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Improving Device-to-Device Connectivity with Responsive Web Technology

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Abstract

Since Tim Berners-Lee introduced the idea of the web to the world in the late 1980s, the way information is produced, accessed and used has been constantly changing. This was once again an era of upheaval after Apple's Steve Jobs introduced the smartphone to the world in the mid-2000s. Before the advent of smart devices, web browsing was mainly done using desktops. After the advent of this device, the era of solving almost all human needs with a small PC in the palm of your hand has arrived. The necessity of seamless connectivity between devices, which are constantly emerging and evolving, asks our attention more than ever. In this study, we will discuss a case of design and development of a national open access website, which is optimized for dynamic online user behaviors with diverse devices. Our goal is to provide one true web for people to use in their environment. Device makers need to provide products identical to the desktop environment as much as possible. Service providers should also provide services optimized for each device in hyper-connected environments. Providing a web, optimized for user's online context, will eventually result in a sustainable user experience.

Keywords: *Responsive Web, Media Queries, User Experience, Connectivity, Internet, Sustainable ICT*

1. INTRODUCTION

Since Tim Berners-Lee introduced the idea of the web to the world in the late 1980s, the way information is produced, accessed and used has been constantly changing. This was once again an era of upheaval after Apple's Steve Jobs introduced the smartphone to the world in the mid-2000s. Before the advent of smart devices, web browsing was mainly done using desktops. After the appearance of this device, the era of solving almost all human needs with a small PC in the palm of your hand has arrived.

Figure 1 shows that Internet users worldwide spend more time online through mobile devices than on desktops [1]. It can be seen that desktop users are decreasing as time goes by, while mobile users are steadily increasing.

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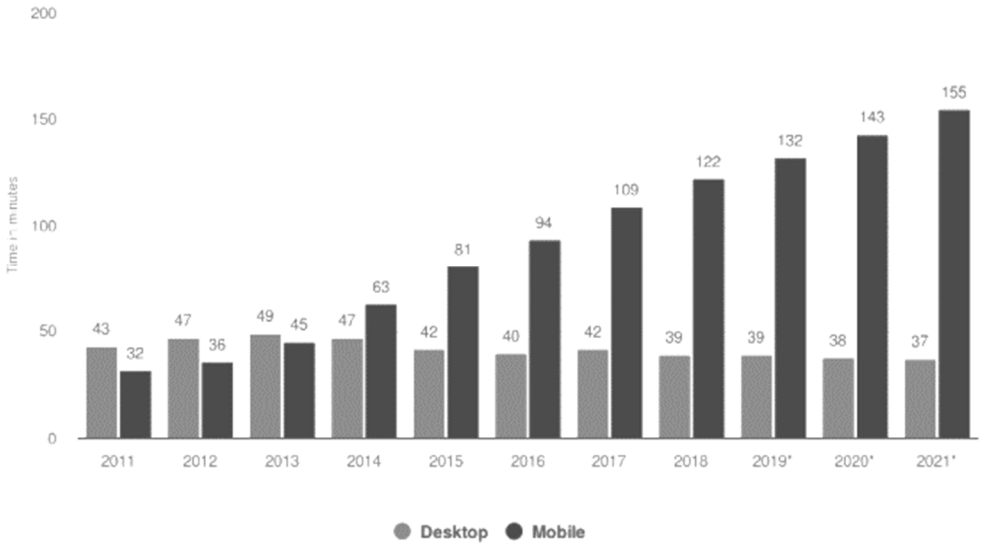

Figure 1. Daily time spent online by device

A closer look at the time spent in daily life by medium (Figure 2) shows that among mobile devices, the use of applications/webs through smartphones is increasing rapidly [2]. It can be seen that the use of Internet/web/applications through tablets and computers is relatively low. It can be inferred that there is a tendency to prefer small PCs in the hand that are easy to carry around in order to solve the user needs that arise online.

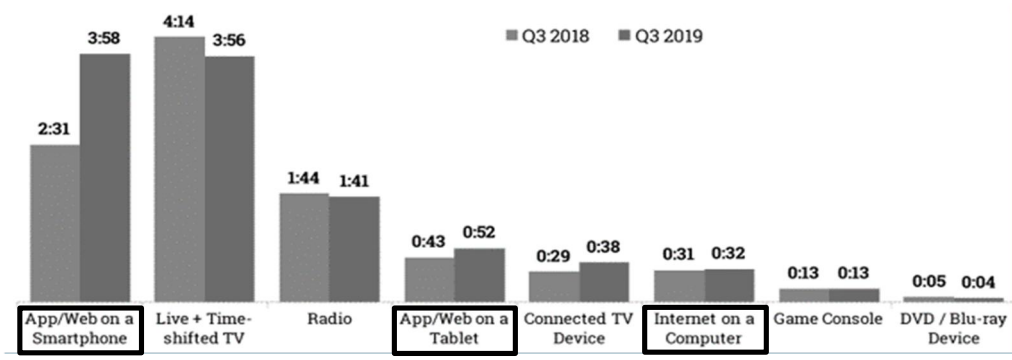

Figure 2. Daily time spent with media

With the rapid advance of information technology, human behavior that adopts and utilizes these tools is also changing dynamically. The necessity of seamless connectivity between devices, which are constantly emerging and evolving, asks our attention more than ever [3, 4]. In this study, we will discuss a case of design and development of a national open access website, which is optimized for dynamic online user behaviors with diverse devices.

