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This study gives an overview of the issues and solutions to develop Web sites for low bandwidth areas. It sheds lights on the fields in web design, cross-cultural environment, low bandwidth, and mobile web design. It provides some examples and potential solutions from the design and technique perspective to solve low bandwidth problems. And finally a demo project was created to prove the correctness of the analysis.

Headings:

Web design

Cross-cultural analysis

Low bandwidth

Mobile web design

WEB DESIGN FOR LOW BANDWIDTH AREAS

by
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Approved by

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Introduction

This master's project is an overview of the design and technique issues for the users in low bandwidth areas. It focuses on the common research area in Web design, but it also focuses on some special areas, for instance, in cross cultural environment, and in countries or regions with low bandwidth.

Literature Review

There is already significant amount research and articles about Web design, cross-cultural environment and low bandwidth. From the common design part to the special low bandwidth focus, the literature sheds lights on all these specific aspects of this project.

Web Design

According to Wikipedia:

“Web design encompasses many different skills and disciplines in the production and maintenance of Web sites. The different areas of Web design include Web graphic design; interface design; authoring, including standardised code and proprietary software; user experience design; and search engine optimization”.

(Wikipedia)

Good Web design should meet all the end users' requirements and allow visitors to generate a sense of visual pleasure.

Responsive design is a major trend in Web development to cater for the diversity of devices used for Web browsing. Most existing Web sites need considerable modification to adopt this new design pattern and they are limited to desktop-to-mobile adaptation. *Michael Nebeling, Moira C. Norrie* Hearst's paper "Responsive Design and Development: Methods, Technologies and Current Issues", highlighted several limitations of the original approach in Web design and showed how the concepts and methods can be extended to adapt to many different viewing conditions including large-screen settings and touch devices. (Michael, Moria, 510)

Mark W. Newman and James A. Landay's paper "Sitemaps, Storyboards, and Specifications: A Sketch of Web Site Design Practice", introduced a way to analyze a Web site, and also introduced tools to help make better design of Web pages. (Mark, James, 263) From their study case and experiment, they addressed different principles on different aspects of the design.

Deborah E. Rosena and Elizabeth Purinton's paper, "Web site design: Viewing the Web as a cognitive landscape", gave an overview of all the different steps in Web design. From Web content and cognitive landscapes, to methods and results, they used a small data set to prove that the goal should be to give access to the information Web surfers' desire in the most expedient way possible. By providing site designers with a better idea of how to facilitate interacting through the cognitive landscape of the Web, simplicity may be more effectively accomplished. (Deborah, Elizabeth, 787)

Cross-cultural analysis

The Wikipedia describes cross-cultural issues as:

“Modern societies are confronted with communication problems caused by cultural misunderstanding and cultural contrast. Intercultural trainings try to solve such problems by developing strategies to train personnel and private person for working abroad, dealing with migration or accomplishing projects in multinational teams.”(Wikipedia)

Different countries and regions may have their different appetites in the Web designing and form designing. For instance, in America, most people have their first name, last name and middle name. But in other countries, say, China, they don't have their middle name. And in some countries in Africa, people are not named in the form of first name plus last name. Thus the design in cross-cultural environment is worth researching.

A good learning Web site is www.Web-design.co.za. This Web site is dedicated to Web design with a focus on Web design in South Africa. This Web site's primary focus is to promote Web site designers in South Africa, whether by listing them on the Web design company's page or by supplying Web design awards for great Web designs. (Web Design) It gives designers a lot of great examples of good Web site design in South Africa, and it provides the designers tips and lessons about how to make a good Web interface in South Africa. It introduces the African Web design industry to the people outside Africa.

