Facilitating the Web Browser User Experience Through Thumbnail-Enhanced Tabs

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ABSTRACT
Most popular browsers used across platforms implement a similar tab system to help users navigate between webpages. These systems make it difficult for user to navigate between tabs when the number of tabs is more than 10. In this research, we develop a new tab preview system that allows user to see a thumbnail of the tab underneath its alias. This new system works as an in-place linear menu that attached with the tab alias.

In the research, we compare our system with the current system, where user can only the tab alias when they open more than 10 tabs. As this is a new system, we conduct parametric test with one-way ANOVA and non-parametric tests with Wilcoxson Signed Rank tests. We found that this enhanced view has helped to significantly reduce errors when navigating between tabs and have the potential to fully develop as new tab preview system.

Author keywords
Web browser, in-place, tab preview.

General terms
Design, Experimentation, Human Factors

1. INTRODUCTION
The proceedings are the records of the conference. ACM hopes to give these conference by-products a single, high-quality appearance. To do this, we ask that authors follow some simple guidelines. In essence, we ask you to make your paper look exactly like this document. The easiest way to do this is simply to down-load a template from [2] and replace the content with your own material. While very advanced and rich in functionality, modern browsers still present flaws to its users. Most popular browsers used across platforms implement a similar tab system to help users navigate between webpages. This system, which is placed at the top of the browser window, displays open webpages in a horizontal list. Throughout the list, each tab holds a short string of text that gives users a hint as to which webpage is open. This implementation of the tab system has been worked on for years, but some of its issues are still present to this day. In fact, the increase of multitasking in recent years has pushed the implementation to its limit, revealing the flaws.

There are important problems that are encountered when multitasking with the current browsers. Depending on the user's monitor resolution, the web browser window may not be able to display many tabs at once which means each tab occupies less space on the screen. Shrinking the tab size means that some information will be hidden to the user, which is potentially important in identifying the tab. Losing this information impacts how well the user can navigate the browser as well as how efficient they can be in finding their desired tabs.

2. BACKGROUND
The primary inspiration for researching better implementations of a browser tab system is the limitations of existing web browsers. Experience with many of the browsers available for various operating systems has demonstrated that these issues can be encountered often and could be designed differently. Additionally, there is little design changes between the popular existing browsers, as they all implement tab systems that are almost identical.

Existing implementations of browser tabs reveal two major problems in terms of user experience. The primary issue occurs when the browser window is too small, or the user opens an extensive list of tabs. In both cases, each tab shrinks in size and the tab title are shortened as a result. By truncating the tab's text, further information is cut from the user which increases confusion. Without this information, users may not be able to properly identify their desired tab. Following this primary issue, it is possible for tab titles to be fully displayed but still contain insufficient information about the webpage that they contain. Particularly, this problem is encountered when websites do not take advantage of dynamic tab titles.

Users cannot differentiate between two tabs holding different pages on the same website when both tabs only display the website's name as their title. Users that encounter these situations will find the browser increasingly difficult or confusing to use, as they require more time to navigate the interface. The time taken to search for specific tabs is also impacted due to the lack of tab information forcing users to search through each tab individually.

3. DESCRIPTION
To approach the issues detailed above, we designed a system that builds upon the existing browser implementations. Since the problem is concerned with the strings of text displayed on each tab, we decided to associate a thumbnail to each tab. By having thumbnails be aligned with the tab bar, users now have two identifying components to help distinguish tabs. The aim of this improved system is to give users an additional way to find their tab when the text is not enough.

To develop this tab system design and mock browser, we used the Processing language. To ensure that the system built closely resembles real browsers, we based the browser design on the Google Chrome browser. For the base version, we replicated the

basic functionality of the browser without any extensions (figure 1). For our implementation, we extended the existing version by adding the set of additional functionality described above (figure 2). Specifically, we added a horizontal list of thumbnails that is placed under the list of tabs. The thumbnails are hidden by default but can be revealed by the user when they hover over the tab bar. In addition to the enhanced view, users can also interact with the thumbnails. To navigate to a tab, they can user the cursor on the tab title or on the thumbnail itself.

