An Estimation Framework of a User Learning Curve on Web-Based Interface Using Eye Tracking Equipment

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Abstract. This paper addresses an estimation framework of a user learning curve on Web-based interface. Recent Web-based interface has rich features such as "dynamic menu", "animation" and so forth. A user sometimes gets lost in menus and hyperlinks, but gradually improves the performance of his/her task that is to find target information during the session. This performance change is in a sense considered to be "learning curve" as to the Web-based interface. To estimate the "learning curve" is necessary to evaluate the Web-based interface from the viewpoint of a user's task achievement. Our proposed estimation framework consists of two steps; One is to identify the relationships among the processing time, eye tracking log, and Web structure. The other is to identify the estimated formula as a "learning curve". This paper reports the relationship from preliminary experiment using several Web pages and eye tracking log.

1 Introduction

Recent Web-based applications have rich interface by using new technology such as "Ajax", multimedia plug-in and so forth. This movement will be enhanced when "HTML5" is practically used on Web browsers. On the other hand, such interface may become complicated appearance against problem-solving environment for a user's tasks. Therefore rich Web interface using new technology has trade-off on good-looking and ease-of-use from a user's viewpoints.

Usability of Web pages has been argued mostly from results of subjective questionnaires, error count measurement, processing time and so forth. Moreover "eye tracking" technology makes it possible to evaluate such interface design from ergonomics viewpoints. Even if such usability evaluation is well-executed by interface designers, practical situation by a user is still under fog, that is, the user learning curve is properly ascending one or not. Though the learning curve is considered to be significant indicator in several domains [1][2][3], Web-based interface is not enough to be evaluated by this viewpoint.

This paper addresses how to estimate the learning curve on user operations when using Web-based interface. Collected data of the processing time and eye tracking log against trial tasks are fused for identifying the estimation formula by using sysntheszing mathematical expression elements.

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2 Estimation Framework

2.1 Problem Definition

As mentioned in the introduction, Web-based interface design process needs to be evaluated the usability from "learning curve" The learning curve has been argued mostly about productivity under repetitive tasks such as assembling work, practicing exercise and so forth. Of course tasks by Web-based interface include repetitive operations to some extent, however, most tasks have slight variations to achieve. This fact causes a user to feel complexity and stress when using such interface.

Even if some experimental evaluation concerning the Web-based interface design shows good usability, the variation of tasks may lead to impair such usability in practical usage phase. Therefore it seems to be indispensable to estimate the learning curve for practicability. If such evaluation based on the learning curve is allowable from usability viewpoints, the interface design is endurable in spite of having some complexity. We believe this is significant for re-designing the Web-based interface.

2.2 Proposed Framework

Fig.1 shows an overview of our proposed framework. Given a Web-based interface and typical tasks, several trial operation logs by test users are collected. Collected data are the processing time of each task and eye tracking log. In addition to these data, structural information on Web pages is also significant. Since these data interrelate each other, statistical calculation identifying such relationship is firstly done. Then a certain interval data are used to estimate each user's learning curve and finally summarize the learning curve evaluation for the interface.

As indicated in Fig.1, there exist two S/W modules; statistical analysis module and estimation module. The key issue is how to estimate each user's learning curve, which are inherently non-linear characteristics. Therefore it is slightly hard to assume template formulas with parameters. Our idea is to prepare a set of arithmetic operators and basic mathematical functions and derive a formula by using a certain synthesizing method, for instance, genetic programming technique.

3 Preliminary Experiment

We executed preliminary experiments as follows in order to investigate what types of relationship could be induced by using the processing time, eye tracking log and Web structural data.

3.1 Web Pages and Trial Tasks

Table1 shows Web pages for trial tasks and Fig.2 shows an example of the Web page for tourists. These web pages are mostly provided by tourist offices.