Dianne Cyr and Haizley Trevor-Smith's paper "Localization of Web Design: An Empirical Comparison of German, Japanese, and United States Web Site Characteristics", explored the issues of user interface design and experience, including culturally preferred design elements, and a study was conducted analyzing sites in Germany, Japan, and the United States (30 municipal sites in each country). (Dianne,

Haizley) From the data they collected, they found that some elements are the same among all the different cultures, but some other elements are totally different among cultures. For instance, the specific orientations and page placement vary by culture. The France prefer the features centered on the page. But Germany would prefer a logical and structured layout.

Huatong Sun's paper "Building A Culturally-Competent Corporate Web Site: An Exploratory Study of Cultural Markers In Multilingual Web Design", emphasized that before designing the Web page, the designer should do a thorough research about the culture of the target audience, and it provided some methods in doing such researches. Also, it showed that "the integration of different cultural markers on multilingual Web page design can increase Web usability by making users' navigation more comfortable." (Huatong, 95)

Low Bandwidth

According to Wikipedia:

"In computer networking and computer science, bandwidth, network bandwidth, data bandwidth, or digital bandwidth is a measurement of bit-rate of available or consumed data communication resources expressed in bits per second or multiples of it (bit/s, kilobit/s, Megabit/s, Gigabit/s, etc.)." (Wikipedia)

If the bandwidth is very low, it will affect load speed of the Web page, and also some big pictures or videos are can't be show properly in the Web page.

The Web site Internet World Stats – Usage and Population Statistics gives an overview of the Internet Users and Internet Usage in Africa. It shows the important data like "Africa Internet Usage and 2014 Population Stats", "Internet Penetration in Africa"

and “Arica 2014 population and Internet users statistics”. (Internet World Stats) For instance, it shows that the Internet penetration in Africa in 2014 Q2 is only 26.5%, which is 15.5% lower than the World average. This is very important because these statistics provide understanding of the poor conditions of the Internet in some areas in Africa. Thus it’s necessary to do the research about how to improve user experience in those poor conditions.

Jennifer Mankoff, Anind Dey, Udit Batra and Melody Moore’s paper “Web Accessibility for Low Bandwidth Input”, presented requirements for low bandwidth Web accessibility, and two tools that address these requirements. “The first is a modified Web browser, the second a proxy that modifies HTML. Both work without requiring Web page authors to modify their pages.” (Nifer, Udit, 17) They presented a way to solve the low bandwidth problem in a very efficient way. With these small modifications, such as, band forms with link based widgets or giving quick access to the text and links of interest, the performance can be improve significantly even in low bandwidth environment.

Heather Adair-Rohani, Karen Zukor, Sophie Bonjour, Susan Wilburn, Annette C Kuesel, Ryan Hebert, Elaine R Fletcher’s paper “Limited electricity access in health facilities of sub-Saharan Africa: a systematic review of data on electricity access”, presented a general view about the electricity access in Africa: Access to electricity is critical to health care delivery but also critical to the Internet. If the electricity access is very unstable, it will affect the computer and Internet access as well. The paper showed that only 28% of health care facilities, on average, had reliable electricity among the 8 countries reporting data. (Heather, Karen, 249) Also it is critical to ensure the Data

Synchronism, that is to say the outage will not affect the data entering and the data stored in the database.

Web Design Solutions for Low Bandwidth areas

Here are some tips in designing the Web sign with low bandwidth from Adaptive Organization Web site:

- *“No Page Bigger Than 25kB*
- *Reduce Images*
- *Have a Good Site Structure*
- *Use Style Sheets*
- *Minimize HTTP Requests*
- *Turn on Compression*
- *Make elements Cache-able*
- *Avoid PDFs*
- *Put Useful Items First*
- *Show Link Sizes“ (Aptivate)*

Compared with the Internet in developed countries like United States, the Internet connection in South Africa and other underdeveloped areas is very bad. Most people still experience speeds equal to a dial-up to connect to the Internet. And most satellite connections are too slow, with a transfer latency of around 250ms. What’s more, as the bandwidth is very low, the connection is often congested and the online experience is very poor. To solve those problems, designers should adopt some special design and technique skills. Below are the descriptions about the tips for Web design for low bandwidth. (Aptivate)

1) No Page Bigger Than 25kB.