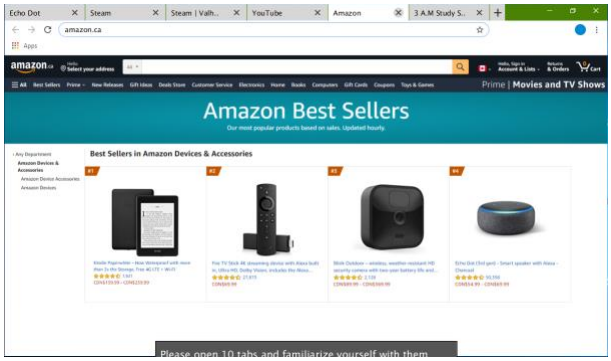

Figure 1. The base system with a few tabs open

Figure 2: The enhanced system demonstrating the extended tab with the built-in thumbnails

Throughout experimentation and testing, we modified the system to ensure it significantly improves the user experience. During development, we made the design decision to scale the webpage thumbnail to be as wide as the tab it lies under. This introduces both improvements and problems, such as thumbnails becoming clear when few tabs are open but too small when many tabs are on the screen. To solve this problem, we added the functionality to hover the cursor over a thumbnail to enlarge it. Another design decision that has an impact on the user experience is the sliding animation of the thumbnail bar. When the user hovers their cursor over the tab bar, the thumbnail view slides down from the top of the window which pushes the webpage down. We made the decision to push the webpage down instead of covering it so that users can still see the upper content. After observing the patterns of websites, such as the location of the important content, we concluded that the upper part of the page should not be obstructed.

As with the first design decision, this functionality introduced some issues. Particularly, we found that the enlarged thumbnail overlaps with the thumbnail to its right. As seen in figure 3, the Amazon tab to the right of the Kindle tab is hidden behind the enlarged thumbnail. After discussing the drawbacks, we made the decision to keep this iteration due to the additional space that would be taken over the webpage if it was displayed below the list.

Figure 3: The user hovering over the Kindle page thumbnail, which enlarges the image

3. EVALUATION

3.1 Goal

Using the system, we have built, we aim to improve the response time of users that navigate between the tabs in a browser. By adding thumbnails to each tab, we want to make it easier for users to identify their desired tab and select it quicker. A system with many tabs becomes harder to use, which impacts how quickly the user can reach their desired website. As a secondary goal, we also built the system to reduce the number of tabs the user clicks by mistake.

In this research, we will try to test 2 hypotheses:

- Hypothesis 1: It takes less time for users to select their desired tab when using our enhanced tab system.
- Hypothesis 2: Using our web browser interface is significantly different than using the normal browser in terms of errors
- Hypothesis 3: User prefer enhanced view over the normal view for web browsing and selecting tabs.

Performance data was collected from computer log with time and error. This data is analyzed with ANOVA test. The post experiment opinion is collected by Google Doc. Survey results was analyzed with Wilcoxon Signed Rank Tests. We choose $\alpha = 0.05$ for all tested conducted in this research.

3.2 Participants

For our experiment, we will select a total of 8 participants. To get these participants, we select students in the class (4) as well as

individuals that are not students in the class (4). The student of the class is familiar with Processing and the others are not. All of the 8 participants used web browser on a daily basis for work and study.

3.3 Description

During each evaluation, users complete four rounds of testing, with two being practice rounds and two being measured rounds. The evaluation begins with a short description of how everything will work, then the first round will begin. In the first round, the user is given a normal browser and will be able to freely open and close tabs. During this practice round, they can familiarize themselves with the base system, and the pages that can be displayed. Then, the user can choose to move on to the second round. During this round, they start by opening 10 tabs to view what each tab contains. Once 10 tabs are open, the system will ask them to return to specific tabs, all given in a randomized order. The system measures the elapsed time between the tab request and the user clicking on the correct tab, with any clicks on wrong tabs being recorded as errors. It is important to note that the tabs will be requested through text, for example "Go to the Amazon store page for remotes" will request them to find the Amazon tab that contains the correct store page. We measure the time taken for each request until twenty requests have been completed.

Once the first two rounds are completed, the participants begin the third round where they are asked to select 30 target tabs in a random order with the normal view. The fourth round is identical to the third round and ask the user to recall 30 tabs selected in a random order, but this time is with enhanced view. Once all four rounds are completed, we will gather data from the third and fourth round to analyze the differences between the two systems with ANOVAs tests.

After the participant complete the all the trials, they complete a short survey of 7 questions. These questions are rating base which the scale from Strongly Disagree to Strong Agree. The data formatted to the grading scale of 1 to 5 after collected and is used for our non-parametric tests.

3.4 Results

After conducting the experiment on 8 different participants, our group has found the following.

3.4.1 Task completion time

For task completion time, the means task completion time for enhanced view was 1899.8ms. This was 9.2% less than the means of 2092.20ms of normal view.

