

Detecting Low Usability Web Pages using Quantitative Data of Users' Behavior

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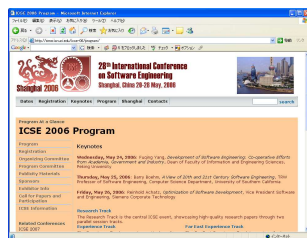
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Background

■ Designing attractive Web sites is an essential issue in business

- Web sites directly reflect the images and sales of companies [1]



Examples of Usability Problems [2]

- Long Scrolling Pages
- Dead links
- Inconsistency

[1] Kelly Goto, Emily Cotler: "Web ReDesign," Peason Education, 2002.

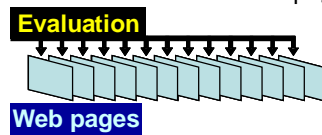
[2] Jakob Nielsen, "Designing Web Usability", New Riders Pub, 1999

Web usability evaluation

To find usability problems about a Web site

■ Usability testing

- Discover problems based on users' behavior as recorded by VTR
 - Discover serious problems which evaluators usually do not discover
 - Analyzing recorded data takes time because evaluators have to check the Web pages that the users browsed



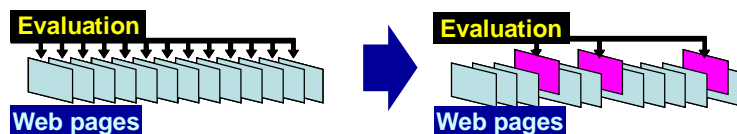
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3

Research goal and approach

■ To empirically verify a proposal of a quantitative usability evaluation method

- Various quantitative data of users' behavior have been proposed for evaluation
 - Gazing point
 - Browsing time
 - Mouse movement



- we hope to be able to efficiently identify : Low usability web pages

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4

Experiment

■ What is the quantitative data which can discriminate the low usability web pages?

- confirm the relationship between users' evaluation results and various quantitative data

■ Users' evaluation

- hard to use
- relatively hard to use
- relatively easy to use
- easy to use
- don't know



■ Quantitative data

- Browsing time
- Moving distance of mouse
- Moving speed of mouse
- Wheel rolling
- Moving distance of gazing points
- Moving speed of gazing points

Outline of the experiment

■ Subjects

- 10 users who are familiar with the Internet
- They have never visited the sites used for the experiment

■ Tasks

- Objective information: starting salary for a new masters degree graduate
- Web sites: 5 company's sites
The order of the sites was performed at random for every subjects

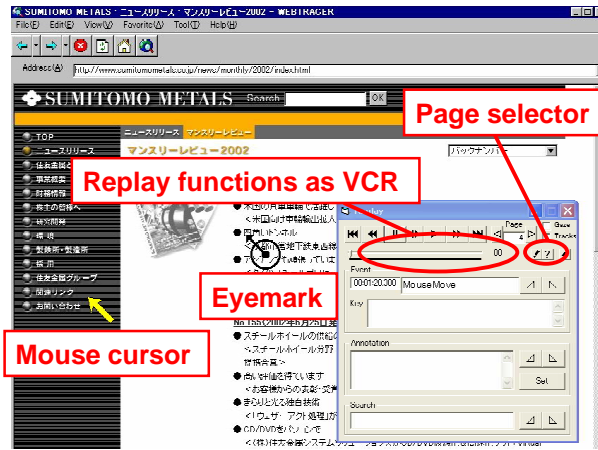
Experimental setting



Eye tracking equipment



- Quantitative data of users' behavior
 - Gazing point
 - Browsing time
 - Mouse movement



Integrated usability evaluation tool : WebTracer
We can monitor what the subject was actually looking at

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7

Experimental procedure

1. Task

- Quantitative data of the user's behavior are recorded using WebTracer
- Don't take any interruptions for questions

2. Evaluation by subjects

- Web pages that the subjects visited are displayed
- Subjects choose the ease of use for every visited Web page from the 5 levels

3. Interview

- About their comments on their search with replaying the record of user's behavior

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8

Analysis

- What is the quantitative data which can discriminate low usability web pages?
 - We test the hypothesis that there is a difference between the quantitative data for “low usability” and “others” pages

Evaluation by subjects

- hard to use
 - relatively hard to use
 - relatively easy to use
 - easy to use
 - don't know
- } Low usability pages
- } Others

t-test of “low usability” and “others”

Quantitative data of users' behavior for each pages	Low Usability (18pages)		Others (174pages)		t-test (significance probability P) <0.05
	average	standard deviation	average	standard deviation	
Browsing time (sec)	17.7	12.8	12.5	11.5	0.06882
Moving distance of mouse (pixel)	1267.9	717.4	1170.3	1186.0	0.61434
Moving speed of mouse (pixel/sec)	95.6	70.3	111.7	79.3	0.40922
Wheel rolling (Delta)	606.7	995.9	246.2	592.4	0.14885
Moving distance of gazing points (pixel)	8743.3	5808.3	4445.8	3815.9	0.00628
Moving speed of gazing points (pixel/sec)	515.6	102.5	374.4	126.9	0.00001

have both significantly different standard deviation and means

Analysis

- What is the quantitative data which can discriminate the low usability web pages?
 - Difference between the quantitative data for “low usability” and “others” pages
 - ⇒ Moving distance of the gazing point is long
 - ⇒ Moving speed of the gazing point is high