The goal is to have a 10-15 second load time at 20kbps. Visitors would likely wait for 30 seconds for a page to finish loading if the critical content they want to appears in two seconds.

2) Reduce Images.

Images will consume too much traffic considering the Internet situation in low-bandwidth areas. So the designers need try to use CSS for layout rather than images. One important thing for low bandwidth design is that to make sure the site is usable if images are turned off.

3) Have a Good Site Structure.

If the Web site has a good site structure, users avoid loading unnecessary pages. Users can get to the page they want directly rather than visiting some unnecessary pages before they find what they want.

4) Use Style Sheets.

Designers may be used to using tables for layout, but style sheets (CSS) would be more efficient. CSS allows different style sheets to be applied to the same markup for different purposes such as on screen and in print. (Aptivate)

5) Minimize HTTP Requests.

The goal is to design a Web page which requires as few resources as possible. Remember that each image, CSS file, JavaScript file and HTML page requires a separate HTTP request. If the designers put too many things in one page, it would have a large HTTP requests.

6) Turn on Compression.

The compression technology is enabled by default on most of the browsers, but it is disabled on Web servers by default. If the designers turn on the HTTP Compression technique on both browsers and servers, it will reduce the size of text download by 50-90%. (Aptivate)

7) Make Items Cache-able.

This is easy to understand, that is to say if the system stores the data it already received, it can avoid asking for it again.

8) Avoid PDFs.

PDFs files are considerably large compared with HTML data flow. The designers need try to avoid letting users download PDF files. If links to large files are necessary, the designers should show the file size to the users. Or the designers can use optimization technology for PDFs. PDFs can be optimized by using vector-based graphics and minimizing the number of fonts. (Aptivate)

9) Put Useful Items First.

The designers need to make sure that the useful information comes out first. So even if the rest of the page is still loading, users can read the information they want while waiting for the page finishes loading.

10) Show Link Sizes.

The designers should try best to avoid downloading files form the Web site. But if it is necessary, the designers need to inform the users how large the files are going to be.

Web Design in Africa

Most home page of African Web sites, show a preference to orderly grids with small pictures and little text descriptions. Below are three examples from the main organizations' Web sites in Africa.

IN THE NEWS

Monday, 30 March 2015

From the VC's Desk: Update on Rhodes statue and occupation of Bremner Building



Herewith an update on the matter of the Rhodes statue and the occupation of the Bremner building by protesting students.

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UCT Great Minds: Nine of South Africa's most well-known poets



UCT has been privileged to play host to some of our country's most talented poets – as teachers, and as students. Here are just nine.

[Read more...](#)

Skydiving centenarian is 'inspired to live'



100-year-old Georgina Harwood, née Mitchell, graduated with a BA from UCT in 1934, but it's her more recent escapades that have grabbed headlines. If you imagined her 100th birthday party would involve much sitting, and perhaps a spot of tea – perish the thought.

[Read more...](#)

Picture 1: from <http://www.uct.ac.za/>

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1 week 6 days ago



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100% Fees Policy
Deadline for Sem II
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Upcoming Events

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27
Mar

2nd Annual Human Rights Expo
27 Mar 2015 - 2:00pm

30
Mar

Guild Executive and GRC 2015-2016
Swearing-In Ceremony
30 Mar 2015 - 2:00pm


1
Apr

FISH FARMING BUSINESS EXPO
1 Apr 2015 - 1:00pm

Picture 2: from <http://mak.ac.ug/>

News

"Sociology is both Science and Art,"- Hon. Adesina Kawonise




The former Commissioner for Information and Orientation, Ogun State, Hon. Adesina Kawonise, has...

