

A Smart Framework for Web Content and Resources Adaptation in Mobile Devices

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Abstract

Accessing the Internet from mobile devices is becoming increasingly popular, for the past few years mobile devices (mobile phone, smart phone, PDA, palmtop) have rapidly become an integral part of our lives, with an internet connection we can have access to any kind of web content.

Mobile web users face a big problem that the majority of web content are tailored for desktop computers which can have a large display area and high connection speed compared with mobile devices which have smaller display area and limited connection bandwidth. So we have to take in our considerations the severe resource constraints on the mobile devices [1], their performance is usually much lower, smaller processor memory, their screens are smaller, and generally their internet connections are much slower, power, form factor, bandwidth and battery.

Our proposed smart framework for web content and resources adaptation in mobile devices (WRAMD) intend to provide a majestic tool for webmasters that could weaves both mobile web and traditional web production into just one single tool. This will help them to facilitate the web content production for both desktop and mobile web users, and will move the world into faster and simpler mobile web site development, with light weight transfer over a wireless channel. Our target is to provide the best web view to the connected mobile devices, enhance the http response, give a minimized bandwidth usage for mobile access and provide a device specific view for connected mobile device.

Keywords

Wireless Technology, Mobile Applications, Mobile Content Adaptation, Mobile Browsing, Mobile Usability, Template Engines, Web Applications, Interface Design

1. Introduction

There are still many web sites that are unaware of mobile presentation and, when accessed from handheld devices, offer a poor user experience [2], [3]. Browsing web pages which is not adapted for small screen viewing is still very inconvenient [2]. One of the available solutions to have a good web browsing view is to let web browsers handle it by trying to solve the interaction problems that occur when small screen devices are used to access web pages designed for large screen viewing, but the research's results indicate

that the user's performance was poor on mobile browser as users expected similar experience as on desktop [2].

Web access from mobile devices presents its own unique challenges [3], [4]. The performance of mobile devices is usually much lower than desktop. We have to treat it in different way to save the limited mobile resource.

Hence in the majority of the cases it is impossible to display the original web content that is customized to a desktop computer, on the display of a mobile device in a usable and efficient way. This paper proposes a model that will provide multi adaptable web content of the original content to match the capabilities of the client device, and provide a device specific adaptation. Our proposed model will enable multiple heterogeneous devices to display the same content without re-authoring the web content again and use the original one to fit both the desktop and most mobile users, with a minimized bandwidth usage access and lower use of mobile resources.

Another important issue to take into consideration is that when authoring web content for mobile devices we should do much effort in optimization to deliver such web content and save mobile resources like CPU, memory and battery's consumption power. The Proposed model's principal objective is to improve the user experience of the web when accessed from such devices, minimize the HTTP response, improve the display of web content to fit the mobile users through applying browsing and media adaptation and finally minimize the bandwidth usage by employing a smart technique to our template engine.

In this paper we will use Joomla CMS as a case study in our implementation, this does not mean that our proposed model is for a specific web application but its general enough to be used also with any web application that use the template engines approach.

The paper's contributions are:

- A proposal for browsing adaptation and provide a device specific adaptation.
- A proposal for media adaptation to provide special version of the best optimized and compressed media for mobile users.

- An enhancement for the template engine approach to minimize the transferred data size for mobile access.
- Design and implementation of a dynamic model, and integrate all our modules to the CMS for testing case.

The rest of the paper is organized as follows, in section 2, we discuss related work, section 3 we discuss the features of the proposed model and how it could help the web publish industry, section 4 the proposed model architecture, section 5 we present preliminary experimental results on the implemented prototype to validate the model, and finally section 6 is the conclusion and future work.

2. Related Work

There were many approaches that provide a mobile web adaptation, but most of them provide just browsing or media adaptation or depend on re-author the original web content again, which led to different view and does not give the same look and feel of the original desktop web site.

Here we will discuss some approaches and their drawbacks, the first approach is a web page filtering and re-authoring for mobile users [5]. It provides techniques for displaying web pages on small screen devices and classified them into five general approaches, device specific authoring, multiple-device authoring, client-side navigation, automatic re-authoring and web page filtering. This approach based on re-author the content which add much processing overhead and does not give the same look and feel of the original desktop web site.

Others relay on adaptation based on component document model [6], based on extracting page content and converting it to an XML schema, then adopt this xml result and send it to the client with its XSLT style sheets. The drawback of this model is that the final results could be much more difference from the original one, provide a static adaptation and could treat each device in different ways and needs much layers and code.