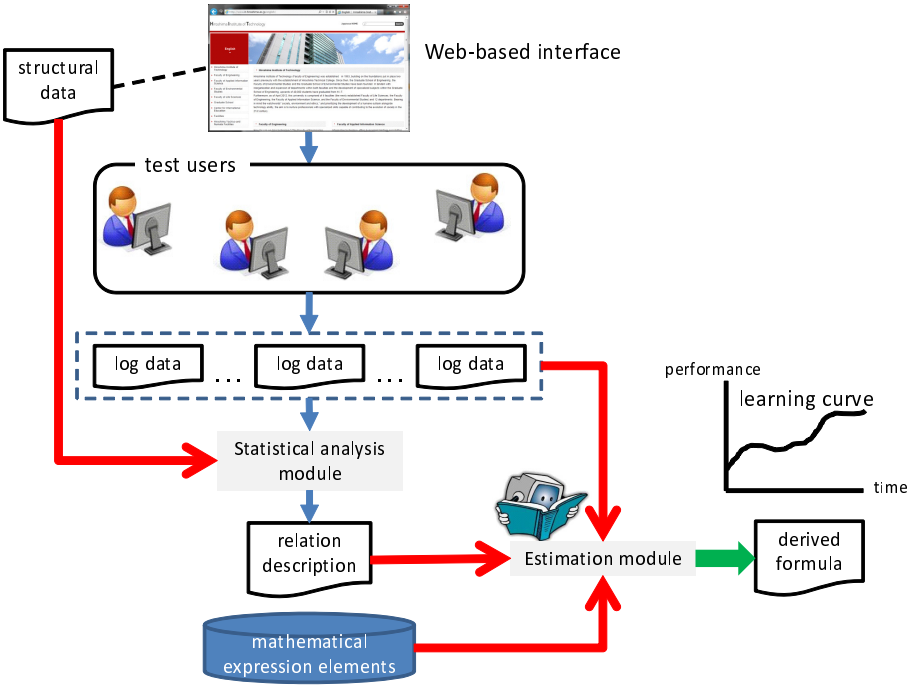

Fig. 1. Overview of estimation framework for the learning curve

Trial tasks are to search the appropriate information on "historical spots", "cultural spots", "adventure spots", "commercial area" and "trip information". As indicated in Table1, these pages are similar to each other. The layouts as shown in Fig.2 are also similar.

3.2 Result on Trial Tasks

The left-hand graph in Fig.3 shows the processing time concerning each site. In this experiment, the Web page of "California" is used to have a user understand the tasks and operations. During the task, the traversal time from one task to the other is recorded.

The right-hand graph in Fig.3 shows the detailed processing time concerning each site. Fig.4 shows the overlapped result of California Web pages and its eye tracking log as to the "historical spots" search task.

From this right-hand graph in Fig.3, a user learns the Web page structure from the first task of searching the information on "historical spots of California", which needs more processing time than the rest of tasks. After that a user smoothly executes the tasks on the rest of site Web pages.

Table 1. Web pages for trail tasks

Site		California	Great Britain	Australia	Germany	Jamaica
Web data	Total links	73	33	162	91	52
	Category menu	Yes	Yes	Yes	Yes	Yes
	Explicit Home menu	Yes	No	No	Yes	Yes
	Dynamic menu	Yes	Yes	Yes	Yes	Yes
	Search box	Yes	Yes	Yes	Yes	Yes

