suggestions are proposed accordingly
(7) Summarized analysis and conclusions	

4 Results

The research results are discussed in two aspects: one is aimed at the work steps conducted by the users on the typical tasks and the problems they encountered; the other is to explore users' feel about the interface usability and their satisfaction on the design. In the end, all the data are integrated and compiled to conclude the tested website's usability problems and set forth proposals on the design.

4.1 User Query Problems

The analysis of user behavioral patterns on e-map queries is based on the two given typical tasks, from which the users' actual clicking patterns are recorded and analyzed. The most commonly clicked items and webpage links as well as the time spent on each of the objects are observed, and then interviews with the testees are given to find out the causes behind the query patterns, and based on which design suggestions are proposed.

4.1.1 Typical Task I: A Single-Location Query

The testees are asked to execute the query of "where is Yilan County's Dongshan River Water Park located?", and print out the query result and then send it out via an email. The results show most of the testees can easily finish the task, except for a few who encountered some problems at certain points. The subsequent interviews reveal that most of the testees had no idea about what the categorized items on the navigating pages were talking about, and for a novice user, the information volume was too large to decide where to start with, thus they felt negatively about the interface. There are 16 out of the 20 testees who possess this kind of negative perception, in that the webpage contents became identifiable and associated with the users' recognition only after they had spent some time to get familiar with the entire webpage and then gone through trial and error for individual objects, one by one. This experience is like trying a lucky lottery.

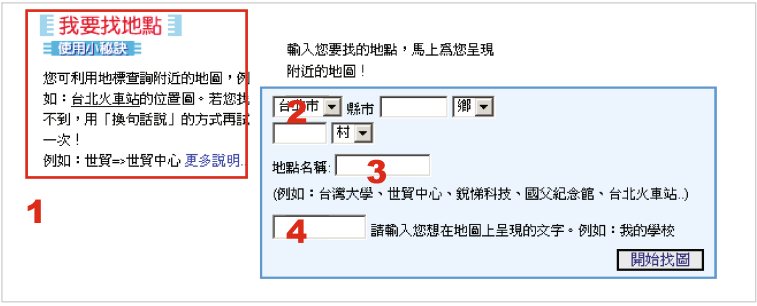

Fig. 1. Interface for location search

As for the query patterns, most of the testees clicked the "location" icon to enter the query. The pop-up interface then displays a pull-down menu for the testees to select "Yilan". The webpage also provides an interface for direct type-in of search text, but the too

many textboxes can easily confuse the users on which box to fill. About 11 out of the 20 testees mistakenly typed the searched location in the bottom textbox (Fig. 1: box label 4), resulting in wrong search, although they finally completed the search through several times of trial and error. This scenario is further consolidated in subsequent interviews; i.e. people generally do not care about text descriptions (Fig. 1: description label 1), either due to the small font or simply ignorance, and prefer to directly enter the search text via trial and error. Therefore, the user tips should be concise and easy to read, and placed at a noticeable spot on the webpage.

4.1.2 Typical Tasks II: An End-to-End Query

The testees are asked to search for the closest route from the Taipei City Museum of Art to Printemps Department Store. This typical task consists of two queries: first using the "location" function to search and position the museum, and then using the "path" function by entering the road name where the destination (the department store) is located to search for the closest route. The test result shows that most of the testees took some time to learn before being able to finish the tasks, except for two who finished the task in predefined steps, due largely to the occurrence that they could not find the "path" function and not even know how it works. There were 3 testees who had already clicked the "path" function but only to exit for not knowing how to use it, and they finally finished the task after assistance was provided. This scenario was consolidated in subsequent interviews, where most of the testees expressed their problems of finding an one-step "end-to-end" search which is supposed to have by default, thus causing a lot of unnecessary time for trial and error or even give-ups. In the course of executing the task, most testees were using the trial and error approach to first search for the location of the Taipei City Museum of Art, but only to encounter odd problems, such as the descriptive text and markings on the map unable to clearly convey the correct messages they are intended to, let alone indicate which road name is the correct one. The marking of targeted objects is another major issue here. There were 6 testees who executed the location search and got the resulted map display, but couldn't spot the marking of the target. The subsequent interviews reveal that this scenario could happen when the marking is not obviously colored or prompted with text. Therefore, markings should be distinctly colored and prompted with text, in line with the rule of thumb for webpage usability. In the process of typical task II, problems hiked quite a bit. The complex query and poor visual design are to blame. For example, the text arrangement and color design shown on Fig. 3 are not indicative enough - either unclearly marked of the spots or poorly readable of the text. In particular, the unidentifiable colors do not distinguish sections of roads to the destination and, what's worse, the colors are not defined and categorized. Apparently, the coloring and text description on this map need to be redesigned or reinforced.

4.2 Satisfaction Assessment and Post-experiment Interviews

By way of subjective assessment, the Likert Scale was given to the testees to tick on the indicators of operability, sense of design, friendliness, consistency and overall satisfaction, and the result is analyzed to examine the testees' feel about the website usability. The questionnaire analysis of the 20 testees are arranged in Table 2 below.

