

Academic Laboratory Website Development

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Abstract— The Internet is an important source to get information about everything in human lives. Developing websites is one of the best ways to give information to people. Nowadays, there is a rapidly growing number of websites for many purposes. The websites of university laboratories are the examples. Usually university laboratories have websites to provide information to students, laboratory members, visitors, etc. Our research goal is to investigate a methodology of the high quality development of an academic laboratory website by a small number of developers in a short period of time. In this paper, we discuss approaches, methods, and technologies used in this development. We illustrate utilized methods by samples of the code. Key findings in this research include bilingual support without reloading pages, multi-device support and a technique of the second server usage to avoid restrictions for the official web server. Our findings were used to develop a new website of the software engineering laboratory of the University of Aizu. Our created from scratch website within two months would attract visitors.

Keywords— Website Development, Responsive Web Design

I. INTRODUCTION

World Wide Web (WWW) revolutionary influenced human lives. The Internet is an important source to get latest information practically about everything. Developing a websites is one of the best ways to provide information to people. However, it is still challenging to create a website that is easy and intuitive to those who use it.

There are many studies that propose how to evaluate the website by using frequent patterns of web usage mining, interactions of users, etc. But there are a few studies that explain how the development is done and the actual methods are used.

In particular, the development methods of academic websites such as university laboratories are not covered yet. In this paper, we discuss approaches, methods, and techniques used to develop a website of the software engineering laboratory of the University of Aizu [6].

The existed laboratory website was created 10 years ago utilizing tools and technologies used in the early years of 21 century. The initial goal of this project was to develop the site to attract attention of 3rd year students of the university. The authors had only two months for the development: This project had to be finished by the beginning of April 2015. In April, the students have to select laboratories for specialization.

To create the laboratory website, we used Bootstrap and jQuery to speed up the work and get the high quality development. As the results, three key features characterize the project: responsive website for multi device support, an access counter that can analyze accesses based on countries, and bilingual pages without reloading when changing language. To implement the access counter, we utilize the technique of second server usage to avoid restrictions for the official web server. Information in the site is presented in Japanese and English.

The rest of the paper is organized as follows. In Section II, we briefly review related publications. In Section III, we characterize the selected development methodology. In Section IV, we explain key features of the frameworks used. In Section V, we discuss methods utilized in this project. In Section VI, we highlight significant findings and present our view on future work.

II. RELATED WORK

Study [1] discusses the website development for mobile devices. They suggest some technical rules for high performance websites. According to them, web developers should not worry about memory because it is so plentiful on desktops. In this project, we must take into account the development of a responsive website for multi devices.

Study [2] surveys the techniques and standards used for website development within 25 organizations in UK. They show that ad hoc approaches and the use of a combination of tools for developing a website are common place.

Study [3] discusses the needs of navigational design skills for website designers.

Study [4] suggests that a university website has two types of audiences. The primary audience is academic, general staff and the students. Another audience is the general public and other educational institutions. They summarize the questions to maintain best practice web design principles into four main sections: finding the information, understanding the information, supporting user tasks, and presenting the information.

In this project, we consider these results and suggestions from the publications.

III. WEBSITE DEVELOPMENT METHODOLOGY

Nowadays, the Internet is a means for small and medium size business to find a niche in the market. High quality websites help save money: There is no need to hire staff, rent

offices, etc. Requirements for the website development become very strong: aesthetic design with graphics, the agility feature, secure payment transactions, multi-device, multi-browser support, etc.

The reality of the today's highly mobile society requests the academic institutions to renovate their websites to provide information to the user in more understandable way reflecting changes in the technology.

For this project, initial requirements were strong and as usual contradictory. The authors were tasked to create from scratch a laboratory website to attract the junior students and help them make right selection of the laboratory for their specialization. The site must be bilingual (supporting English and Japanese). It must have a multi-device support and minimize data traffic between the server and the remote user. A special requirement was to find a solution to overcome several restrictions on usage of CGI scripts on the official university server. The basic information and illustrations including photos to be placed on the web site were given in English.

The authors selected the tools and technologies after analyzing the existing instruments in the open domain.

The time frame for the development was two months.

In order to meet the agility requirement, the authors selected Bootstrap and jQuery framework. It was right solution because the general page layout and graphical design were adjusted several times during the development.

To satisfy the requirement on the minimizing the traffic for multi-devices, the graphical files were presented in several variants. The file adjustment was done using JPEGmini [8].

Key solutions to implement the site are discussed in detail in the following sections.

IV. FRAMEWORKS

As we mentioned in the previous section, to meet the agility requirement, we used Bootstrap and jQuery design frameworks. Bootstrap is an open source collection of tools for creating websites and applications. jQuery is a JavaScript library designed for simple client side scripting of HTML5.