Adaptation based on Profiles and configurations, and use Wireless Universal Resource File (WURFL) [7] also could be used we will use a small part of this approach just to identify the connected device, this model also could not provide the same look and feel for original web content and error in source code will lead to bad adaptation results. Also CMo [8] is a proxy server used for browsing. CMo takes the original Web pages, processes them, and presents them to the users. Page elements and adapt the page for mobile browsing, the problem is divide the original page into several mobile page this give the user inconvenient browsing mode and may be give the user a part that is not of interests.

Some approaches were interested in organizing web pages into tree structures and summarizing their content [9], [10], [11], [12]. But summary structures often cause needless navigational steps when a user is interested in some specific content. Other some adaptation approaches [13], [14], [15] also have some advantage on the adaptation but also all of them dose not provide the same look and feel for original web content. Our proposed model will try to avoid the problems that face the previous approaches, and try to take advantage of the others [7], [16].

3. Features of the Proposed Model

- Solve the problem of creating two versions of web site.
- Could detect connected device and set best technique to treat it.
- Give the web master a majestic tool to edit web site content once for both mobile and desktop user and minimize work effort.
- Could be integrating with any content management system (CMS) or any template based system.
- Give the connected mobile devices best web view.
- Enhance the http response.
- Mobile devices will get a minimized bandwidth usage access.
- Use the same platform and web hosting without any extra features or cost.
- Support, expand and cover a wide range of mobile devices.

4. Proposed model Architecture

The proposed model will facilitate the web content production for both desktop and mobile web users, web masters will not have to create two versions, one for desktop users and other for mobile users, also they could edit web site content once and after publishing, the content will be available for both users with special adaptation options. Our prototype will based on Joomla CMS [17] as a case study, our model offer browsing adaptation, media adaptation and use a smart technique with the template engine to minimize the processing overhead and reduce the amount of transferred data over a wireless channel, figure 1 provides outline for proposed model.

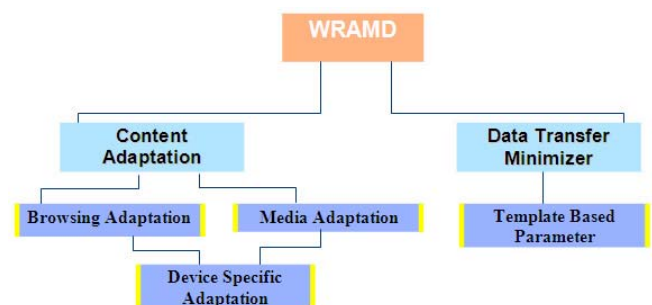


Figure 1 Proposed Model Outline

4.1. Browsing Adaptation

This section concerns about providing the best view for the connected device, our approach is not based on using a static template. Based on the connected device’s screen width we could pass special parameter to the template engine and tell it the name of best template that it could be used for this device. We will use user agent profile (UAProf), to check to connected device [18] and read x-wap-profile then get the screen width of this device, we will also cache this x-wap-profile and its extracted information also to give faster response at the next request.

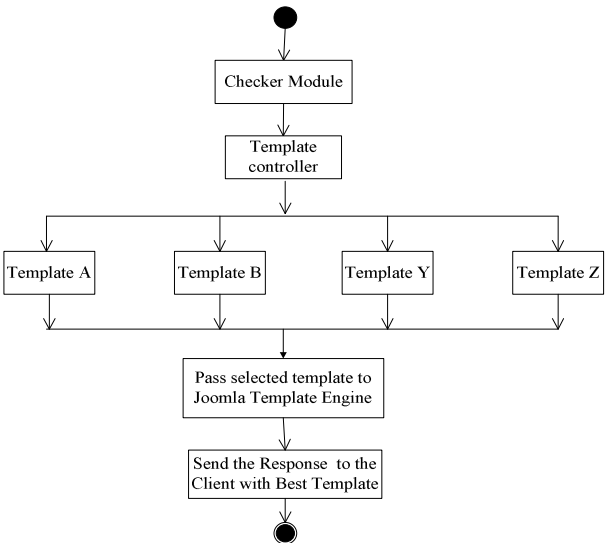


Figure 2 Browsing Adaptation Process

This defines the formal notation for template variations set:
 $C = \{c \mid c = A + B + Y + Z, A \in \{a, b, c\}, B \in \{d, e, f\}, Y \in \{g, h, i\}, Z \in \{j, k, l\}\}$

Where C is our entire template set, A, B, Y, Z is a sub group for this set which is specific for some types of devices, for example template set A will work well for Nokia E61, 63 or 71 and template set B will work well for any screen resolution 176 x 208 this technique will be our target during the implementation process, We will use HTML, CSS, XHTML MP for mobile templates, figure 2 illustrate the process of browsing adaptation.

