Entry and Selection Methods for Specifying Dates in Mobile Context

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Abstract. With the increasing use of mobile phones and tablets and the widespread use of internet networks, the use of applications designed for these platforms is increasing. Users generally have to input various types of data while using these applications and specifying date is one of the input types. In the scope of this study, a user study with 10 participants was conducted to compare four different input methods, which were used for specifying dates in mobile forms. Four different input methods were textbox, divided textbox, datepicker and calendar view. Time required to complete date entry tasks and errors occurred during these tasks were recorded and participants' preferences were gathered. Textbox was found to be the fastest and most accurate input method while calendar view was the slowest and most error prone. In addition, participants preferred divided textbox the most.

Keywords: Mobile input methods · Methods for specifying dates · Mobile forms
Performance of mobile input methods

1 Introduction

Nowadays, the availability of mobile devices and applications running on them allowed people to conduct many of their daily activities with them rather than traditional desktop computers. They have to fill in various types of data on these devices with different input methods. The performance of these different methods has become an issue because if the users feel hurdle, then they may leave to use application. This will result in loss of users and loss of profit for commercial applications [1]. Therefore, developers of these applications should consider the issues regarding the performance, accuracy and satisfaction.

There has been a substantial research regarding these interaction methods generally in traditional desktop environment [2–4]. In addition, many vendors published

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guidelines for them as well [5–7]. Similar there are some current guidelines for mobile applications published for iOS [8] and for Android [9] which were the most widespread used mobile operating systems [10]. However, there were not many studies that include comparison of these interaction methods empirically in mobile context.

In this research, a user study was conducted to investigate the performance of four different mobile input methods used specifically for specifying dates in mobile applications. The investigated methods were determined as; two entry methods which were text box and divided text box and two specifying methods which were date picker and calendar view. The main aim of the study was to determine which mobile input method is most likely to result in faster, less error-prone and more satisfactory for specifying dates in mobile forms.

2 Related Work

Several studies have compared different input methods in traditional desktop environments. One of the early studies were Gould et al.'s study [11] in which they compared seven different input methods for entering dates by considering experience level of users. They reported that text input methods were faster and more accurate with both groups of users. There were some other studies that compared different input methods that could be used for other tasks than specifying dates [3, 12–16]. In a more recent study, Bargas-Avilla et al. [4] again evaluated six different input methods used for entering dates in web forms and reported drop-down menu should be used when the format errors should be avoided. Their experiment also resulted text box method lead to faster completion time and higher user satisfaction.

When we investigated the studies in mobile context, there were various studies generally analyzing the performances of different input methods in terms of text input with physical keyboards in mobile phones [17–19] or with touch-based virtual keyboards [20–23]. On the other hand, Deniz and Onay Durdu [24] performed a user study that compared four different input methods on touch-based mobile phone with filling in a questionnaire task.

3 Method

In this study Bargas-Avilla et al. 's [4] study which was conducted in web environment was adapted and a similar methodology was used in mobile context. This section briefly summarizes the applied methodology and provides information regarding participants, data gathering tools, tasks and procedures used.

3.1 Participants

A total of 10 participants (4 female and 6 male) aged 18 to 41 (Mean = 27.1; SD = 7.88) took part in the study. All of the participants had no disability and they were volunteered through personal contact. They all had previous experience with mobile phones as well as touch based smart devices. However, half of them can be considered as novice for

Android operating system since they were using iOS device. Participants' detailed information can be seen in Table 1.

Table 1. Demographic and smartphone related information of the participants

Participants	Age	Gender	Mobile OS experience	Occupation
F1	18	F	ANDROID	Undergraduate student
F2	18	F	ANDROID	Undergraduate student
M1	25	M	ANDROID	Teacher
M2	35	M	ANDROID	Teacher
M3	30	M	ANDROID	Computer engineer
M4	41	M	IOS	Teacher
M5	34	M	IOS	Electrical engineer
M6	32	M	IOS	Teacher
F3	18	F	IOS	Undergraduate student
F4	30	F	IOS	Teacher

3.2 Data Gathering Tools

There were two questionnaire in the study. The first one was to gather demographic information of the participants and it was applied before the user test while getting participants' consent. The second questionnaire was satisfaction and preference questionnaire, which was applied at the end of user test of each input method.