Table 1. Average task completion time for each participant

	Normal	Enhanced
Participant 1	2843.967	2626.200
Participant 2	3156.733	2225.200
Participant 3	1773.567	1671.233
Participant 4	1839.867	1761.300
Participant 5	1916.400	1795.700
Participant 6	1573.667	1575.033
Participant 7	2067.500	1984.200
Participant 8	1565.867	1559.167
Average	2092.196	1899.754

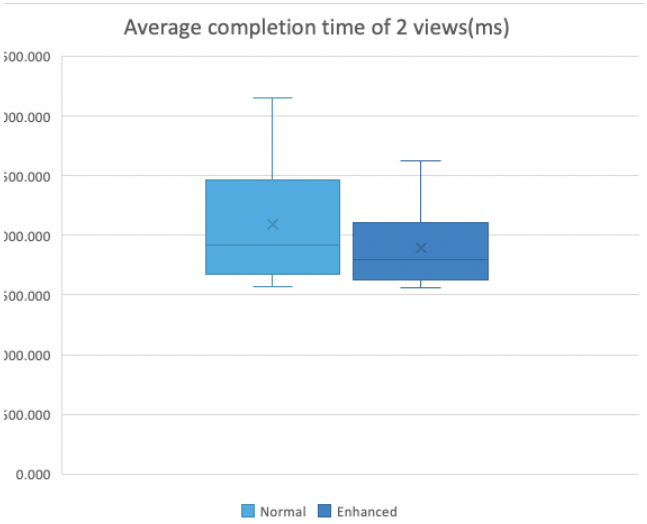

Figure 4. Average task completion time of 2 views

However, as there was substantial variation in the observation across participants, the difference was not statically significant as revealed in an analysis of variance ($F_{1,7} = 3.156$, $p > .05$)

3.4.2 Errors

For accuracy, there are 35 total errors in normal enhanced view mode and 13 errors enhance view, over the number of 240 trials for each mode. The error rate for normal view was 0.146. This was 270% higher than the error rate 0.054 of enhanced view. the difference was statically significant ($F_{1,7} = 10.205$, $p < .05$)

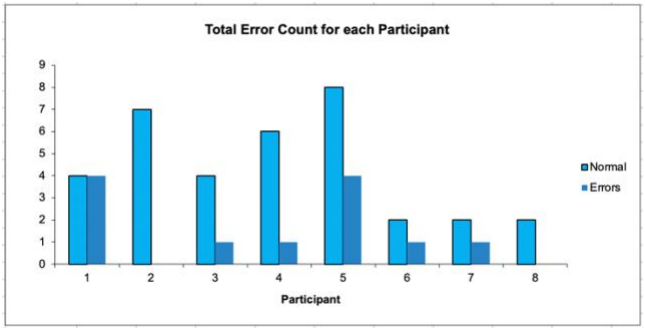

Figure 5. Total Error Count for each participant

3.4.3 User opinions:

For each section we asked the participant the 3 following questions:

- I found system mentally demanding to use.
- I found system easier to use.
- I found the system faster to use.

We also conclude a generic question as which system would they prefer.

5 out of 8 participants answered they would prefer enhanced view (System B) over the normal view (System A).

ID	I found system A	I found system B	How easy did yo	How easy did you	How fast did syste	How fast did systen	For everyday us
5	1	2	3	4	4	3	System A
6	2	4	5	2	3	4	System B
1	3	4	2	3	2	4	System B
7	1	3	5	3	4	2	System A
8	4	1	4	4	2	4	System B
4	4	3	2	4	3	4	System B
2	4	2	1	5	2	5	System B
3	5	2	2	5	2	5	System A
null	3	2,625	3	3,75	2,75	3,875	

Figure 6. Post system survey result

Using these data, we conducted 3 Wilcoxon tests as follow:

For the first hypothesis: "I found system A mentally demanding to use than system B", the null hypothesis cannot be rejected and remains tenable (z = -0.560, p = 0.5754).

For the first hypothesis: "I found system A easier to use than system B" The null hypothesis cannot be rejected and remains tenable (z = -0.845, p = 0.3980)

For the first hypothesis: "I found system A faster to use than system B", the null hypothesis cannot be rejected and. is remains tenable (z = -1.540, p = 0.1235)

Thus, we cannot reject any of the 3 null hypotheses.

4. RECOMMENDATION

We believe that we were successful in designing and developing a system that offers an alternate browser tab experience. Our system closely resembles a real-world web browser, which helped participants quickly adapt based on their previous browser experiences. By extending the modern implementation of a browser tab system, we were able to add significant functionality without changing the core mechanics of the system. We strongly believe that this system could be implemented into a real browser, and that people would be willing to use it.

While it is a possible alternative or extension to the usual tab navigation system, we recognize that some work can still be done to further improve the system. As discussed in the description, the thumbnail system does not erase all the flaws with tabs. An important feature that negatively impacted the experiment for participants is the placement of the enlarged tab thumbnails. We received feedback that in some situations the enlarged thumbnail covered their desired tab and slowed them down. Additionally, our system's browser did not have the functionality of resizing the window. This means that no matter the number of tabs, the window remained smaller than the screen it was tested on. While this did not impact the user experience, it may lead to an interface that is naturally harder to use since it is smaller compared to other browsers. If we were to start the project again, we would design a browser that can be resized to fit each user. A similar issue can be said about the thumbnails themselves, as they sometimes appeared pixelated or slightly distorted. Having a system that shows thumbnails that are more faithful to the webpage may have an impact on how well users can identify the tab by its image.