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Picture3: from <http://covenantuniversity.edu.ng/>

For online database forms, there are few difference between Web sites in Africa and Web sites in America. They typically use text fields such as First Name, Last Name, E-mail Address, Day, Month, Year. And they also use dropdown menus, drop down lists and verification code. Below is an online form examples from the online registration part of an African Web site. This is good design because it is very concise and there are no redundant information, pictures and links.

Please complete the form below so recruiters can find you. Please complete all fields marked with an asterisk (*).

First Name *

Last Name *
Current Location *
E-mail Address *
Confirm E-mail Address *
Password *

Please complete the form below so recruiters can find you. Please complete all fields marked with an asterisk (*).

Nationality *

Date of Birth *
Gender *

Male Female

Ethnicity *

Disability *

No Yes

When did you start your very first job?

 I have no work experience

Current Job Title *

Picture 4: from www.careers24.com

Mobile Web design for low bandwidth

RESS (responsive design with server-side components)

The adoption of the RESS (responsive design with server-side components) will optimize the performance of the Web sites. It reduces the size of the page and increase the loading speed.

One study about the adoption of the RESS technique showed that the image's size would change according to the size and resolution of the screen of the mobile phone. They provided three screen shots of the same Web site. Though they looked the same, however, the actual sizes of the Web pages are different.

“The discerning reader will note that the screenshots all look the same, and that’s the whole point: The optimization procedure we’ll be applying ensures that the optics of the Web site remain intact, while improving the user experience significantly due to the smaller page size. In fact, the screenshots are not exactly the same (click to view them at native size), but the slight differences in the quality of the images tend to go unnoticed on phone screens.” (Ronan Cremin)

The optimization of a mobile Web page mainly lies in three aspects. Firstly, the biggest impact is to reduce the size of the image. The best way to do this is replace the image source's attribute with a reference to a resized version of the same thing. The second thing is to reduce the JavaScript and the CSS payload. What's more, if some of the mobile phone doesn't support certain JavaScript code, the application can just ignore the JavaScript code automatically. The last but not least part is the optimization of the connectivity detection. Their idea is that the size of the image is dynamically dependent on the bandwidth of the user. If the user's bandwidth is large, there will be little or no

image compression. But if the user's bandwidth is low, there would be considerable compression on the image.

PageSpeed

The PageSpeed tools are a great technique to analyze and optimize the Web site. The PageSpeed Module could be downloaded and installed from the Google Developers Web site.

“The PageSpeed family of tools is designed to help you optimize the performance of the Web site. PageSpeed Insights products will help you identify performance best practices that can be applied to the site, and PageSpeed optimization tools can help you automate the process.” (Google Developers)

In their study, they compared the size of the Web site before and after the adoption of the PageSpeed technique. The result of the comparison is shown below:

Component	Size over network before	Size over network after
HTML	3 KB	3 KB
Images	941 KB	177 KB
JavaScript	55 KB	51 KB
CSS	27 KB	12 KB
Total	1027 KB	253 KB

The study also showed that the lower the resolution of the phone's screen, the more decrease in the size of the image. For instance, for some functional phone, like some old Nokia devices, the image is only around 90 KB. And as long as the phone's screen is relatively small, there are no perceptible difference to the user even though a large portion of data have been removed.

After using the code of the PageSeed, it was remarkable that the loading speed was much faster than before, and the benefit would be more returns of the visitors, as it would save a lot of data in their plan. Also the wider device and network compatibility would lead to an improved Internet access.

Techniques

If the designers know some devices doesn't support JavaScript and rich CSS, one good practice is to remove the JavaScript and corresponding CSS files from the HTML, which would save more data. The following PHP codes are making the determination of a low-end device based on its rendering engine.

```
$highEndDevice = (isset($properties['browserRenderingEngine']) &&  
in_array($properties['browserRenderingEngine'], array('Gecko', 'Trident', 'WebKit', 'Presto')));
```

After detecting the variables, the application will learn that which resources are useful. If some resources are not useful, the application should decide not to include them in the Web page. If the application detects some low end devices, it choose to remove the JavaScript and some CSS files. In bandwidth situations, some low-end phones really don't support some JavaScript and CSS file, the application should chose not to let them run those codes.

