Integrating Mobile Web Development into IT curriculum

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ABSTRACT
Recently, the use of mobile phones to access the web has increased exponentially. This technological shift has created a growing demand for mobile website developers in the IT market. To reflect on this recurring demand, the skills taught for an IT undergraduate in a web related course need to take this topic into consideration. In this paper we present our experience in implementing a module on mobile website design and development in an advanced web technologies course. We also report the results obtained from implementing the module in terms of students' feedback and final remarks.

Categories and Subject Descriptors
K.3.2[Computer and Information Science Education]: Computer science education.

General Terms
Design, Experimentation, Human Factors.

Keywords

1. INTRODUCTION
The global thrust on accessing websites using mobile phones has created an increased demand for mobile web developers in the IT market. This demand requires specific skills and knowledge not only in general web development but in the principles of mobile web design.

Currently, teaching the principles of mobile website design and practicing the development of mobile websites for CS and IT students is not adequately addressed in the computer education literature. By scanning the literature, we can see that mobile application development are only taught in introductory CS courses [1], or integrated into some courses throughout the CS curricula e.g. [2][3].

In year 2011 SIGCSE conference, a complete session was dedicated for mobile computing with four papers addressing mobile development tools [4] and developing software in mobile platforms [5]. However, the presented papers focus was on native mobile application development, with a clear shortage in papers focusing on mobile web development.

Apparently, native mobile application development has gained some momentum in major CS conferences such as SIGCSE and ITcSE; IT conferences, on the other hand, did not witness a similar momentum in both native mobile application and mobile website development. As a result, concepts such as "designing for mobile first" as well as promoting the World Wide Consortium (W3C) call for mobile web with recommended best practices are driving IT academics to rethink the way web systems are taught for IT students.

In this paper we report on our experience in integrating a module on mobile web development and design within an advanced web technologies course. The paper is structured as follows: section 2 describes the organization and the topics taught in the advanced web technologies course. Section 3 presents in details the content of the mobile web development module. Section 4 highlights the criteria used to assess students work. Section 5 reports the students experience after teaching the mobile web development module. Finally the paper concludes with some recommendations.

2. COURSE OVERVIEW
2.1 Course Organization
The advanced web technologies course is a 3-credit hour course and is currently being taught as a core course in the web and multimedia track in the new IT curricula at the Information Technology Department, College of Computer and Information Sciences, King Saud University, Riyadh, Saudi Arabia.

The course was first offered in spring of 2011 and had 14 female students enrolled in it. In 14-Weeks semester, students meet once a week for 2 lecture hours and 2 lab hours.

As a prerequisite to the course, the students are required to complete the web applications course, where they learn about the principles of web design and development.

2.2 Course Topics
A wide range of topics applicable to the advancement of web technologies were covered as separate modules during the course. The covered modules are:

• XML Technologies.
• Rich Internet Applications using:
  • Ajax and JSON.
• HTML 5 and CSS3.
• Mobile Web Design and Development.
• Java Web Technologies.
• Web services (SOAP and REST), Web APIs and Mashups.
• Cloud Computing.

3. THE MOBILE WEB DEVELOPMENT MODULE

In the advanced web technologies course, a complete module was reserved for teaching the principles of mobile web design and development. The module consisted of two parts:

1) Designing for mobile web, which covers the following topics:
   a. Types of mobile phones and applications
   b. Mobile browser classes
   c. Markup languages for mobile browsers
   d. Mobile web design considerations
   e. Delivering Mobile Content to Mobile devices
   f. Mobile Information Architecture
   g. Mobile design best practices

2) Developing Mobile web applications for touch screens, which included the following topics:
   a. WebKit in Mobile Browsers
   b. What makes a mobile web app?
   c. Media Queries
   d. Libraries for mobile web apps (jQuery mobile)
   e. Cross-Platform Web Apps using PhoneGap

During this module, many in-class and lab activities took place. One activity asked the students to report on their experience on using a mobile website, and to try out mobileOK service for testing mobile websites compliance to W3C best practices recommendations. Another in-class activity challenged the students' ability to convert a full website design to its mobile version using paper prototyping. Figure 1 shows an example of the activity.

![Figure 1: A student's paper prototype for a mobile website](image)

The module also employed a range of tools and languages to help the students build their mobile websites. These include: HTML5 and CSS3, mobileOK service, Mobile Best Practices 1.0 guidelines, jQuery Mobile Library and the Android emulator.

At the end of the module a project was assigned to each student to be finished within two weeks. The project consisted of two parts:

1) A critical analysis and comparison of four different mobile websites. The objective of this part is to open the students' eyes on the difference in user experience between full websites and mobile ones. The students were asked to follow the steps illustrated in [6] while presenting their findings.

2) A practical implementation of a mobile website. Where the students are obliged to choose a Saudi government website that does not have a mobile website counterpart, for practicing what they have learned in the module. The students were asked to design and implement a mobile version for the full version of one of the Saudi government websites. Therefore, in order to complete this part, the students must analyze the designated government website and determine what pages, content and functions will be added to the mobile version. Next, the students need to design the clickstream and wireframes of the mobile website. Then, implement the mobile website using HTML, CSS and JS/Ajax so that it is displayable on touchscreen phones such as iPhones and Androids. Finally, the students are required to validate the HTML and CSS code and evaluate the produced mobile website using MobileOK service.

4. STUDENTS' ASSESSMENT CRITERIA

The evaluation of the project, particularly the second part, was not an easy task due to the diversity of students' websites and the lack of a comprehensive rubric for evaluation.