4.2. Media Adaptation

In Mobile web browsing there is no need to send a large and high resolution images, to display on a limited small screen we could provide a small and low resolution image, and this will give us almost the same view as we display a high resolution image. In contrast the desktop user may need to view a higher resolution image. We will make use of this idea to create media adaptation module which will be an automated process that will run after each publication of a new content and its role is to recreate another version of web media with a low resolution and smaller size also, then reset all required parameters so call it for mobile users only.

This will save the bandwidth usage and mobile resources in the running time.

We use a compression on JPEG in our prototype we use the compression ratio of 1:40.8 it gave us optimistic results, and the end user perspective didn’t fell too much different, was not notice too much difference between it and the original one, table 1 displays a comparison between the original image and the compressed one. Figure 3 show the media adaptation flow chart.

	Original image	After compression
File size	64,799 bytes	11,769 bytes
File type	JPEG	JPEG
Pixel format	24 bits	24 bits
Compression ratio	1 : 7.4	1 : 40.8
Image Histogram		

Table 1 Comparison between the original image and the compressed one

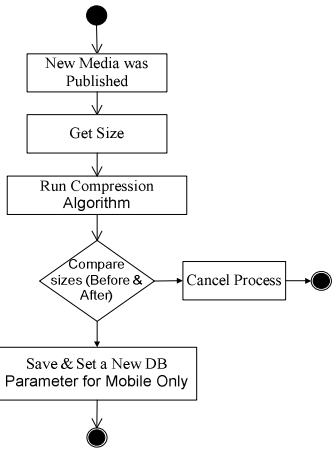


Figure 3 Media Adaptation Process

4.3. Device Specific Adaptation.

This module is based on browsing and media adaptation, after running the checker module that its role is to identify the connected user is a desktop user or a mobile user, this pass the request to the template controller which role is to decide which is the best template to use for this device from the template repository, and also which media files version to use for this device. This module will generate a custom adaptive version for this device that could mach its screen size and also send to it smaller media files which is a result of low bandwidth usage and lower mobile resource usage also.

4.4. Data Transfer Optimizer

Any template engine based system depend on re-process the whole template again, for each client request than regenerate the whole page again from desired template, with the new content for this requested page.

We will use a new model based on IBM research laboratory [16], but with some enhancement especially for user agent. Our proposed model will divide the original page layout into three main parts header, main area and footer, we could also sub divide the main area into other sub areas, each divided area will have a unique name indicator to identify it. After a user receive its first response all this areas with their names will be already known for his mobile browser, when a use click on any link to request another page, we will not send the whole page again rather sending the only data that was requested without reloading the whole page again, this technique will minimize the size of transferred data, and help the mobile device to save its resource because it will not run the whole page again, it will just render the new requested data only, figure 4 and 5 illustrate this concept for first request and any other requests.