Based on our opinion and the results we have received from the survey; we believe it would be an effective alternative to the current implementation of the tab navigation system in term of error reduction. After making the necessary changes to fix the few issues that were revealed during the experimentation, it would work well as an optional extension for browsers.

5. REFLECTIONS

Overall, our research had followed the initial plan and archived the result we expected. Having a survey at the end of the experiment allowed us to collect very useful feedback on the state of our system. We believe that using ANOVA for the system data and non-parametric tests for the survey greatly helped us to properly make conclusions based on our results.

As for the development process, in a future project we would allocate more time to ensure that the UI does not have flaws such as the overlapping thumbnails. It would also help the participants to have more detailed instructions, since a few mentioned being confused by the system at first.

If we were to conduct a similar experiment in the future, it would be better to have more than eight participants. Having more participants would allow us to better measure the improvement that the enhanced system brings. While it may be specific to the context of this project, we would also begin looking for participants earlier in the process to ensure that we have as many as we can.

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6. ACKNOWLEDGMENTS

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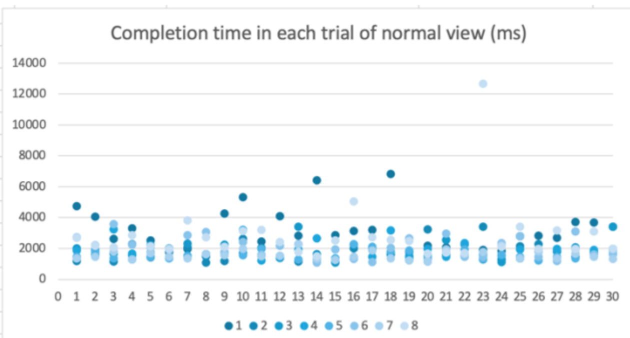
APPENDIX A – SURVEY QUESTIONS

1. Question: I found system A mentally demanding to use.
Measure: On a scale from 1 to 5, 1 being not demanding at all and 5 being very demanding

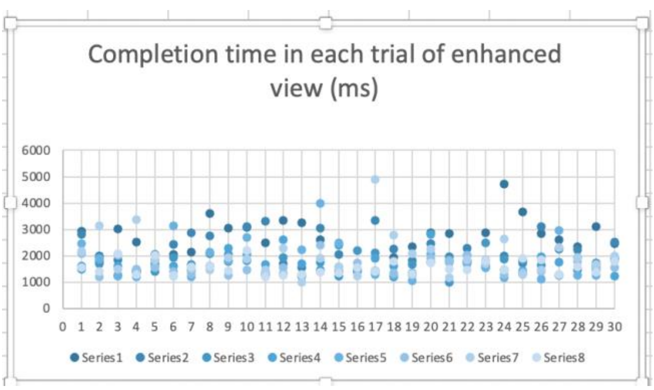
2. Question: I found system B mentally demanding to use.
Measure: On a scale from 1 to 5, 1 being not demanding at all and 5 being very demanding
3. Question: How easy did you find system A?
Measure: On a scale from 1 to 5, 1 being very hard and 5 being very easy
4. Question: How easy did you find system B?
Measure: On a scale from 1 to 5, 1 being very hard and 5 being very easy
5. Question: How fast did you find system A?
Measure: On a scale from 1 to 5, 1 being very slow and 5 being very fast
6. Question: How easy did you find system B?
Measure: On a scale from 1 to 5, 1 being very slow and 5 being very fast

APPENDIX B – CHARTS

1. Scatter chart for completion time in normal view



2. Scatter chart for completion time in enhanced view



APPENDIX B – TEST RESULT

1. ANOVA test result for task completion time

ANOVA_table

2. ANOVA test result for error

Effect	df	SS	MS	F	p
Participant	7	3056881.357	436697.337		
F1	1	148135.501	148135.501	3.156	0.1189
F1_x_Par	7	328552.176	46936.025		

Data_file: anova_input copy.txt

1. ANOVA test result for error

ANOVA_table

Effect	df	SS	MS	F	p
Participant	7	35.000	5.000		
F1	1	30.250	30.250	10.205	0.0152
F1_x_Par	7	20.750	2.964		

Data_file: anova_input copy.txt

APPENIDX C – PARAMETRIC DATA

Please refer to the Parametric.xls attached.