A mobile interface prototype for four different input methods was developed with Axure RP 8. These interfaces were tested on a General Mobile e-tab 5, which had an Android OS.

3.3 Tasks and Procedures

Participants were given some pre-specified dates during the experiment as MacKenzie and Soukoreff (2002) emphasized this since this would allow participants to use their time efficiently. In addition, the dates chosen were based on some special events and they were given on the interface by their descriptions rather than their numeric format to prevent the visual cue of a particular format for entering a date (Gould et al. 1989). In addition, when determining the possible dates some were chosen closer to present date while the others were past date since this would also affect the performance in some input methods. Example set of dates can be seen in Table 2.

Table 2. Pre-specified dates given to participants

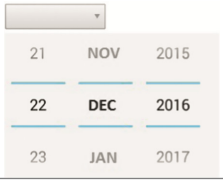
Sample dates for tasks
Specify your birth date
Specify the birthday of your friend which is tomorrow
Specify the first day of the next year
Specify the proclamation of the republic

An observer guided the participants during the user test. He gathered their informed consent before the experiment and asked them to fill in the demographic information questionnaire. Afterwards, participants were given with dates list that they had to enter them with different input methods. The experiment started with the selection of one of the input methods randomly. They specified dates with one input method and then pressed enter key on the interface. Time spent by the users was recorded. After entering dates with each input method, they were asked to fill in its satisfaction and preference questionnaire.

3.4 Data

Within the scope of this study, four different input methods were used as independent variables. These can be seen in Table 3 with their explanations.

Table 3. Input methods and their definitions

Input method	Design version	Explanation
Text box		Text box in which the date format is visible until user clicks in the field
Divided text box		Separate text boxes for day, month and year with visible format cue that should be overwritten when clicked
Date picker		Special box that enables to select a date from a popup or inline calendar
Calendar view		Calendar view tool that enables to find a date on a pop up calendar and specify exact date

As dependent variables, the following data were collected

- Task completion time: Time needed to specify dates
- Errors: Date entries which users challenged or could not fill in at all
- Satisfaction and preference: Questionnaire findings

4 Results

4.1 Task Completion Times

Task completion time of four different input methods were recorded during the test. Each participant completed four tasks with each input method and their average task completion times with each method can be seen in Fig. 1.