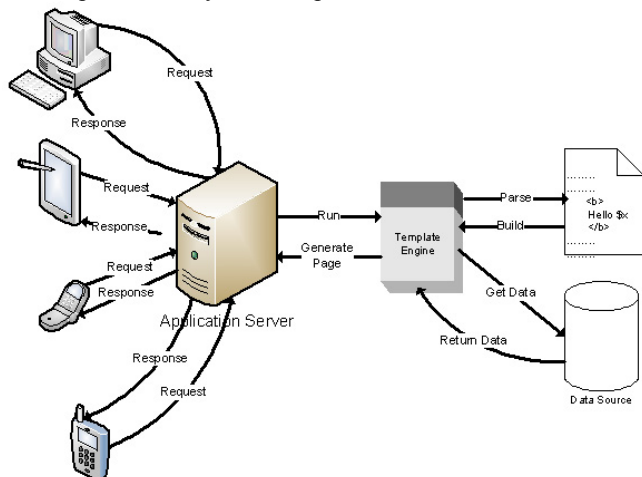


Figure 4 First Request – Response

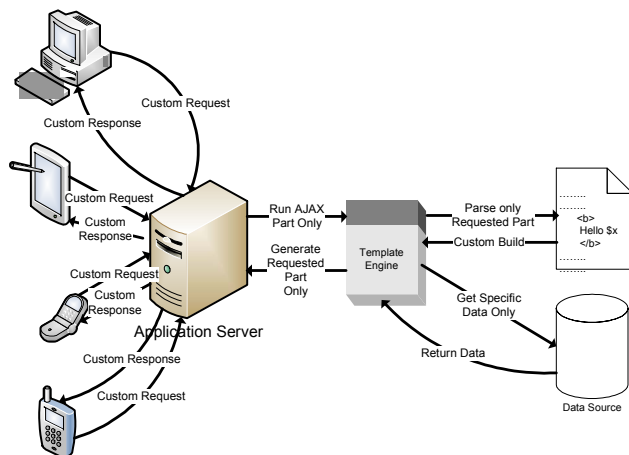


Figure 5 Custom Request - Response

5. Experiments

Our model will be evaluated using different measures, the mobile view, response time and minimized transferred data size. We will use different mobile emulators and try to cover most common mobile screen width, table 2 explain the screen size used in testing and also what device we use for this size, our contribution here is to explain how can we adopt the web site layout to work well in most mobile device in different screen sizes.

We have created a five testing scenarios, the first one will be for a desktop user with a Firefox web browser running on a windows machine the other four scenario each one will based on access the same web content but from different mobile device with different device parameters and different screen size, this will give us a real experiment results which will proof that we can have a many different version from a single web content without having to create and retype the same content again or go through re-authoring solutions or add more layers to the system which is not perfect all the time.

Mobile	Screen Size	Color Depth	Processor Speed	Internal Memory	Display Color
Nokia 6260	176 x 208	16 bit	123 MHz	6 MB	65K
Nokia E63	320 x 240	24 bit	369 MHz	120 MB	16M
Apple iphone	320 x 480	24 bit	600MHz	128 MB	16M
Nokia N97	360 x 640	24 bit	434 MHz	128 MB	16M

Table 2 Different devices emulators with different parameters like screen sizes that used for testing

5.1. Data Transfer Primary Results

Figure 6 illustrate the transferred data size in kilobytes, when access the same content from different devices.

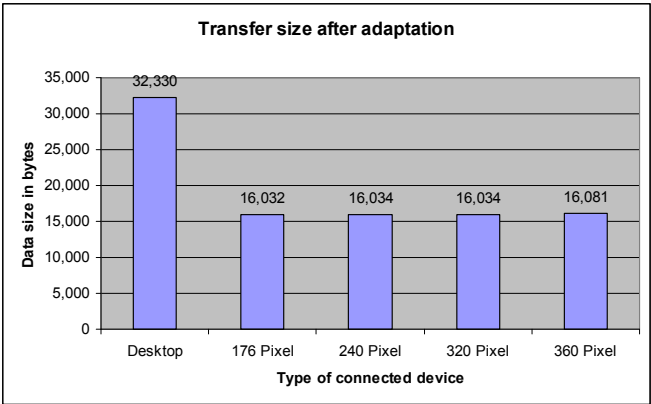


Figure 6 Primary Results for data size transfer after adaptation and custom personalization

5.2. Response Time Primary Results

Figure 7 illustrate the response time in milliseconds, when access the same content from different devices.

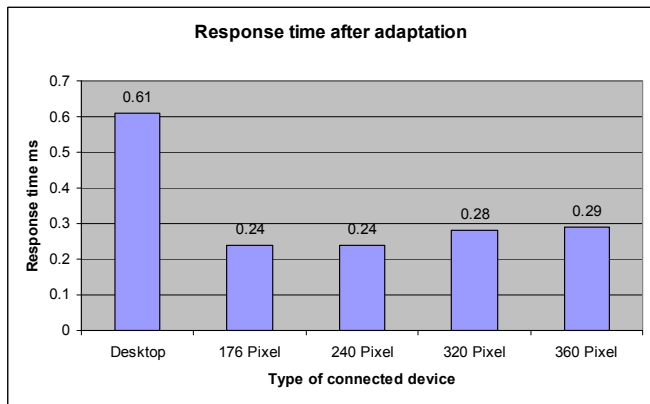


Figure 7 Primary Results for Response Time in milliseconds

5.3. Evaluation on different screen sizes

After we run the five tests on different mobiles with different screen size now we see that we are able to adopt the content depend on the connected device and its screen size, the same content could be viewed from any mobile device with some adaptation to suit its screen. Figure 8, 9, 10 illustrate this concept.