Table 2. Satisfaction by indicators

	Operability	Sense of design	Friendliness	Consistency	Overall satisfaction
Total score	91	84	90	96	89
Total average	4.19	4.52	5.12	4.61	4.87
Percentage (%)	59.85	64.57	73.14	65.86	69.57

Table 3. Post-experiment interviews and compilation of raised problems

Problem category	Problems raised
Functional design	The system does not have online help or instructions for novice user (2 times) In search for the closest route, user not knowing how to begin with and how to proceed (1 time) The system does not provide detailed addresses for location search (1 time) The zoom in and out buttons are confusing (1 time) The textboxes for starting point and ending point are confusing (1 time) A sense of unfamiliarity for first-time users, short of friendliness (1 time) Using trial and error gives a sense of taking chances by luck in search (1 time)
Query design	The end-to-end function is not found (10 times) Query text can be easily entered in wrong textboxes, resulting failed search (1 time) The query system itself has bugs from time to time (1 time) Too many options to locate the desired ones (1 time)
Hierarchical classification	Classification is not clear (2 times); upper layer is unclearly classified (1 time) To many functions to locate the needed ones (1 times) Users feel like unable to see the whole picture clearly (1 time) The pull-down menu may not contain the location to be searched for (1 time) Do not understand the "path" function and its use (2 times); navigation classification is difficult to understand (1 time) The navigation terminology and classification are difficult to grasp (1 time) Location markings could have been directly indicated on the map (1 time) Wrong clicks because of users' different recognition of classification (1 time)
Visual design	Destination not clearly marked - red dot markings not visible (3 times); locations could have been clearly indicated by direct markings (1 time) Poor coloring (1 time); poor color readability (1 time); road sections not well distinguished by colors (1 time) Colors not defined and categorized (1 time); color markings not explained and poorly designed (1 time) Text on map not visible, unclearly marked, and text size too small (3 times) Easy to enter query text in wrong textbox, resulting in failed search (1 time) Destination should be marked with text; the moving button is weird (2 times) Zoom in and out are confusing (1 time); not knowing the meaning of the 1–7 scale (1 time) The webpage layout is not consistent (1 time); flipping direction is unclear and inconsistent (1 time)

Table 2 shows that operability has the lowest 59.85% scoring, while friendliness has the highest 73.14% scoring. The overall satisfaction has a 69.57% scoring, meaning this website's usability is a bit above medium level. Listed in Table 3 are the testees encountered problems, which are induced into four categories: functional design, query design, hierarchical classification, and visual design, described as follows:

In terms of the functional design, the variety of functions but with a lack of decent arrangement make it difficult for users to decide where to begin with when doing the search. And the lack of online help and instructions for beginners make things worse. Other deficiencies include inadequate address data for location search, confusing zoom in and out buttons, unidentifiable textboxes for correct entry of query criteria; these shortcomings bring in a sense of unfamiliarity and unfriendliness for first-time users, who may do trial and error by taking chances in search for a location.

On the query design, the lack of direct end-to-end (location-to-location) query makes route search very inconvenient. Generally, users perceive a spatial construct through location recognition, therefore most users would prefer to have end-to-end search functions. Other deficiencies of the query design include the easy mistakes of entering search criteria in wrong lower textboxes causing failed queries, as well as system bugs and excessive options. On the hierarchical classification, it presents a substantial gap from what general users would perceive. Detailed questions compiled in the post-experiment interviews are listed in Table 3.

The research results show that the testees regard the classification as unclear and do not know its substances; the excessive functions are not helpful in pinpointing the needed ones and confuse the users; the addresses in the pull-down menu not necessarily contain all the addresses desired for search; and some naming is not consistent with the navigation terminologies and classification, and is difficult to understand. Visual design is decisive on usability. The relevant shortcomings, however, include unclear location markings, unseen red dot markings, and inadequate landmark information. Direct marking with descriptive text is therefore suggested. Color indication can be even more critical.

Most testees regard the map is not appropriately colored, making it difficult to read. For example, the sections of roads in the searched route are poorly colored, the color definition and classification are unknown, and the color markings are neither explained nor well arranged. Also, characters on the map are too small to be clearly seen and pinpointed, location markings are vague, search criteria can be easily, mistakenly entered in the lower wrong textboxes resulting in failed search, the zoom-in and -out buttons and the moving directions are confusing, and the meaning of 1–7 ratio is not well understood. These are the shortcomings to be improved in the visual design.

5 Discussion

This research has executed an experiment in which testees are asked to do two predefined typical tasks of search queries on an e-map, and the problems encountered by the testees during the search are recorded and analyzed, and then post-experiment interviews with these testees are conducted for cross-examination. This research has compiled all the experimental findings and concluded as follows:

(1) In the course of implementing the typical tasks, it is found that the homepage information is way too excessive and the classification and naming convention deviates from the public cognition. Based on the principle of minimal user memory burden, a brevity of user interface is strongly recommended and, specifically, the hierarchy of the data structure on the webpage should be simplified to 3 layers only.
(2) The naming of functional options should be based on the users' language, and associated thinking of the option names is crucial. In other words, the current naming needs a complete overhaul.
(3) For better readability, the brevity and consistency in the webpage visual design is strongly recommended.
(4) Results of this research provide guidance to website designers to better meet users' needs and preferences.

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