

Mobile Usability: An Experiment to Check Whether Current Mobile Devices are Ready to Support Frames and iFrames

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Abstract

Frames have traditionally been identified as a usability issue in websites for computers. Literature points out that they may also be a problem for mobile websites but no studies have been carried out to prove it. Since mobile devices have changed a lot in recent years, it is necessary to check whether frames are still a problem for those devices. In this paper we have performed an experiment with twenty-two mobile devices, to test whether the content can be showed in their browsers, as well as their behavior with different configuration of frames and iframes and whether behavior of bookmarks and the back button is correct or not. The results show that frames and iframes should be avoided in mobile devices because they can cause many problems, which are explained in detail in this paper.

Keywords: Frame, Mobile, Navigation, Usability, Web.

1. Introduction

Frames are often used in web pages for displaying at the same time an index frame (usually a menu) and a content frame. When users click on an option of the index frame, a new content will be shown in the content frame. This is an advantage because it is a solution to the problem of needing to keep a context while accessing multiple pages [5], but it also has many

disadvantages that have already been pointed out by many authors in the past. Some of these drawbacks are mentioned below.

When using frames, the URL shown at the top of the browser does not match with the web page that is being shown, because web pages with frames are made of two or more web content pages, which are loaded into the frames, and each of them has a different URL. This is a problem when users want to copy and paste the URL, for example, to include it as a hypertext anchor in other page or email message, because that anchor will not lead readers to the desired view but to the initial state of the frameset [9]. Another problem related to this operation is bookmarking, because it is based on URLs and users will not be able to bookmark the current page and return to it because the bookmark probably points to another version of the frameset [8]. This problem has also been indicated by many other authors such as Nielsen [6], Bevan [1] and the United States Department of Health and Human Services (DHHS) [2]. In HTML 4.0, a new implementation of frames emerged, which is called inline frames (iframes) and which completely replaced frames in HTML 5.0. This new version is supposed to allow bookmarking the main page and navigate as usual, because they are subordinated to the main page [9], i.e., embedded within the current HTML document.

Another issue of frames is that navigation does not work as usual, because the users' view of information on the screen is determined by a sequence of navigation actions instead of a single navigation action [9], i.e., when users press the back button of the browser, the previous loaded frame will be shown, and not the previous visited web site; and this could bewilder users.

Printing is also another problem arising from the use of frames, as many browsers cannot print framed pages appropriately because the print command usually results in the printing of a single frame, and this is especially problematic with scrolling frames, as browsers do not know if only the visible part of the frame should be printed or the whole content, taking up more room than it does on the screen [9]. Other authors in the literature have also pointed out this problem, saying that frames can interfere with printing [1], that printouts become difficult when using frames [8] and that frames pose problems when users attempt to print [2].

Firtman [3] said that "in 1997 some people were happy using frames technique, creating fixed menu bars and dealing with links between frames, until search crawlers came into action and frames became the worst thing you could ever do in a website". The problem for search engines is due to every frame is a different HTML document [3], and therefore they have troubles since they do not know what composites of frames to include as navigation units in their index [9]. This problem has also been pointed out by the DHHS in guideline 6:13 [2].

Another major problem is that not all web browsers support frames [4], so some users may not be able to see a site with frames [9]. This is especially important when using mobile browsers, as they many of them do not support frames [11] or will not allow users to scroll inside a frame or iframe [3], so probably users will not be able to see the whole content. However, these statements were made years ago, mobile devices have changed a lot since then and frames are still used (HTML 5 is a recent technology and it supports iframes), so this should be checked and updated for current mobile devices.

Finally, frames also pose an additional problem related to the small screen of mobile devices: splitting the screen into smaller windows as frames is uncomfortable for users, because the space for the content will be even smaller when a part of the screen is being continuously occupied by a frame.

As aforementioned, HTML definition introduced iframes in version 4.0, as they are supposed to cause fewer problems than frames, which have been definitely removed in HTML 5.0. Since version 5.0 only iframes are supported, but are devices (especially mobile devices) ready to use them, or do not support it? That is one of the questions that the work presented in this article will answer.