Some examples

Use good navigation (menu)

- *Most Popular Cars*
- *Band A - Z*
 - *Band A:*
 - Acura*
 - Audi*
 - Aston - Martin*
 - ...
 - *Brand B:*
 - Bentley*
 - BMW*
 - Bugatti*
 - ...
 - ...
- *Cars by Category*
 - *Sports Car*
 - *Super Car*
 - *more than \$300000*
 - *\$100000 to \$300000*
 - ...
 - *Convertible*
 - ...
 - *SUV*
 - ...
 - ...
- *Search for Cars*
- *About us*
- *Contact us*

Use External Style Sheets Rather than Embedding CSS in the Page

If the CSS is separated from the HTML, it would save more data by reusing the CSS across the application. For instance, the original table would be 10KB. The separate CSS would be 10KB and the new table without CSS would be 5KB. However, the users only need to download the CSS once, thus they can save a lot of data if there are many pages.

The original table:

```

<table>
  <tr>
    <td>First Name:</td>
    <td colspan="2"><input id="txtFirstName"/></td>
  </tr>
  <tr>
    <td>Last Name:</td>
    <td colspan="2"><input type="text" id="txtLastName"/></td>
  </tr>

```

If the designer replaced it with CSS:

```

<style>
div.block{
  overflow:hidden;
}
div.block label{
  width:160px;
  display:block;
  float:left;
  text-align:left;
}
div.block .input{
  margin-left:4px;
  float:left;
}
</style>

```

And the HTML:

```

<div class="block">
  <label>First field</label>
  <input class="input" type="text" id="txtFirstName"/>
</div>
<div class="block">
  <label>Second field</label>
  <input class="input" type="text" id="txtLastName"/>
</div>

```

Cache

Set expires header:

```
Expires: Sun, 05 Apr 2015 08:00:00 GMT
```

Set cache separately using Cache-Control header:

```

Pragma: no-cache
Cache-Control: no-cache
Cache-Control: max-age=0 (or negative)
Preventing caching of private content:
Cache-Control: private
Avoid the Auto-Refresh Header:
Refresh: 0

```

Or

```
<meta http-equiv="refresh" content="0">
```

Links

If the download file is larger than 75KB, the designers should show the size of the link like this: [PDF Report](#) [237kB]

Use Relative URLs

The absolute URL was: <http://www.widernet.org/directories/people/staff/>

The base directory of the document: <http://www.widernet.org/directories/people/>

The relative URL would be simply: [staff/](#)

Keep Directory and File Names Short

Long URLs:

http://www.widernet.org/Regional/Africa/Training_Opportunities/Online_Training/

Should be abbreviated to this: <http://www.widernet.org/reg/af/tr/on/>

Considerations for software

Oracle: Oracle Database (commonly referred to as Oracle RDBMS or simply as Oracle) is an object-relational database management system produced and marketed by Oracle Corporation. It is typically used for large corporations, and the price is high.

Microsoft SQL Server: Microsoft SQL Server is a relational database management system developed by Microsoft. It is typically used by small and mid-sized companies. Its primary query languages are T-SQL and ANSI SQL.

MySQL: MySQL is the world's second most widely used relational database management system (RDBMS) and most widely used open-source RDBMS. It is free and it works perfectly with PHP.