Analysis

- What is the quantitative data which can discriminate the low usability web pages?
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 - Discriminant analysis of “low usability” pages

Discriminant functions

Quantitative data of users' behavior	discriminant coefficient	constant term	discriminant boundary
Browsing time (sec)	0.0391	-0.5898	11.5
Moving distance of mouse (pixel)	0.0001	-0.0897	1186.0
Moving speed of mouse (pixel/sec)	-0.0026	0.2703	79.3
Wheel rolling (Delta)	0.0009	-0.3781	592.4
Moving distance of gazing points (pixel)	0.0003	-1.7411	3815.9
Moving speed of gazing points (pixel/sec)	0.0090	-4.0217	126.9

above discriminant boundary, the page is discriminated to low usability

test of statistical hypotheses

		Evaluation result by subject	
		Low Usability	Others
Discrimination result	Low Usability	Power of test (1-b)	Type I error a
	Others	Type II error b	Power of test (1-a)

- **Power of test (1-b):** The evaluation results by subject are **low usability**
The discrimination results are **low usability**
- **Type II error b:** The evaluation results by subject are **low usability**
The discrimination results are **others**
- **Type I error a:** The evaluation results by subject are **others**
The discrimination results are **low usability**
- **Power of test (1-a):** The evaluation results by subject are **others**
The discrimination results are **others**

Discriminant analysis result

Quantitative data of users' behavior	Power of test (1-b)		Type II error b		Type I error a		Power of test (1-a)	
	pages	%	pages	%	pages	%	pages	%
Browsing time (sec)	9	50.0	9	50.0	37	21.3	137	78.7
Moving distance of mouse (pixel)	8	44.4	10	55.6	57	32.8	117	67.2
Moving speed of mouse (pixel/sec)	11	61.1	7	38.9	99	56.9	75	43.1
Wheel rolling (Delta)	7	38.9	11	61.1	29	16.7	145	83.3
Moving distance of gazing points (pixel)	8	44.4	10	55.6	31	17.8	143	82.2
Moving speed of gazing points (pixel/sec)	14	77.8	4	22.2	45	25.9	129	74.1

We focus to clarify which quantitative data can detect low usability pages

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15

Discriminant analysis result

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14 of 18 low usability pages are detectable

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16

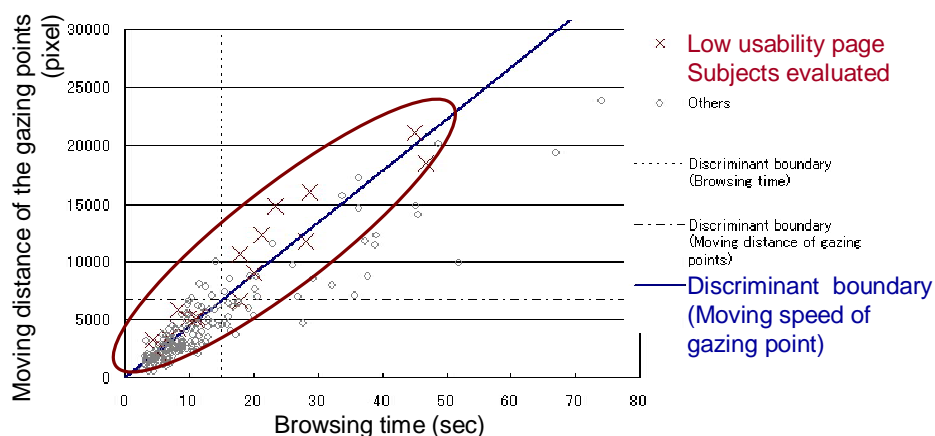
Analysis

- What is the quantitative data which can discriminate the low usability web pages?
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 - Moving distance of the gazing point is long
 - Moving speed of the gazing point is high
 - Discriminant analysis of “low usability” pages
 - Moving speed of the gazing point (Best detectable)
 - 14 of 18 low usability pages are detectable (= 77.8%)

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17

Scatter plot of low usability pages and other pages



Moving speed of the gazing point is best detectable quantitative data

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18

Discriminant analysis result

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- To make the power of test (1-b) higher
 - Large amount of Wheel rolling, 3 of 4 pages

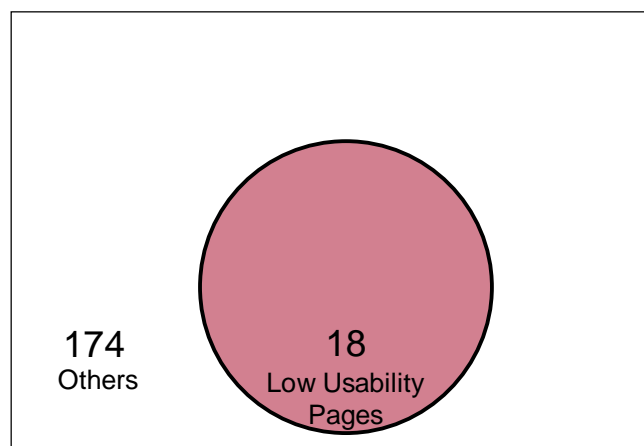
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19

