

# **Usability Evaluation of Navigation Interfaces that Allows Holding a Tablet with Both Hands / Revital Turgeman**

## **Abstract**

Tablet computers (tablets for short), are hand-held touch-screen devices which are a hybrid between mobile phones and personal computers. They are lighter than personal computers and therefore easier to carry around, however they are bigger than mobile phones and therefore allow for better visualization (e.g. for watching movies) and more complicated hand gestures (e.g. for games) than mobile phones. Tablets also allow for some computer functionality, but are not designed for full day office work as their operating systems typically stem from mobile phone operating systems.

Tablets have been with us for a long time, but their popularity rose dramatically with the launching of the iPad in 2010. The iPad introduced the captive touchscreen technology that (unlike the resistive touchscreen technology) uses the fingers' conductivity and allows for multi-touch gestures. According to Statista (Statista, 2017) there are currently over a billion tablets used worldwide.

In 2010, right after the iPad was launched, Norman & Nielsen had published an article entitled "Gestural interfaces: a step backward in usability" (Norman & Nielsen, 2010). They claimed that when using touchscreens anything you show and touch can be an interface, and as a result there are no standards and users do not know what to expect. There is a lack of established guidelines for users' gesture control.

The World Wide Web is hyperlink based system. A hyperlink, or simply a link, is a reference to data that the reader can directly follow by clicking on it. Hyperlinks give users flexibility to easily create their own path within a website or app, based on their current interest (Budiu & Nielsen, Usability of iPad Apps and Websites - 1st edition, 2010).

The tablet is a hand-held device, and when selecting from a menu or pressing on a link, the users need to let go of their dominant hand leaving the tablet's weight on the non-dominant hand only. Holding the tablet with a single hand causes muscle stress, which in turn could lead to musculoskeletal disorder (Lozano, Jindrich, & Kahol, 2011). Moreover, the bigger the tablet is, the more stress the users have on their neck and shoulders, with large tablets also stressing the upper trapezius muscles, causing hand, shoulder and neck fatigue and shorter holding time (Pereira, Miller, Huang, Odell, & Rempel, 2013).

Top menus are common navigation systems on websites and mobile applications. Using them makes the user to let go one hand from holding the tablet so they can click the screen and navigate, and leaving the tablet weight on the other hand which causes fatigue. Because of these ergonomic problems, it is clearly desired that users hold the tablets using both hands.

In this study, we tested the effect of the placement of the menu (top vs. side) on participants' selection time, ease of use and hand tiredness. We also tested our wheel menu where there is a wheel at the tablet side allowing the users to choose from the menu by rotating the wheel and then clicking on it.

We compared the use of top menu, side menu and a wheel side menu we designed. We asked our 35 participants to perform 20 random menu selections using each of the three interfaces, using iPad2.

The side menu and the wheel menu both appeared at the dominant hand side, which was right for the large majority of users. All three interfaces were coded in HTML. The wheel menu was slightly more complicated to develop as it used the "swipe" movement to control the wheel rotation. In order to do so, we used the 'Hammer' JavaScript classes. These classes are open source that allow the browser to support for touch gestures at touchscreens (see: [hammerjs.github.io](http://hammerjs.github.io)). We developed two versions of the interface, one for right-handed participants and another for left-handed ones. The entire experiment was recorded in a Java based log file we developed specifically for the experiment. More data were collected using a questionnaire.

Our results clearly support the use of side menus when designing for tablets: selection time using side menu was the shortest, it was considered easier to use, and resulted in less hand tiredness. The side menu was also preferred by the majority of the participants. These results make sense, as unlike top menus in which users are required to manipulate with their dominant hand leaving the entire tablet weight on the non-dominant hand, side menus allow users to hold the iPad with both hands and manipulate the menu using their thumbs.

Our wheel interface scored low on the objective measures (longer selection time, more mistakes) and was not well received by the participants. A possible reason for this may be that when using a wheel interface, the users do not directly select from

menu by pressing on the desired option, but manipulate the wheel which in turn allows for selection.

In the discussion section possible solutions to solve this problem can be found that can be examined in future research.

**System No.**

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