Eclipse: In computer programming, Eclipse is an integrated development environment (IDE). It contains a base workspace and an extensible plug-in system for customizing the environment. Written mostly in Java, Eclipse can be used to develop applications. Development environments include the Eclipse Java development tools (JDT) for Java and Scala, Eclipse CDT for C/C++ and Eclipse PDT for PHP, among others. (Wikipedia)

Apache: The Apache HTTP Server, colloquially called Apache, is the world's most widely used Web server software. Apache supports a variety of features, many implemented as compiled modules which extend the core functionality. These can range from server-side programming language support to authentication schemes. Some common language interfaces support Perl, Python, Tcl, and PHP. (Wikipedia)

EasyPHP: EasyPHP installs a portable local WAMP server including the server-side scripting language: PHP 5, the Web Server: Apache 2, the SQL Server: MySQL 5, a database manager: PhpMyAdmin and others development tools.

LAMP: LAMP is an acronym for "Linux, Apache, MySQL, Perl/PHP/Python." Free-software-open source projects that require a full-featured database management system often use MySQL.

WAMP: WampServer refers to a software stack for the Microsoft Windows operating system, created by Romain Bourdon and consisting of the Apache Web server, OpenSSL for SSL support, MySQL database and PHP programming language.

Identify project/technologies

This is a PHP Web project. The programming languages are PHP, JavaScript, CSS, HTML and SQL. The development environment is Eclipse + Microsoft SQL Server + Apache.

The final outcome for this project may not be a fully functionally Web site. But it should contain the some demos of technologies which are used for low bandwidth environment.

Demo

The demo of the Web site is a Web database form for training registrants. The form contains some basic biographic information of the registrant. It interacts with the SQL Server database, and the users can save and update their information. The original size of the Web page is 80KB, which contains all the CSS, images, JavaScripts, etc. Below is the process helping reduce the size and the potential data traffic of the page.

Applicant Detail Information

Update successful

First Name	Steve	Mid Initial	Mid Initial
Last Name	Jobs	Suffix	Select a value... ▼
Email	Email ex: Name@example.com	Phone Number	Phone Number ex:(999) 999-9999
Confirm Email	Email ex: Name@example.com		

Other Messages

Navigation Bar

The use of the navigation bar would let users go to the “main functional page” quickly, reducing the data traffic of visiting some unnecessary intermediate pages.

Registration

QuickLinks:	Dashboard	HomePage	Training Program	About eGranary	Contact Information
-------------	---------------------------	--------------------------	----------------------------------	--------------------------------	-------------------------------------

<input type="button" value="Refresh page"/>	<input type="text" value="First Name"/>	<input type="text" value="Last Name"/>	<input type="button" value="Register"/>
---	---	--	---



Include PHP files

Some functions or objects are used many times in the PHP files, so it would save much space if the designers put them logically together and include them in the page if those functions are needed.

```
// include the site constants
include_once("Constants.php");

// include the for parameter helper
include_once("GetFormParams.php");

// include the form element helpers
include_once("FormsUtil.php");

// get the user session helper object
include_once('UserHelper.php');

// get the dump utils
include_once('DumpUtils.php');

// include the pulldown helper funcs
include_once ("Pulldown.php");

// include the founder object
include_once ("Founder.cls.php");
include_once ("FounderEdu.cls.php");
```

For example, the “DumpUtils.php” page includes the functions which retrieve or save data into the database. In these certain pages, they also include the lower level files, say, the functions for database connection.

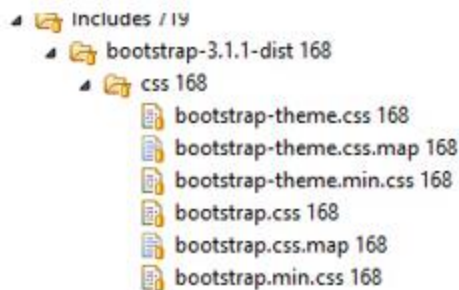
```
{
// include the data access class
include_once("DAO.php");

// include the data access class
include_once("SQLUtils.php");
```


JavaScript and CSS

The purpose to include the JavaScript files and CSS files is similar with including the PHP files. Some JavaScript functions and CSS styles can be used for the whole application. Thus the users only need to download them once, and it will reduce the size of other pages by removing the JavaScript and CSS from the PHP pages.

```
// include the JavaScript file
$scripts = "<script type=\"text/javascript\" src=\"MasterProjectForm.js\" />";
```