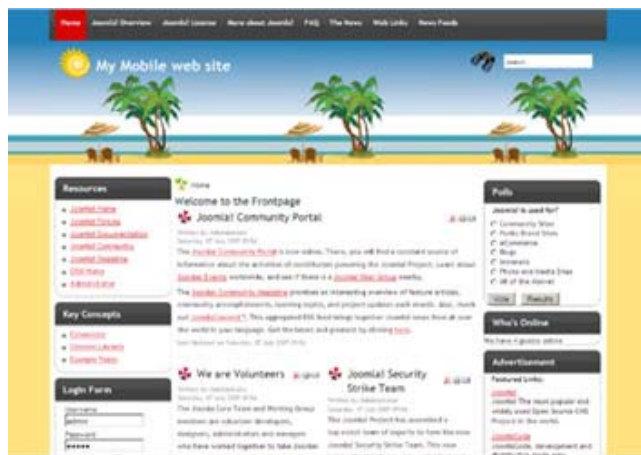


Figure 8 Scenario 1 Home page view when accessed from desktop computer



Figure 9 Scenario 2 and 3 Home page view when accessed from Nokia 6260 and Nokia E63

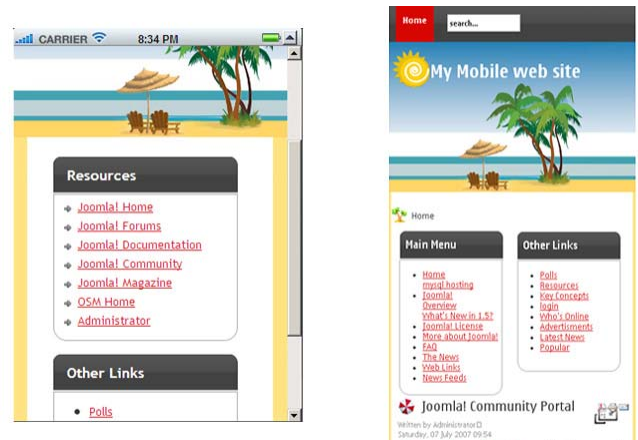


Figure 10 Scenario 4 and 5 Home page view when accessed from iPhone and Nokia N97

5.4. Experiment Subjective Test

We conduct a subjective test with 12 users and webmasters, the rating system scale was 0-3-6-10, 0 is very bad and 10 is perfect, the experiments in figure 11 illustrate the satisfaction for normal users when accessing a web site which is not adaptive from a mobile device, and then when accessing the same web site after implement our adaptation model on it, from a mobile device also. Figure 12 illustrate webmasters satisfaction after they use administration area for our proposed model.

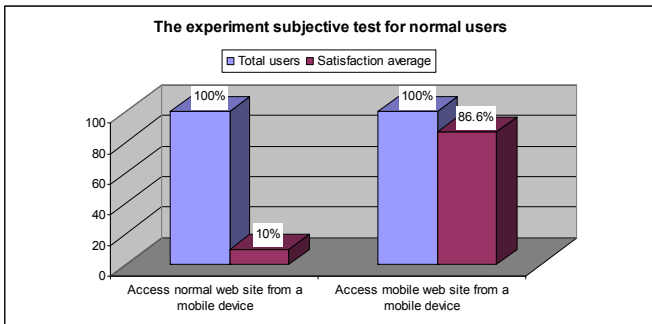


Figure 11 Normal users satisfaction

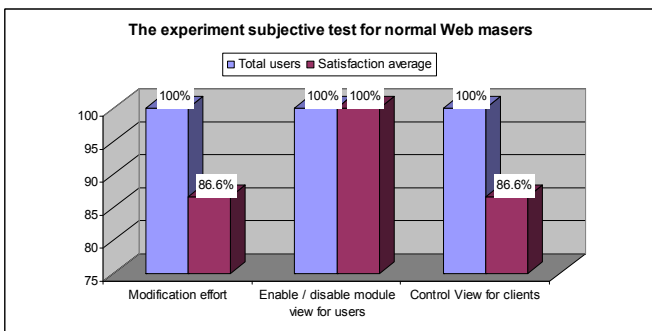


Figure 12 Webmasters satisfaction

6. Conclusion and Future Work

Access the web from a mobile includes an amazing wealth of ideas, for new hot products, for high-quality market

research and analysis by academic experts, in this paper we try to find an applicable solution for mobile web access during implementing the concept in a smart way. Our model enjoys major advantages, the avenues for our work are in many directions and we consider the following as the five main directions:

Detecting the type of connected device (Role of the road sign), Select best way of display content (Role of the explorer), Generate the web content and send back to the client (Role of the postman), Generate adaptable media files (Role of the optimizer), Reduce the transferred data size (Role of the savior), our principal contribution is not only to implement all the previous ideas but put all of them in a single package with a very high coherent to each others.

In the near future, we plan to assess and measure the usability of our framework against real customer needs. We also plan to test the framework on a number of different smart-phones and cellular networks.

7. References

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