Computer Standards & Interfaces xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Computer Standards & Interfaces

journal homepage: www.elsevier.com/locate/csi

A comparison of mobile form controls for different tasks

Gencay Deniz[a,c], Pınar Onay Durdu[b,c,*]

[a] Department of Computer Engineering, Graduate School of Natural and Applied Sciences, Kocaeli University, Izmit, Kocaeli, Turkey
[b] Department of Computer Engineering, Faculty of Engineering, Kocaeli University, Izmit, Kocaeli, Turkey
[c] Human Computer Interaction Research Laboratory, Department of Computer Engineering, Kocaeli University, Izmit, Kocaeli, Turkey

ARTICLE INFO

Keywords:
Mobile form controls
Performance with mobile form controls
Usability
User study

ABSTRACT

Web forms are the design tools that are used for gathering inputs from users in interactive applications. These forms are mainly developed for desktop applications, and transferring them directly to a mobile context did not work well most of the time. Since user experience with mobile devices is different from with desktop computers, the efficiency and accuracy of form controls (buttons, text boxes, drop-down boxes, radio buttons, etc.) in the user interface is essential.

In the scope of this research, a user study was conducted to compare the efficiency, effectiveness, and user satisfaction of mobile form controls. In the user study, an experiment was set up to compare four different form controls that were frequently used in mobile web applications, considering variation by task type and size of data set, in the context of two different touch-based smartphones, one running the iOS operating system and the other running the Android operating system. The form controls in the experiment were button, radio button/switch, spinner/picker, and text field. The task types were mutually exclusive selection, non-mutually exclusive selection, and set-a-value. Set sizes were designated as either small set size for less than 5 items or large set size for more than 5 items. There were 30 participants in the study. The task performance, accuracy, and satisfaction levels of the participants, as well as their perceived and actual performances, were recorded. The results showed that the button was fastest for small-set, mutually exclusive tasks while the spinner was fastest for large sets. In addition, it was found that the radio button/switch was the most effective controller for the non-mutually exclusive tasks. Based on the results of the experiment and analysis of the existing literature, five key issues for these form controls were identified to guide application developers in mobile form design: visibility, data set size, task type, users' experience level with a system, and screen layout.

1. Introduction

Today, the use of mobile devices and smartphones has become very popular. Statistics worldwide [1] shows that the number of smartphone users are about 2.53 billion currently (in 2018) and is expected to be 2.87 billion in 2020. People generally use these devices for daily routines that were previously conducted with computers, such as daily planning activities, social networking, and gaming or entertainment [2]. Mobile device users access websites or use various mobile applications with their smartphones and frequently encounter form controls. They use these controls in many productivity-based applications, and these forms act as an interaction point between user goals and these applications. Users frequently abandon applications that make filling out these forms too complicated or prolonged. This leads to the loss of customers in commercial web applications while leading to dissatisfaction among users in mandatory web applications [3], and it can be expected that these results can be extended to mobile apps as well. Thus, the usability of mobile form controls has emerged as an important issue.

Form controls are used as an interaction method, which is one of the three independent components of human-computer interaction techniques [4]. These components are user interface appearance, interaction methods, and interaction devices. User interface appearance includes variables such as color, shading, and margins—or in other words the look of the screen. Guidelines have been developed for screen appearance variables focusing mainly on vision [5]. The second component, interaction methods, is the way users interact with the system. Many vendors provide user interface guidelines or style guidelines to assist software developers mainly focusing on interaction methods [6–10]. Recently, Google Developers [11] defines guidelines to create efficient forms that require the least input from the user in the mobile web context, which is a little different from mobile applications. However, these guidelines also focus on the appearance and general use of these methods rather than specifying exactly which interaction methods are

* Corresponding author.
E-mail address: pinar.onaydurdu@kocaeli.edu.tr (P.O. Durdu).

https://doi.org/10.1016/j.csi.2018.06.001
Received 5 October 2017; Received in revised form 1 June 2018; Accepted 2 June 2018

best to use for which particular cases. The final component is interaction devices, which are the hardware for display and the control devices used for selecting and entering data.

The usability of various form controls in traditional desktop or web environment is already an existing subject for research [12–14]. However, not many studies have been conducted about form controls in mobile devices. Mobile application developers must consider usability issues for mobile form controls in order to ensure efficient and satisfactory user inputs. Button, radio button, drop-down box, and text box are the form controls that have been most studied in the traditional web environment [13,15–18]. In the mobile context, since the display area is much smaller than that of the traditional web environment, screen real estate becomes another major concern. In addition, mobile interactions are different since they are assumed to be multitasking and require cognitive resource competition [19] so we cannot simply extend our knowledge about desktop interaction to the mobile context.

This study experimentally compared the efficiency, effectiveness, and user satisfaction provided by mobile form controls on touch-based smartphones. In these devices, interaction is provided by hand gestures on a screen rather than by conventional input devices such as a keyboard or mouse. Mistakes can occur in such an environment due to the fact that the screen size is small and a different input approach is being used. Four different form controls that can be seen in Table 1 were compared considering variation that might be caused by task types and data set size. The mobile operating systems with the most widespread use, Android and iOS [20], were included in the scope of the study. The purpose of including two different operating systems is to overcome the effect of look and feel differences based on the operating systems. The preliminary aim of the study was to determine which mobile form controls are faster, less error-prone, and more satisfactory for inputting data, considering variation by task type and data set. In addition, the results were compared according to the gender, experience level, and age group of the user. Finally, five key issues for guiding application developers in mobile form design were defined based on the findings of the experiment and literature.

2. Background

Inputting data through forms has become a part of people's everyday experience, in messaging, online shopping, and sharing on social networks, whether it is with a desktop computer or a mobile device. Form controls act as a bridge, and how useful they are differs for different tasks or scenarios. Several studies have compared the effectiveness of these form controls in the traditional desktop environment. Some of the earliest studies on this subject were Greene et al.'s [21] and Gould et al.'s [4] which compared the effectiveness of text entry and keyboard selection methods for the tasks of entering dates and booking a flight in which the users were grouped by level of experience. Both studies reported that the text entry method was faster and more accurate than selection methods in both groups of users.

Tullis and Kodimer [15] compared the effectiveness of seven different input methods in a database application in a Windows® environment. The radio button and one entry text field input methods were found to be significantly faster than others. In another study, Tullis [5] reported that even experienced user interface developers could not predict their own performance with an input method by just using common sense.

Johnsgard et al. [16] compared the performance, accuracy, and preferences of users when performing specific tasks with different form controls in an experimental study. They considered task type, set size, and set order in their experiment design. The results of their study revealed that radio buttons were significantly faster and preferred for the mutually exclusive selection tasks while checkboxes were preferred for the non-mutually exclusive selection tasks. They also emphasized that the time required for each task increased as the number of options increased, or in other words, as the selection set size was increased.

Heerwegh and Loosveldt [18] discussed the effect of radio buttons and drop-down boxes on data input quality in web surveys and could not find any significant evidence. Similarly, Healey [13] evaluated the use of pop-up boxes and radio buttons in an empirical study that asked users to fill in a questionnaire. Although evidence was found that drop-

Table 1
Form controls in the web context and in different mobile operating systems.

Web	Button	Radio button	Drop-down box	Text box (textarea)
iOS	Button 	Switch 	Picker 	Textfield 
Android	Button 	Radio button 	Spinner 	Textfield