Gesture Navigation: An Alternative 'Back' for the Future

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ABSTRACT
This paper describes the evaluation of a gesture-based mechanism for issuing the back and forward commands in web navigation. Results show that subjects were able to navigate significantly faster when using gestures compared to the normal back button. They were also extremely enthusiastic about the technique, with several expressing their wish that "all browsers should support this".

Keywords: Gestures, web navigation, browser design.

INTRODUCTION
"The smallest of usability problems, when multiplied across thousands or millions of users, becomes a source of massive inefficiency and untold frustration" [3]. In this paper, we show that adding a simple gesture-based navigation facility to web browsers can significantly reduce the time taken to carry out one of the most common actions in computer use: using the 'back' button to return to previously visited pages.

The following fictitious scenario drives our evaluation: Microsoft and Netscape have released new versions of their browsers that support gestural navigation for the back and forward actions. We wish to understand whether these new features increase browsing efficiency, whether users quickly learn to use them, and whether users appreciate them.

GESTURE NAVIGATION: IMPLEMENTATION
To support our experimental scenario we constructed a web-site where each page contained a Javascript program that interacted with the browser. The web-site www.cosc.canterbury.ac.nz/~andy/gestureSite/ demonstrates the gesture system. Using an unaltered browser, the user 'flicks' the mouse, with the left button held down, leftwards to issue the back command and rightwards for forward. To disambiguate between flick commands and other left-button mouse actions, only movements of 35 pixels or more within 250milliseconds were identified as 'flicks'. These values were determined from a pilot study.

EVALUATION
The evaluation compares the effectiveness of gesture navigation with that of the normal back button.

The procedure was the same in all tasks in two experiments. First, the subjects were shown a path of nine web pages through which they navigated using an unaltered version of Internet Explorer. The web pages were familiar to the subjects prior to the experiment, and they were required to rehearse the path at least twice (and more times if they wished). They were then asked to follow the path *as quickly as possible* using the normal back button. Having completed all of the tasks in experiments one and two using the back button, they repeated exactly the same paths using the gesture interface. The rehearsals were used to minimise the impact of learning effects. Essentially, we were measuring expert performance of routine tasks. Tasks were first completed using the back button so that we could investigate any deterioration in subjective satisfaction with the back button after using the gesture system.

Experiment one compared the effectiveness of the two interfaces in depth-first navigation. The path followed four links on subsequent pages then backtracked with four successive back commands. This task represents a directed search style of web-use: for instance, searching for a faculty member's web page starting from a university's home page.

Experiment two examined the effectiveness of the two interfaces in breadth-first navigation, also called 'hub-and-spoke' navigation [1]. Hub-and-spoke navigation involves visiting a series of links (or 'spokes'), one at a time, off a central 'hub' page. Beginning at a 'start' page, the subjects followed a link to a main 'hub' page, then navigated to three 'spoke' links off that page, pressing 'back' to return to the hub each time. A final back command returned to the start page.

When using the back button, the mouse-pointing requirements of experiment two are much higher than experiment one. After selecting each link to a spoke page the user must point to the back button, and then point to the next page link. Fitts' Law [2] predicts that the back button will result in slower task performance. For this reason, a second factor for 'amplitude' was introduced in experiment two, allowing us to analyse the degradation of performance

Table 1: Questions 1 to 7 and mean(s.d.) responses.

Question	Mean(s.d.)
1. The back button is an effective means of page navigation.	2.95(1.13)
2. The back button allowed me to quickly navigate pages.	3.26(1.19)
3. The gesture system will allow me to navigate faster.	4.11(0.81)
4. The gesture system did allow me to navigate faster.	4.63(0.76)
5. The back button is an effective means of page navigation.	2.42(1.12)
6. The gesture system is an effective means of page navigation.	4.26(0.81)
7. The gesture system was easy to learn.	4.26(0.93)

as the distance between the back button and the links on the hub-page increased. The links on the hub-page were vertically aligned immediately above one another at one of three corners of the web page: top-left, bottom-left, and bottom-right to give three levels of amplitude 'low', 'medium' and 'high'. Mean distances between the back button and the group of links were 8.5cm, 14cm, and 20cm for the three levels of amplitude.