We implemented the navigation bar that navigates through all pages from any page by using *Navbar* of Bootstrap. We used Bootstrap to customize images on the gallery page and to create switch button objects.

We utilized jQuery to implement the function for switching the languages.

In this project, these tasks were easy because we just learned how to use the tools it by studying sample code and adjusted some parts of the code presented in [7]. As a result, we created website architecture shown in Figure 1.

V. IMPLEMENTATION

In this section, we discuss methods to implement key features:

- bilingual feature without reloading pages;
- access counter feature to avoid the CGI restrictions on the server;

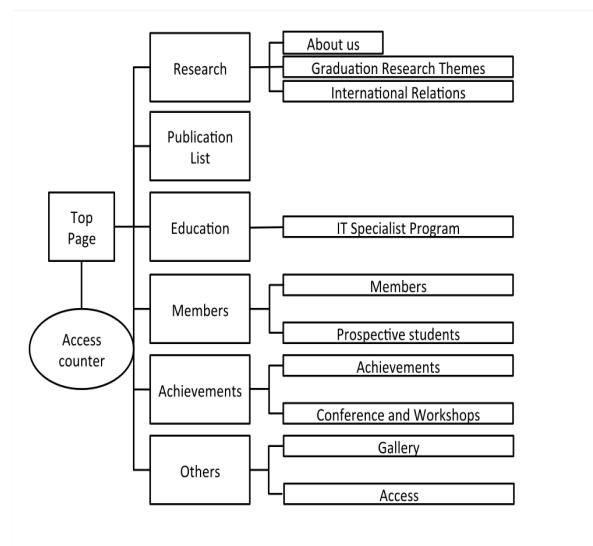


Figure 1. Website architecture

- responsive design feature to support multi-devices.

A. Switch Button for Bilingual Sites

Nowadays, the number of bilingual websites is increasing. For example, websites of Japanese companies, universities and/or government have mainly pages in two languages: Japanese and English. However, those sites often reload the page to switch the language and it takes time, and increases data traffic between the server and user.

Considering mobile devices such as smart phones, reloading pages is not a good solution to switch the language because it takes more time compared with a desktop computer. The official home page of the University of Aizu [5] also requires reloading pages. In addition, there are another disadvantages in at least using reloading pages. The website developers have to prepare two different files that are written in different languages. When they have to add or fix some sentences or lines of code or make changes in graphics, they must update all of them. Moreover, using this style, it is easy to make mistakes and create pages which do not correspond each other.

In this project, we found a solution for this problem. Our site is a bilingual website: Information on it is in Japanese and English. We implemented the switch button utilizing the language class. When visitors click on the button to switch the language, every attribute of the language class is displayed on the browser. It means that our site pages never reload the same page. Every page has the button and it allows visitors to change the language on any page at any moment. Figure 2 shows the sample code to switch the language in HTML5. Figure 3 shows the example of pages in Japanese and English.

```

<button id="en" class="btn btn-default navbar-btn" type="button">English</button>
<button id="jp" class="btn btn-default navbar-btn" type="button">日本語</button>
<h1 class="en">Software Engineering Lab</h1>
<h1 class="jp"><b>ソフトウェア工学講座</b></h1>

```

Figure 2. Sample code to switch the language in HTML5.

The screenshot shows two separate sections of the website. The top section is in English, listing publications by students. The bottom section is in Japanese, also listing publications by students. Both sections include links to the full papers.

Figure 3. Publication list in English and Japanese

B. Access Counter

The software engineering laboratory is responsible for coordination joint research and education projects with some overseas partner universities. Therefore, we implemented the access counter.

Our solution requires the usage of the common gateway interface (CGI). However CGI scripts and functions of server side includes (SSI) are not available on the official server of the university for security reasons. We prepared a new server by ourselves. The server is an apache web server running Ubuntu 14.04 LTS operating system. We put the CGI function to display the total number of visitors on this server. When visitors access the site on the official university server, the site always redirects the CGI request to the second server. We use the server only for counting and displaying the number of visitors.

Figure 4 shows sample code in Perl and HTML5 for the counter. Figure 5 illustrates the implementation of the counter system. Initially in response to the first access, the counter system creates the list of IP addresses. Then, the accesses from the same IP address within 20 minutes from the first access are not counted up. After 20 minutes, the system deletes the records with the time stamp behind the aforementioned period of time from the list of the IP addresses. We added the function to analyze where the access comes from. This function refers to the Asia-Pacific Network Information Centre (APNIC) [9], finds the country, displays

CGI

```

my $file = "ip.txt";
open(FILE,'+<counter.dat');
eval{flock(FILE,2)};
$count = <FILE>;

```

```

++$count;
seek(FILE,0,0);
print FILE $count;
close FILE;

```

HTML

```
<iframe src="http://XXXXX.u-aizu.ac.jp/~YYYYY/cgi/counter/counter.cgi"></iframe>
```

Figure 4. Sample code in Perl to access the counter.