Existing guidelines for PC have different opinions about frames because DHHS recommends using frames when certain functions must remain visible on the screen as the user accesses other information on the site [2], but ISO says that frames should be used with care [7]. Both of them warn about potential but different problems: DHHS says that printing or searching problems may occur, and ISO advices about the use of the back button,

bookmarking of pages, or scrolling of information. However, these guidelines are intended to PC and it is not checked whether they are applicable or not on mobile devices.

Furthermore, there is one guideline about frames especially designed for mobile devices, which is guideline 5.4.2 of Mobile Web Best Practices [11]. This guideline says that frames and iframes should not be used because they are generally problematic, but it does not mention any specific problem. Although this guideline is addressed to mobile devices, it is necessary to check whether it is valid for current mobile devices, as it was established in 2008 and, as aforementioned, mobile devices have changed a lot and these guidelines may have changed since then. In addition, some of the above problems have already been solved in the past for Personal Computers (PCs) [10], but some of them may still remain for mobile devices.

On the other hand, as far as we know, there are no experiments testing frames and iframes on mobile devices (smartphones and tablets), and existing guidelines were defined some years ago and are not updated for current mobile devices. This is important because technology changes very fast and usability guidelines should be updated to be adapted to new technologies. For example, some years ago the most common interaction method for these devices was the keyboard, while today are touch screens. Screen size has also changed, and all of this influences how users use these devices and therefore usability guidelines have to be updated. This paper presents an experiment to check whether the aforementioned problems are still present in mobile devices or not, both with frames and iframes, and to give an updated recommendation about frames for mobile web, because all the existing usability guidelines about frames are addressed to PCs or old mobile devices.

Section 2 of this paper presents the experimental design, Section 3 shows the results obtained in the experiment carried out, Section 4 presents the discussion of these results and finally Section 5 presents the conclusions obtained in this work.

2. Method

In this paper we are focusing on how feasible is using frames and iframes to navigate from a mobile device. To do this, an experiment has been carried out with several mobile devices and evaluating four different configuration frames (without scroll and with combinations of scroll) for displaying information from those kind of devices. Both the ability to display the content and the behavior of frames and iframes are studied. The main problems indicated by previous works (i.e. behavior with bookmarks and the back button) have also been studied.

2.1. Subjects

The subjects of the experiment were twenty-two real mobile devices, which had different interaction methods (keyboard and touch screen), operating systems and screen size (Table 1).

Table 1. Mobile devices used as subjects in the experiment.

Device	Screen size	Device	Screen size
HTC Magic	3.2"	Samsung Galaxy Mini	3.2"
BB Curve 9360	2.44"	Samsung Galaxy SIII	4.8"
Nokia Lumia 610	3.7"	Samsung Galaxy Nexus	4.65"
LG L3 E400	3.2"	iPad 2	9.7"
HTC Wildfire	3.2"	HTC Desire	3.7"
BB Torch 9860	3.7"	iPhone 4	3.5"
HTC Radar	3.8"	Samsung Galaxy Young	3.27"
Nokia Lumia 710	3.7"	Samsung Galaxy S	4"
Samsung Omnia W	3.7"	Samsung Galaxy Tab 3	7"
BB Curve 9300	2.46"	Samsung Galaxy S4	5"

Sony Xperia U	3.5"	BQ Pascal Lite C	7"
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The default mobile web browser was used in each device, as most (or all) of them allow installing new web browsers, but we preferred to study the default one because users could use them since they purchase the device, and the results are more consistent using the default one than using a new web browser that may not be available in all platforms.

2.2. Tasks

The tasks performed with each subject were:

1. Checking whether the content could be displayed completely or not.
2. Checking whether the behavior of the frames/iframes was the expected or not.
3. Checking whether the behavior with bookmarks was correct or not.
4. Checking whether the behavior of the back button was the expected or not.

To perform the first task, we evaluated whether all content could be displayed, so if any part of the content could not be displayed, the answer to this task was "no". To perform the second task, we evaluated whether the behavior of the frames/iframes were correct. An incorrect behavior was considered when a frame does not have scrolling but it scrolls for showing the content and when it has scrolling in only one direction but it scrolls in another direction to display the content. The third task was evaluated by adding a webpage loaded in a frame to bookmarks, and then trying to reload it. If the webpage was not properly loaded, then the answer to this task was "no". Finally, to perform the fourth task, we evaluated whether the behavior of the back button was the expected (i.e., if it returned to the previous webpage) or not (i.e., it returned to the previous frame).