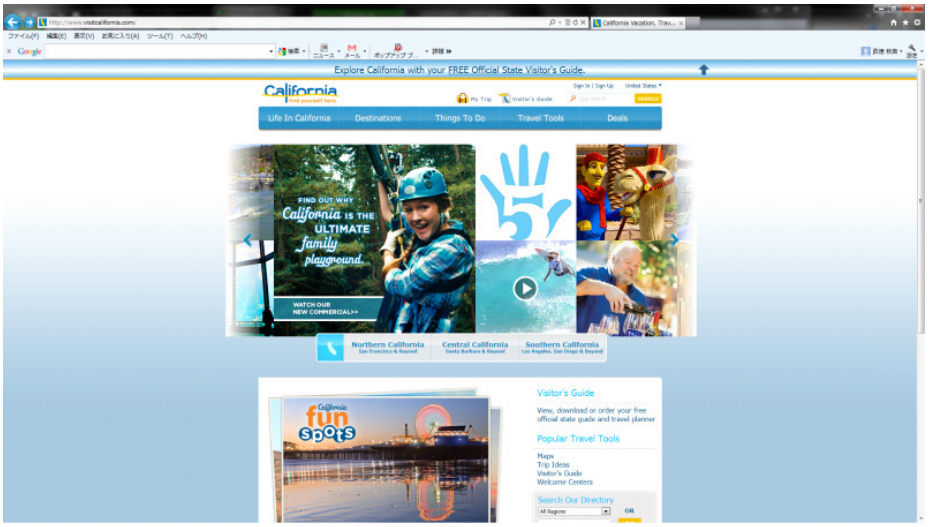

Fig. 2. An example of Web page for trial tasks

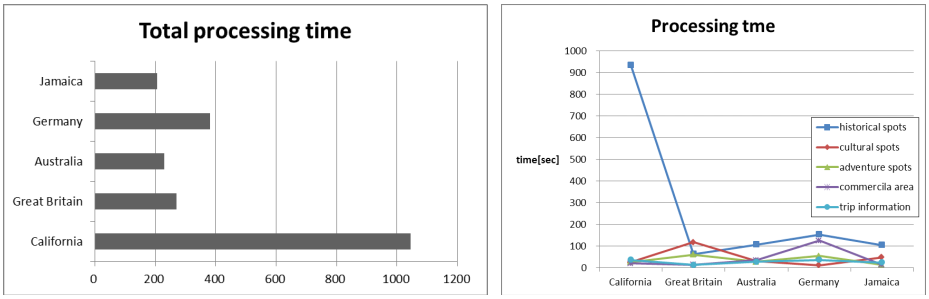

Fig. 3. Result for trial tasks

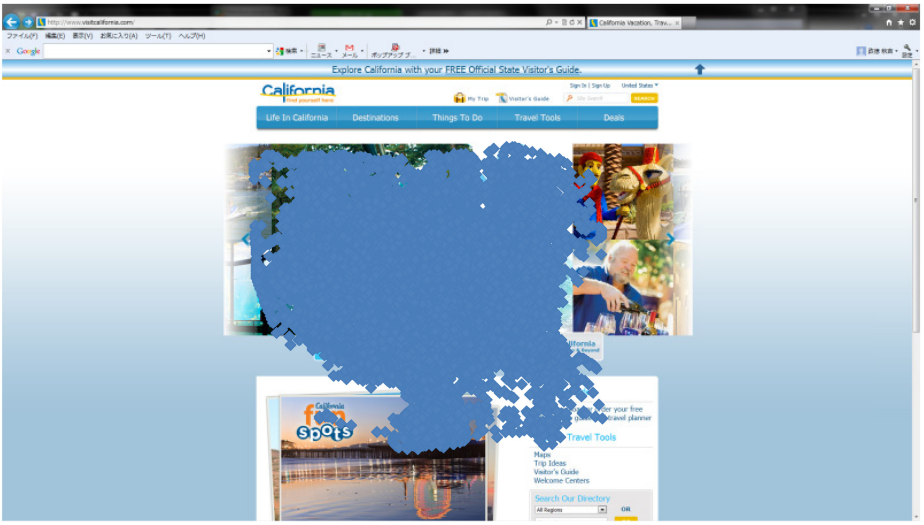

Fig. 4. An overlapped Web page and eye tracking log of "California"