The Web site uses the Bootstrap for CSS. Bootstrap is the most popular HTML, CSS, and JavaScript framework for developing responsive, mobile-first Web sites.

```
function dumpBootTextField($id, $paramName, $size=null, $maxLength, $disabled='', $inlinelabel=null, $tooltip=null)
{
    // init the size html value
    $sizeHTML = "";

    // was a size passed in for the text box
    if (isset($size))
        $sizeHTML = ' size="' . $size . '"';

    // init the bootstrap html value
    $bootstrapControl = ' class="form-control" data-toggle="tooltip" data-placement="bottom" ' . ' title="' . $tooltip . '" placeholder="" ' . $inlinelabel;

    // output the control
    echo '<input type="text" id="' . $id . '" ' . $bootstrapControl . $sizeHTML . ' name="' . $paramName . '" maxLength="' . $maxLength . '" ' . $disabled . ' />';
}
```

For instance, for the Text Field, firstly it should be designed as a function, which can be used in each page if a text field is needed. Secondly, it uses the Bootstrap variables, for example, the “class = ‘form-control’”, “data-toggle = ‘tooltip’” and “data-

placement = 'bottom'". If the users download the CSS once, it can be used for the whole application.

Reduce Images

After adding a picture to the page, the size of the page increases 38KB.



Casting a Wider 'Net.

Update successful

First Name	<input type="text" value="Steve"/>	Mid Initial	<input type="text" value="Mid Initial"/>
Last Name	<input type="text" value="Jobs"/>	Suffix	<input type="text" value="Select a value..."/>
Email	<input type="text" value="Email ex: Name@example.com"/>	Phone Number	<input type="text" value="Phone Number ex: (999) 999-9999"/>
Confirm Email	<input type="text" value="Email ex: Name@example.com"/>		

Other Messages

Show download size

If the application allows users to download data from the Web site, it should show them the size of the files before they decide whether to download it or not.

<input type="button" value="Show/Hide CSV Export Options"/>	<input type="button" value="Export data to .CSV"/>	【Size: 647KB】
---	--	----------------------

Cache

The coders can add some code at the end of the script that caches the final output, and code at the beginning that checks to see if the page is cached. If the page was found in cache, send it and exit rather than running the queries again. And this needs lots of customization for the setup, including cache expiration, a \$cache_key that meets the needs, and error detection so bad pages aren't cached. (Stackoverflow)

```
function cache_file() {
    // something to (hopefully) uniquely identify the resource
    $cache_key = md5($_SERVER['HTTP_HOST'] . $_SERVER['REQUEST_URI'] . $_SERVER['QUERY_STRING']);
    $cache_dir = '/tmp/phpcache';

    return $cache_dir . '/' . $cache_key;
}

// if we have a cache file, deliver it
if( is_file( $cache_file = cache_file() ) ) {
    readfile( $cache_file );
    exit;
}

// cache via output buffering, with callback
ob_start( 'cache_output' );

//
// expensive processing happens here, along with page output.
//

function cache_output( $content ) {
    file_put_contents( cache_file(), $content );
    return $content;
}
```

Size comparison

If all the PHP functions, database connection files and JavaScript, CSS and Images are added into one page, the size of one page would be 80KB. After removing all there from the page, the size of one page would be 12KB.

Conclusion

The paper gives an overview of the design and technique issues in designing a Web site for areas with low bandwidth. From the design perspective, a good navigation bar and less images would help to save a significant amount of data. From the technique

perspective, the adoption of cache and CSS would reduce redundancy. Also, there are some existing tools and libraries which provide web developers good ways to reduce the size of the page. As shown in the Demo, if all the good design and technique skills are used, the size of the Web site will be decreased to an acceptable level for those areas with low bandwidth.

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