2.3. Design

Four different interfaces were designed for the experiment (Fig. 1), each of which had two frames (left and right). The left frame was the same for every interface and did not have scrolling, and the right frame varied for every interface: the first one (called W1) had a frame without scrolling, the second one (W2) had a frame with vertical scrolling, the third (W3) had a frame with horizontal scrolling and the fourth (W4) had a frame with both types of scrolling, i.e., vertical and horizontal.

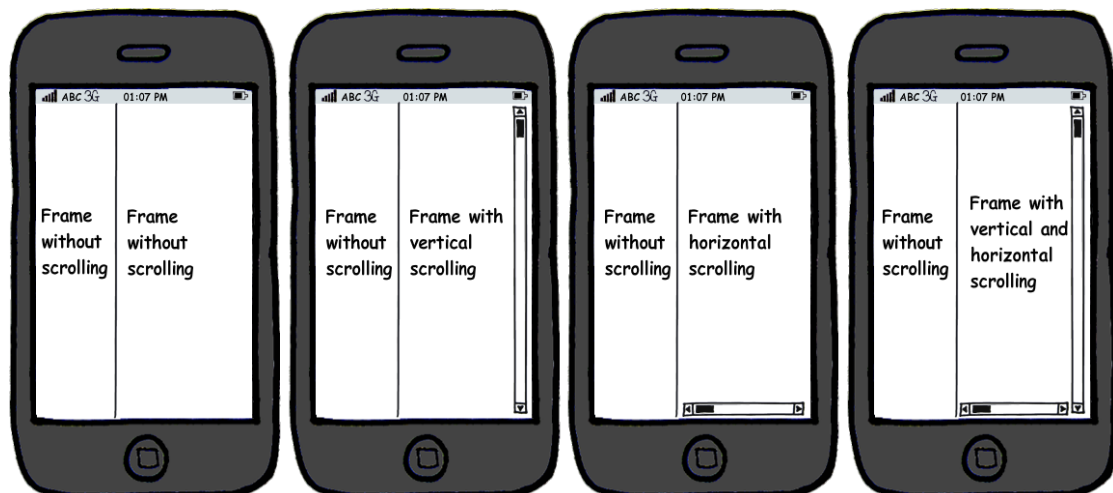


Fig. 1. Prototype of interfaces (W1, W2, W3, W4) designed for the experiment.

The independent variables were the kind of frame tested on each interface (i.e. W1, W2, W3, W4), the device orientation (portrait or landscape) and the frames implementation type (frames or iframes). The experiment had a within-subjects design. The dependent variables were (1) the ability to display the whole content, (2) the correct behavior of the frames in each

case, (3) the correct behavior of frames with bookmarks and (4) the correct behavior of frames with the back button. The dependent variables number 1 and 2 were measured for all interfaces and orientations, and dependent variables number 3 and 4 were measured only for one kind of interface (an additional interface designed, which contained two frames: the left one had a menu and its target was displayed in the right one) and in portrait orientation. This was because two different content pages were necessary to be loaded in order to check the behavior of bookmarks and back button, and interfaces of Fig. 1 only had one page loaded. Therefore, the experiment consisted of 22 subjects x 4 interfaces x 2 orientations x 2 implementations x 2 dependent variables = 704 data plus 22 subjects x 1 interface x 2 implementations x 2 dependent variables = 88 data. In summary, 792 data were collected in total.

2.4. Procedure

The experiment consisted of two phases: preparation and main testing.

In the preparation phase, the interfaces for the experiment were developed and uploaded to a web server, in order to be accessible from all the mobile devices via Wi-Fi connection.

In the main testing phase, all subjects were tested individually. Firstly the experimenter loaded the first interface in the mobile web browser, and then she tried to display the whole content and checked the behavior of the frame. The results (whether the content was fully displayed and the behavior of the frame about scrolling, bookmarks and back button) were written down for further analysis. Then the process was repeated for the remaining cases, i.e., with the other interfaces and orientations, until all the experimental conditions were performed.

3. Results

After the experiment was performed with all the subjects, the data collected were analyzed to extract interesting data.