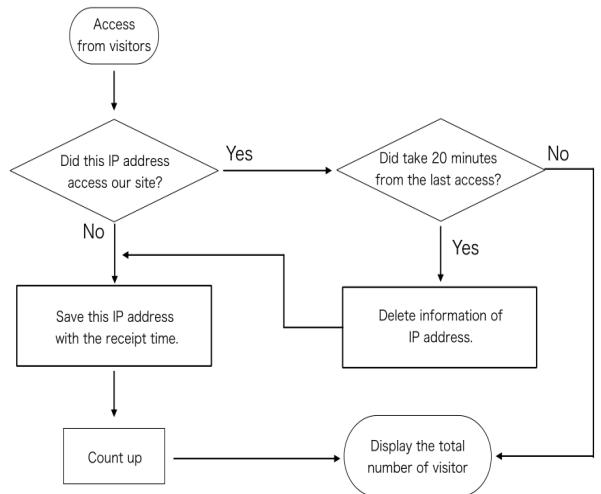


Figure 5. Flowchart of the counter system



Figure 6. The website access counter

the country flag and the number of visitors from the country. Figure 6 shows the result as of 25 April 2015.

C. Device Adaptation

Developing a responsive website is one of necessary tasks in modern website design because there are many devices that can connect the web and browse websites. So, we also needed to develop this functionality.

We prepared three types of CSS3 files. The implemented approach is to estimate the maximum width of the window size. For a smart phone, we set the maximum size to 480 pixels. If the window size is less than 480 pixels, we adjust the website for the actual smart phone size. In the same way, we

```

@media screen and (max-width:480px){
img{
max-width: 100%;
height: auto;
width: auto;
}

@media screen and (min-width: 481px) and (max-width: 768px){
img{
max-width: 100%;
height: auto;
width: auto;
}

@media screen and (min-width: 769px){
img{
max-width: 100%;
height: auto;
width: auto;
}

```

Figure 7. Sample code for the responsive site in CSS3.

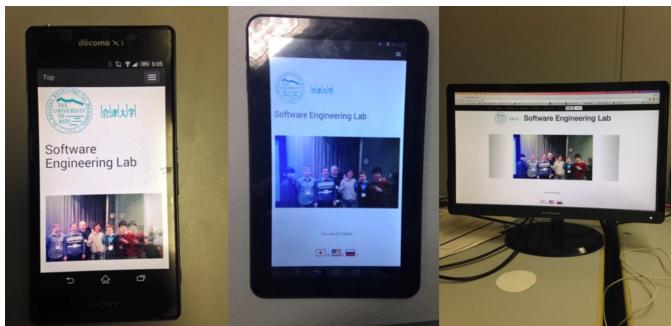


Figure 8. Responsive page accessed from a smart phone, tablet PC and desktop computer

set the maximum size to 768 pixels for tablet PC and minimum width size to 769 pixels for desktop computer. In addition, study [1] suggested that the size of images should be reduced and we actually reduced the size of all images on our website utilizing JPEGmini. Figure 7 shows the sample code for the responsive site taken from the CSS3 files. Figure 8 shows the same page accessed from a smart phone (5.5 inch screen), tablet PC (10.1 inch screen) and desktop computer (22 inch screen). The website provides the same page design for any device.

VI. CONCLUSIONS AND FUTURE WORK

There are many tools for website development. They help maturing the websites. In this project, we utilized the modern approaches to develop the laboratory website. The bilingual feature is implemented via the language switch button without reloading pages. As the result, any device does not have to reload any pages and this is a good solution for mobile users. Size of photos in our site was reduced for loading pages quickly. We followed a common practice to combine the development tools: We utilized Bootstrap and jQuery. We presented samples of code to illustrate the key methods used in the development.

While this project has processed, we faced some problems and proposed solutions for them. We designed the access counter that can get the number of visitors and their countries from which access to our site is made. We relayed on the second server to avoid CGI script restrictions on the official server. We developed the responsive websites by taking into account features of devices.

This website helped us choose good applicants among junior students who selected our laboratory for specialization accessing the website.

We hope that our experiences will be helpful for future website developers.

As for the future work, we will enhance our site to be more attractive for visitors by adding new features and/or fixing some its parts.

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