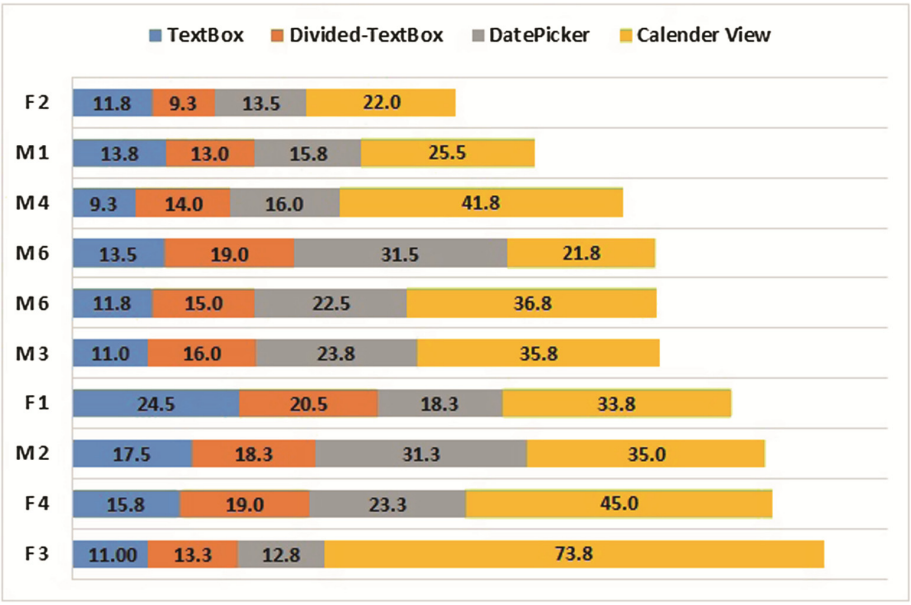


Fig. 1. Task completion times for all participants with four input methods

Task completion data was analyzed with the non-parametric Friedman ANOVA and it was revealed that there was a statistically significant difference in task completion times depending on the four different input methods, $\chi 2(3) = 21.720$, $p = 0.000$. Post hoc analysis with Wilcoxon signed-rank tests was conducted with a Bonferroni correction applied resulting in a significance level set at $p < 0.008$. Mean task completion times for each input method can be seen in Fig. 2. The differences among the methods were analyzed with Wilcoxon signed rank test and there were no significant differences in task completion times between text box and divided textbox ($Z = -1.531$, $p = 0.126$). On the other hand text box was significantly faster than date picker ($Z = -2.395$, $p = 0.017$) and calendar view ($Z = -2.803$, $p = 0.005$). Divided text box was significantly faster than both date picker ($Z = -2.395$, $p = 0.017$) and calendar view ($Z = -2.803$, $p = 0.005$) and finally date picker was significantly faster than calendar view control ($Z = -2.448$, $p = 0.014$). When all of these task completion data were analyzed according to gender, age group or experience level, there were no statistical significant found between any of the groups at $p < .05$.

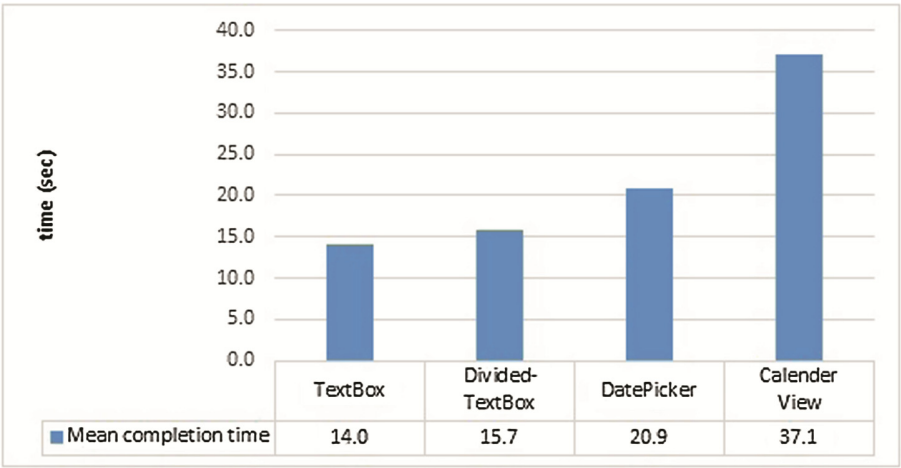


Fig. 2. Average task completion times of four input methods

4.2 Errors

Participants were observed while completing their tasks and if they were challenged while entering a date or cannot enter a date at all, these were counted as errors. Participants did not make any errors with text box input method with a success rate of 100%, while only one participant was challenged with divided text box method. On the other hand, participants were challenged in many of tasks with date picker and calendar view input methods. In addition, participants failed with calendar view input method with 27.5% of the tasks as can be seen in Fig. 3.