However, after some extensive research, we came up with an evaluation criteria consisting of three dimensions, namely: (1) design criteria, (2) usability criteria, and (3) required criteria.

In the first dimension, the design criteria, we evaluated three requirements: (a) website analysis, (b) clickstream design and (c) wireframe design. The students were asked to analyze the full version of a government website in order to select the features and content that should be considered in the mobile version. 30% of the project grade was allocated for these three requirements.

When we evaluated the clickstream design, we focused on the number of hops in the design. Generally, in any mobile version website the maximum number of hops should not exceed 2-3 levels in one path.

Similarly, we evaluated the wireframe design, considering that it should reflect the actual website. Also, we evaluated what components were used in each page to check whether the content of each page is suitable to be displayed on mobile device screens.

In the second dimension (usability criteria), we relied on the W3C Mobile Web Best Practices. We selected a number of criteria that can be easily evaluated by a human. Some of the used criteria are listed in Table 1. The overall weight dedicated for this part was 8%.

1 A free service by W3C that helps check the level of mobile-friendliness of Web documents, and in particular assert whether a Web document is mobileOK

2 http://www.w3.org/TR/mobile-bp/
Table 1: Distilled Mobile Best Practices Criteria from W3C

<table>
<thead>
<tr>
<th>No.</th>
<th>Criteria</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Minimal navigation at the top</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Trade-off: too many links at top and too many links to follow</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Consistent Navigation</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Identify the target of each link</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Limit scrolling to one direction</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Short and descriptive page title</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Use of stylesheets to control layout</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Coherence when accessed from several devices</td>
<td></td>
</tr>
</tbody>
</table>

In the third dimension (required criteria), we evaluated whether the students have used a number of features to support the appearance of their websites on mobile screens e.g. the use of media query, viewport, encoding and relative font size. 42% of the project grade was allocated for these requirements.

Also, we emphasized on the size of the page itself, which it should not exceed 15-20 KB, due to the limitations of the mobile devices.

We also, utilized the W3C HTML validation tool and the W3C CSS validation tool to evaluate student's websites. We did not consider the W3C Mobile OK validation service, because it produces errors when testing a website that uses the jQuery Mobile library. The devoted weight for the validation was 20%.

The used evaluation rubric is shown in Table 2.

Table 2: Evaluation Rubric

| Part#1 Total: 20% |
| Part#2 Total: 80% |

**Design criteria (30%):**

<table>
<thead>
<tr>
<th>No.</th>
<th>Criteria</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Website Analysis</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>Clickstream design</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Wireframe design</td>
<td>10</td>
</tr>
</tbody>
</table>

**Usability criteria (8%):**

<table>
<thead>
<tr>
<th>No.</th>
<th>Criteria</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Minimal navigation at the top</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Trade-off: too many links at top and too many links to follow</td>
<td>1</td>
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<td>1</td>
</tr>
<tr>
<td>7</td>
<td>identify the target of each link</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Limit scrolling: 1 direction</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Short and descriptive page title</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Use stylesheets to control layout</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Coherence when accessed from several devices</td>
<td>1</td>
</tr>
</tbody>
</table>

Finally, a sample of the students' projects is shown in Figure 2.

Figure 2: Samples of the students' mobile websites for two Saudi government websites [Ministry of justice (left) and Ministry of Water and Electricity (right)]

5. STUDENTS FEEDBACK

After the students have completed their project, a questionnaire was posted online in order to collect students' experience after accomplishing this module.

The first question solicited the students' opinion on the difficulty of the project. Overall 57% of the students rated the project difficulty as medium, while 36% found it quite easy and 7% (i.e. one student) found the project somehow difficult.

When we asked them to list the difficulties encountered. Most of the students mentioned that they have technical problems with jQuery Mobile Library because it generated many errors using the MOBILEOK validator, others complained about CSS inconsistency. However, some students reported finding difficulties in distilling the best features and content from the full version of a website to appear in the mobile version. As one of the students have mentioned "Actually the most difficulty I found is the selection of pages and services from the full site to provide them in the mobile version, until I sat with my father and asked him: is that important or not?" Also, for those students who were involved in building right to left website (to display Arabic content); they faced many problems in encoding and content alignment using CSS.

The second question asked the students about their competencies of being able to build future mobile websites after experiencing it in this project. Surprisingly, 29% of the students were confident of their abilities to build future mobile websites, however 57%
were somehow confident, while 14% stated that they are not confident at all. Inquiring about what is missing to get them more competent in mobile web development, some students reported the following responses: "Time to practice more", "more discovering" and "I know if I want to have the experience I must try building more mobile site with different content and functionality".

Finally, two questions were asked regarding the students experience and their future recommendations. As for their experience, 93% enjoyed working on this project and showed their willingness to continue working on completing the mobile website and building future mobile websites if they were asked to do so. In a follow up question about their recommendations for continuing this kind of project for next semester course, all students expressed increased interest in exposing future students to this kind of exercise.

6. CONCLUSIONS
The popularity of using mobile devices for accessing the web is inspiring IT faculty to look for ways to teach students how to develop mobile websites. However, in the current ACM IT Curricula and in particular under the web systems pillar, there are no explicit teaching recommendations regarding the development of mobile websites.

This paper has reported on our experience in integrating a mobile web design and development module into our advanced web technologies course taught as a core course in the web and multimedia track in the new IT curricula at the Information Technology Department, College of Computer and Information Sciences, King Saud University.

The result of the integration was very positive and future improvements to the module will be considered to cope with the evolving nature of the web.

In conclusion, we strongly recommend integrating the principles of mobile website development and design to any web systems course, in order to stay abreast of the technological change in the field of web development.

7. REFERENCES