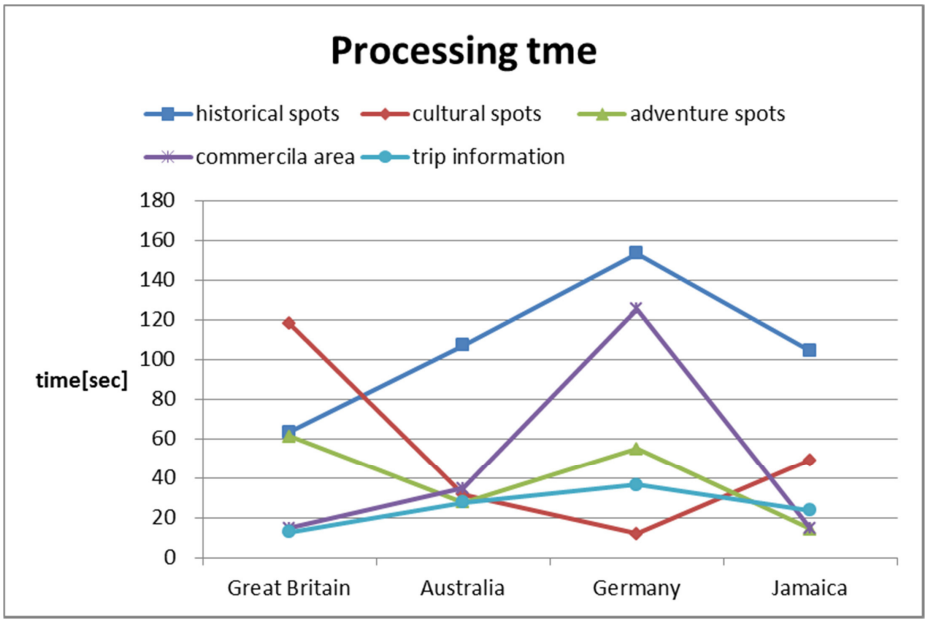

Fig. 5. Comparison result for trial tasks

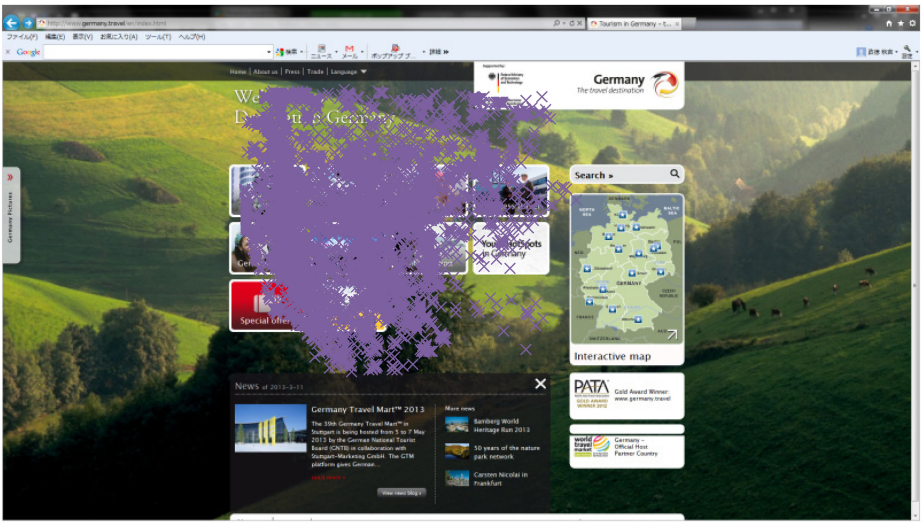

Fig. 6. An overlapped Web page and eye tracking log of "Germany"

Fig.5 shows the detailed processing time concerning sites except "California". From this result, we induced which factors of Web structural data affect the processing time.

Fig.6 shows the overlapped result of Germany Web page and its eye tracking log as to the "commercial area" search task. The "eye tracking log" shows the movement towards the menus including "Explicit Home menu item". This eye movement sometimes happens during a user's back and forth traverse of the Web pages. "Explicit **Home** menu item" is considered to provide quick jump to the starting point, however, this result indicates it is considered to make worse side-effect during a user's back and forth operations.

4 Conclusion

This paper addresses how to estimate the learning curve of user operations when using Web-based interface. Evaluation on Web-based interface is often discussed from usability viewpoints through collected data, for instance, subjective questionnaires, error count measurement, eye tracking log and so forth. The proposed framework aims to induce the estimated formula for the learning curve by using test users tasks which record each processing time, eye tracking log and Web structural information. Through trial tasks, there exists relationship which affect this approach.

References

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