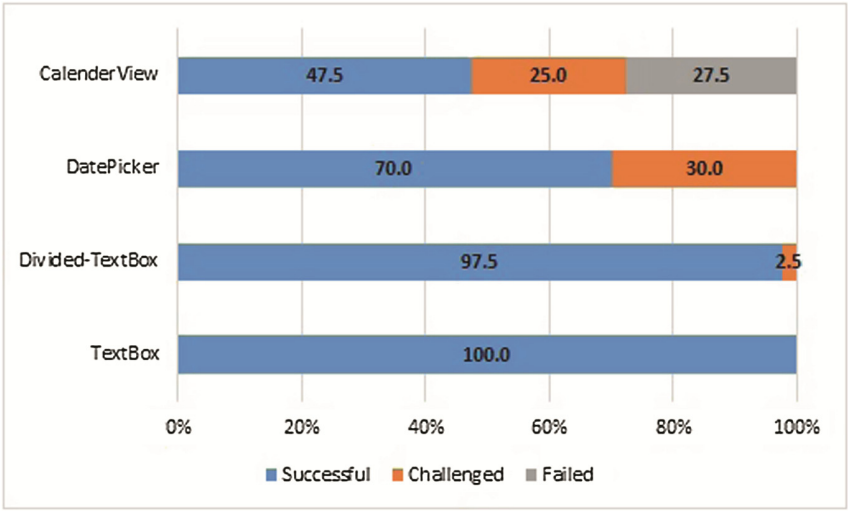


Fig. 3. Participants error rates with four input methods

4.3 Satisfaction and Preferences

At the end of user test, participants were asked to evaluate the four input methods with a questionnaire and to state their preferences among the methods. In Table 4, the results of the evaluation questionnaire can be seen. Participants were generally satisfied with divided-textbox followed by text box, date picker and calendar view input methods, respectively. However, they thought that they input dates more accurately with calendar view input method since this method enabled them to pick the exact date from the calendar view tool so they did not need to consider about the accurate format or accuracy of date. Meanwhile, participants' preferences were coherent with these. They preferred mostly the divided text box while at least calendar view as can be seen in Table 5.

Table 4. Participants' satisfaction of the input methods

	Textbox	Divided-textbox	Date picker	Calendar view
	M	*M*	*M*	*M*
Entering dates with this input method was comfortable	4	4.5	3.8	2.8
I've entered dates quickly with this input method	4.4	4.3	3.6	2.7
I am sure that I input dates with this method accurately	4.8	4.8	4.8	4.3
I am sure that I input date formats with this method accurately	4.9	4.8	4.9	4.6
This input method was easy	3.9	4.6	3.6	2.9
Overall	4.4	4.6	4.14	3.5

Table 5. Participants preferences among the input methods

	M	SD
Textbox	2.3	0.8
Divided-textbox	3.7	0.5
Datepicker	2.7	1.1
Calendar view	1.3	0.5

5 Conclusion

In this study, a user study was conducted to assess the performance, accuracy and satisfaction of four different input methods that were used in specifying dates on a touch based Android mobile smart phone with ten users. The analysis on task completion times revealed that entry methods were faster than selection methods and the text box was the fastest which was a similar finding to previous studies which were conducted in traditional desktop environments [4, 11]. On the other hand calendar view was the slowest. This result can be explained according to Keystroke Level Model [25] since these methods required more key presses to complete tasks. In addition, for past dates they

also required lots of key presses compared to the dates closer to present. Some users preferred to terminate the application while trying to reach the past dates with the calendar view. Similar to performance results, text box and divided text box enabled more accurate date input while participants challenged more or could not accomplish at all with these specifying methods. In addition, participants preferred divided text box most while calendar view least. In summary, the use of a text box or a divided text box would be more appropriate for recent date entries while date picker or calendar view would be more appropriate for past dates.

There were some limitations in this study. One of this was that the study was conducted in an artificial environment for mobile context. The tasks were artificial including the given dates or they were not completed in a realistic scenario. The other limitation was related with the sampling of the study since the number of participants was low and they were gathered voluntarily by personal contact. Next, all the input methods were compared on just one type of device which was Android. In order to overcome these limitations, future studies should be conducted by considering these issues.

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