The performance data in experiment two were analysed using a two-factor analysis of variance with repeated measures. The factors were 'interface type' with two levels (back button and gesture system) and 'amplitude' with three levels (low, medium and high).

Subjective measures and subject details

Seven questions (5-point Likert-scales) were presented to the subjects to measure their satisfaction with the back button (both before and after using the gesture system) and with the efficiency and learnability of the gesture system: see Table 1.

The twenty subjects were all volunteer postgraduate Computer Science students familiar with web navigation. Each subject's training with the gesture system immediately followed solving experiment one using the back button. Training involved a brief (one or two minute) demonstration of the 'flick' gestures and explanation of the rules determining a valid mark. Each evaluation lasted approximately twenty minutes.

RESULTS

In experiment one, the mean task completion times for the back button and gesture systems were 6.1 (σ 1.1) seconds and 5.4 (σ 0.96) seconds. This is a significant difference ($t(18)=2.68$, $p<0.05$), showing a reduction of 11% in the mean task time when using gestures.

In experiment two, the mean time for the back button was 7.44 (σ 1.12) seconds compared to a mean of 6.09 (σ 1.19) seconds for the gesture system, giving a significant main effect: $F(1, 18)=82.2$, $p<.001$. The gesture system reduced the mean task time by 18%.

The mean times for the three levels of amplitude were not significantly different ($F(2,36)=1.17$, $p=0.32$). This is unsurprising because amplitude has no effect on task completion time in the gesture system. As expected, the interaction between factors 'interface type' and 'amplitude' was significant: $F(2,36)=6.78$, $p<0.01$. Figure 1 reveals the interaction: as the amplitude increases, the mean completion times for the back button increase, but the task times for the gesture system remain relatively constant.

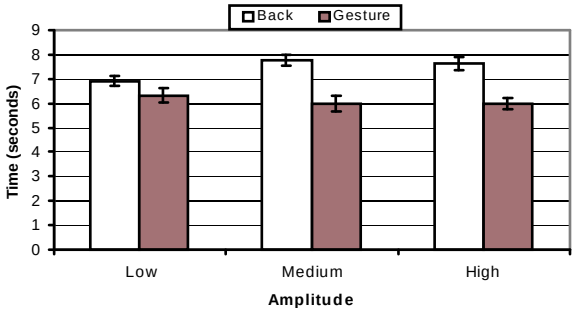

Figure 1: Mean times (and standard errors) in experiment two for the normal and gesture interfaces.

The subjects' comments go far beyond the quantitative results in demonstrating the effectiveness of the gesture system. Half of the subjects were extremely enthusiastic about the system, making comments such as "Fantastic", "That's amazing", "Really really nice" and "Brilliant!" Eighteen of the twenty subjects rated the efficiency of the gesture system more highly than the back button (questions 5 and 6, Table 1). The remaining two subjects gave the same rating for both interfaces. The mean responses for the effectiveness of the back button and gesture system were 2.42 (σ 1.1) and 4.26 (σ 0.8), giving a significant difference: Wilcoxon Signed Ranks, $N=17$, $z=3.46$, $p<0.01$.

The few negative comments on the gesture system concerned limitations in our Javascript implementation of gesture recognition. These resulted from the failure to recognise gestures initiated over page links, and a momentary highlighting of page text during gestures. These problems would be relatively easy to overcome in a commercial implementation.

CONCLUSIONS

Our results show that using gestures to issue the back and forward commands in web browsing can significantly increase the efficiency of common web browsing activities. Users' subjective ratings also showed a strong preference for the 'flick' system, and their comments were extremely positive. We encourage commercial software developers to incorporate gesture navigation into their browsers, and to investigate other areas where gestures can be used to increase the efficiency of common user actions.

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