3.1. Ability to Display the Content

As seen in Table 2, the content in W2 and W3 could be completely viewed in 100% of the devices when using both frames and iframes (please note that when cells contain two numbers, the number in parenthesis takes into account the cases where devices could not be in landscape orientation, i.e., in some cases landscape orientation was not supported by some devices, so the number in parenthesis represents the value over the total number of devices). Interface W4 could be viewed in 100% of the devices when using frames, but around 95% when using iframes. This was due to scrolling did not work in both directions in one of the devices. On the other hand, the content of W1 could not be completely viewed in around 26% on average (between portrait and landscape) in the mobile devices when using frames and around 7% when using iframes. This happens when the device is not able to show the whole content in the screen (due to its small screen size) and it is not possible to scroll (because for the case W1 it was not allowed).

Table 2. Results of the experiment for the first task (displaying content).

		Frames				iFrames			
		Yes		No		Yes		No	
Int.	Orientation	N	%	N	%	N	%	N	%
W1	Portrait	17	77.27	5	22.73	20	90.90	2	9.10
	Landscape	14	70.00 (63.63)	6	30.00 (27.27)	19	95.00 (86.36)	1	5.00 (4.54)
W2	Portrait	22	100	0	0.00	22	100	0	0.00
	Landscape	20	100 (90.90)	0	0.00	20	100 (90.90)	0	0.00

W3	Portrait	22	100	0	0.00	22	100	0	0.00
	Landscape	20	100 (90.90)	0	0.00	20	100 (90.90)	0	0.00
W4	Portrait	22	100	0	0.00	21	95.46	1	4.54
	Landscape	20	100 (90.90)	0	0.00	19	95.00 (86.36)	1	5.00 (4.54)
Total		157	93.45 (89.20)	11	6.55 (6.25)	163	97.02 (92.61)	5	2.98 (2.84)

In general, the content was viewed more times when the devices were in portrait orientation, which suggests that mobile browsers are well designed for navigating in portrait orientation, but not in landscape orientation.

3.2. Behavior

The results for the second task of the experiment (behavior of frames) are shown in Table 3 (please note that when cells contain two numbers, as in the previous table). First of all, it is important to say that "correct behavior" means that a frame having scroll lets to move the part of the webpage having scroll in the direction it is enabled, but not over the whole page, because this is not the default behavior of frames and this could mislead users.

Table 3. Results of the experiment for the second task (behavior of frames).

Int.	Orientation	Frames				iFrames			
		Yes		No		Yes		No	
		N	%	N	%	N	%	N	%
W1	Portrait	9	40.91	13	59.09	5	22.73	17	77.27
	Landscape	8	40.00 (36.36)	12	60.00 (54.54)	3	15.00 (13.63)	17	85.00 (77.27)
W2	Portrait	3	13.64	19	86.36	10	45.46	12	54.54
	Landscape	2	10.00 (9.10)	18	90.00 (81.80)	7	35.00 (31.81)	13	65.00 (59.09)
W3	Portrait	3	13.64	19	86.36	10	45.46	12	54.54
	Landscape	2	10.00 (9.10)	18	90.00 (81.80)	7	35.00 (31.81)	13	65.00 (59.09)
W4	Portrait	3	13.64	19	86.36	10	45.46	12	54.54
	Landscape	2	10.00 (9.10)	18	90.00 (81.80)	6	30.00 (27.27)	14	70.00 (63.63)
Total		32	19.05 (18.18)	136	80.95 (77.27)	58	34.52 (32.95)	110	65.48 (62.50)

When using frames, in around 88% (average between portrait and landscape) of the 20 devices the behavior was incorrect for W2, W3 and W4; and only in around 60% the behavior was incorrect for W1. On the contrary, with iframes, the behavior was worse in interface W1 (around 81% of the devices had an incorrect behavior) than in interfaces W2 (around 60%), W3 (around 60%) and W4 (around 62%).

As in the case of displaying content, the behavior was also better when the devices were in portrait orientation instead of in landscape orientation, and iframes worked (in general) better than frames. There is only one case in which frames had a better behavior than iframes: with interface W1. This was due to the design of the web page, i.e., the right frame had a big content to be shown and no scrolling was allowed in the source code, so mobile browsers have to choose in these cases their behavior: they can show the whole content, ignoring the source code and using scroll to do this; or they can meet the source code and do not allow scrolling, and therefore the whole content will not be displayed. With frames there were more mobile browsers that met the source code than with iframes, and that is why the content was displayed fewer times than with iframes.