Relationship between gazing point and wheel rolling

- Subjects evaluation result

192 pages

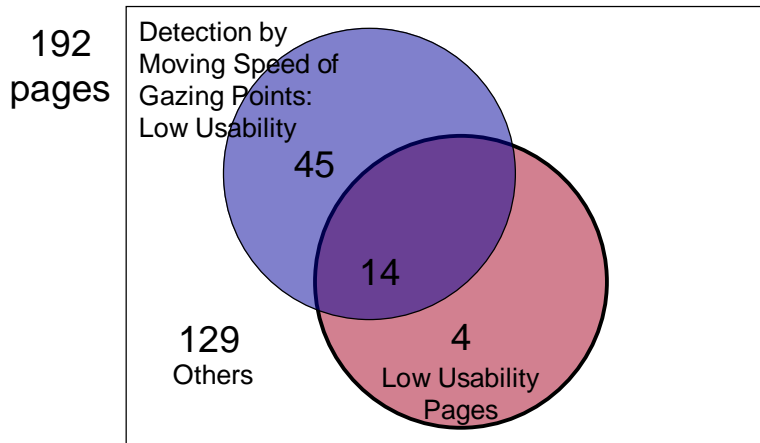


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20

Relationship between gazing point and wheel rolling

■ Subjects evaluation result

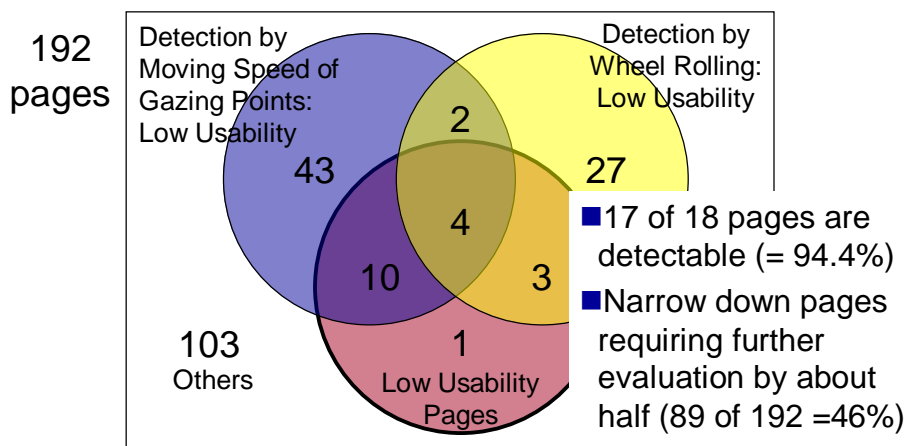


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21

Relationship between gazing point and wheel rolling

■ Subjects evaluation result



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22

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 - 14 of 18 low usability pages are detectable (= 77.8%)
 - + Wheel rolling
 - 17 of 18 low usability pages are detectable (= 94.4%)
 - Narrow down the pages requiring by about half

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23

Cause for false discrimination

- Users' behavior in 18 low usability pages
 - 17pages
 - Subjects get lost because a link is not found
 - "I couldn't easily find the link which leads to the objective information."
 - "I got lost because the menu layout is bad."
 - 1page (not detected)
 - The subject did not stray and clicked the link smoothly
 - subject can not found objective information under the link

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24

Discussion

- Why is there difference only in moving speed of the gazing point?
 - Moving of gazing point
 - While searching, all subjects continue moving
 - Browsing time
 - Not low usability even if browsing time is long
 - Moving of mouse
 - Moving differ from one subject to another
 - follows the gazing point
 - put mouse cursor on space area in web page
 - Wheel rolling
 - There are subjects not using a mouse wheel for scroll

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25

Discussion

- Why are the variables (moving speed of the gazing point and wheel rolling) selected?
 - When subjects are rolling the wheel, although the screen scrolls, the gazing point does not move too much
 - In the case of wheel heavy users, the moving speed of the gazing point is low

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26

Future Work

- More elaborate large scale experiments
 - This will clarify the relationships between the various types of quantitative data and the various issues regarding Web usability problems
- Analyze users' behavior within a web page
 - At this time, the experiment focused on searching across web pages within web sites
 - So, we need to analyze each web page to find out further usability problems

Conclusion

- A significant difference between the quantitative data for “low usability” and “others” pages appears in moving of the gazing points
- Best detectable quantitative data is the **moving speed of the gazing point**
 - 14 of 18 low usability pages are detectable (= 77.8%)
- More detectable by combining the **wheel rolling**
 - 17 of 18 low usability pages are detectable (= 94.4%)
 - Narrow down pages requiring by about half

End

Thank you!