3.3. Bookmarks

After performing the third task, we found that bookmarks did not work well in 100% of the devices, as they saved the URL of the main webpage with the default frames or iframes, so if users want to save in bookmarks a webpage different from the loaded by default, they will not be able to retrieve it.

3.4. Back Button

In 100% of the devices the back button did not work as expected, because when using frames and iframes and pressing the back button, all the mobile web browsers showed the previously visited frame/iframe, and not the previous webpage, as it may be expected. This behavior could be disorienting for the user.

4. Discussion

With the experiment shown in this paper we have empirically verified that the most frequently mentioned problems related to frames in PC websites (bookmarking [1], [6, 7, 8] and back button [7], [9]) are still remaining in mobile web browsers. They do not allow properly bookmarking, neither using frames nor even using iframes, which are a newer implementation in HTML and were supposed to bookmark properly in PC [9]. The back button neither worked properly in none of the devices, neither using frames nor using iframes, because when this button was pressed the previous content was shown in the right frame, but not the previous visited website. Therefore we could say that those problems pointed out in guideline 9.3.10 of ISO 9241-151 [2] for PC websites are still valid for existing mobile devices. These problems should be specified in guideline 5.4.2 of Mobile Web Best Practices [11] to help developers to know what problems they may find when using frames or iframes.

On the other hand, we also tested the ability to display the content and the behavior of frames in mobile devices, as some authors indicated that not all web browsers support frames [4], [9], especially mobile web browsers [11], some of which would not allow users to scroll the content within a frame or iframe [3]. Our results support those affirmations, as not all devices were able to display the content or behave as expected, especially in frames and iframes with scrolling.

As tablets are being used increasingly, one limitation of our study is that most of the devices used to carry out the experiment were smart phones, and we should have included more tablets in the sample, but we could not do it because of economic issues. Including pointer devices in the sample (and also a representative set of devices) would have also been interesting, but the same reason applies to why they have not been used.

5. Conclusion

From the first task performed in the experiment, we could conclude that the content can be always displayed if the implementation of a web page with frames or iframes is correct, except when an iframe has both horizontal and vertical scrolling, where some mobile devices can be found that are not able to manage both scrollings at the same time to show the content. The biggest problem found for showing the content was when the implementation was not correct, because the content was bigger than the device screen and the source code did not allow scrolling, so that the content could not be fully displayed. In addition, it is recommended to use mobile devices in portrait orientation when viewing web pages with frames or iframes, as the content can be viewed in more cases when using this orientation.

The results for the second task are even more noteworthy because most of the devices had an incorrect behavior, and behaviors were very varied depending on the mobile device used. Therefore, if a web site uses frames or iframes, mobile users can be misled, since in most cases the behavior is not as expected. This is more pronounced when frames and iframes have scrolling and when using frames rather than iframes, so we could conclude that iframes have

improved their behavior compared to traditional frames. As in the case of displaying content, the behavior was also better when the devices were in portrait orientation rather than in landscape orientation, and it was worse when the implementation was not correct, i.e., when the source code says that no scrolling should be used, but mobile devices do it. Hence, as aforementioned, we recommend using mobile devices in portrait orientation when navigating web sites with frames or iframes.

It has also been shown that bookmarks do not work well in mobile devices, either with frames or iframes, and the back button does not work as expected, as it breaks the traditional concept of navigation. Therefore, these traditional usability issues are still present in new browsers such as those of mobile devices.

According to the results, using frames and iframes does not follow the principle of universal accessibility, since users who have some specific mobile devices will not be able to view the content of the website. Therefore, we could conclude that frames and iframes should be avoided in mobile devices because the content may not be displayed, their behavior may not be that expected, bookmarks do not work well and using the back button neither. If using frames is strictly necessary then developers should be careful when implementing (because otherwise users may not view the content), and should use iframes instead of traditional frames, as they are newer, allow displaying the whole content more times (in average) and their behavior is better (in average). This is a new guideline about frames and iframes for mobile devices and that is not included in any recommendation or standard, so it would be important that designers and developers take this into account when designing and developing mobile websites. It is also important to continue researching new methods of structuring information in mobile websites, avoiding the problems detected in frames and iframes.

Finally, as mentioned above, some problems detected were specific in some devices, so that mobile devices manufacturers should be aware of the importance of solving these issues to improve usability for their users.

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