2. INTERACTIVE WEB: THE TECHNIQUES

When designing a dynamic web, the following methods have been mainly used [5-7].

CSS is a web standard methodology for efficient development and management by separating structure (content) and presentation (style).

Efforts to overcome the handset difference have been around for a long time. You can apply styles aimed at mobile devices, by using CSS2's small device media type. But most smartphones use a screen media type instead of a small device.

Liquid layout is a layout technique that changes the size of the layout relatively (in % units, etc.) according to the size of the browser. When the screen size is small, if there are multiple columns, the readability is greatly reduced.

An adaptive layout technique is a method that detects the width of the user's screen with JavaScript and replaces the CSS class name so that an appropriate layout appears.

Fluid grid is a method to convert the design grid to a variable width.

CSS3 media query is a technique, designed to provide suggestions in various devices by adding a media feature to the CSS2 media type. It was first proposed by Opera Software. Most browsers support it. Different styles can be applied according to the screen width of the device. If the current situation meets the condition, the declared style is applied, and if it does not match, false is returned.

Responsive web design is a term that has grouped and systematized fluid grids, flexible images, and media queries.

It is difficult to detect the mobile context in a web browser. For example, using a smartphone at home or a laptop while moving. From a general point of view, mobile web refers to using the Internet using an Internet connection program or browser on a mobile device connected to a wireless network, such as a smartphone or tablet computer. It does not mean any other 'type' of the web used on mobile devices, but refers to the 'act' of using the web with mobile devices. Stephen Hay has an interesting definition of the mobile web [8]. According to Hay, there is no such thing as a mobile web. Likewise, there is no such thing as a desktop web or a tablet web. There is only the web. It's just a different way of looking at it.

If we agree with Hay's definition, we can have the following questions: Do we need to restrict access to only certain devices? Do we need to restrict access to only certain browsers? We will discuss these issues in the following chapters.

3. RESPONSIVE WEB DESIGN: A CASE

When designing and developing a website or web service, the most important consideration is whether budget, time, and labor are used efficiently. For example (See Figure 3), if you develop a site for each device when you want to build an 'ABC Service', this will bring inefficiency in terms of budget, time, and labor. Responsive web can be considered as a way to solve this problem.

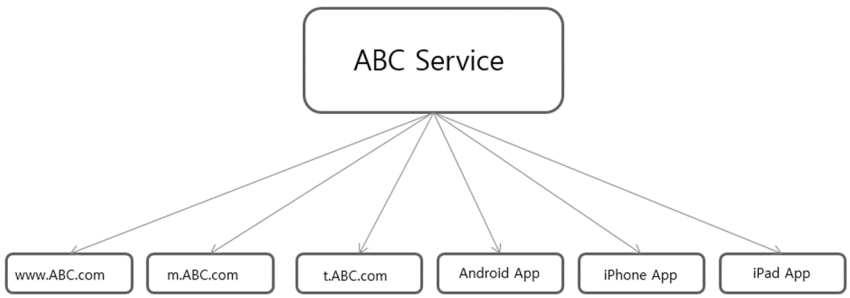

Figure 3. A case of a web service site

As web services are moving not only from PCs but also to various mobile devices, various attempts are being made to reflect this trend. First of all, the development of commercial or non-commercial apps for mobile

devices is spreading. Next, n-screen or responsive web is used to accommodate various platforms, including mobile devices, with a single page. With the advent of new information technology and the diversification of users' needs, designers and developers planning online Web services are demanding more effort than in the past. Providing a web, optimized for user's online context, will eventually result in a sustainable user experience.

Responsive web can be defined as a user-friendly user interface, which is beautifully designed and elegantly coded. It literally means the form of the web that appears in response. It is configured by optimizing the layout in response to the width of the web browser.

Responsive web does not need any development of new technology. It can be considered as a technique of web user interface, using the properties of CSS3. The basic components are HTML5, CSS3, and Media Query. Media query is one of the recommended CSS modules, published by the W3C's CSS Working Group in 2012. Main techniques include Fluid Grid, Flexible Images, and Media Queries.

One major advantage of building a responsive website is redundancy management. Flexible responses to future devices are possible, by developing CSS for each device. In addition, efficient investment of manpower and time is possible.

The following part of this chapter provides a case of design and development of a national open access website, using responsive web techniques. This website is developed and maintained by a national research institute in the field of STEM.

The website was developed responsive web technology so that it can be freely serviced not only on PC but also on various mobile devices. Media query technology for screen support for each device was also applied.

Figure 4 shows the CSS configuration, applied for the site.

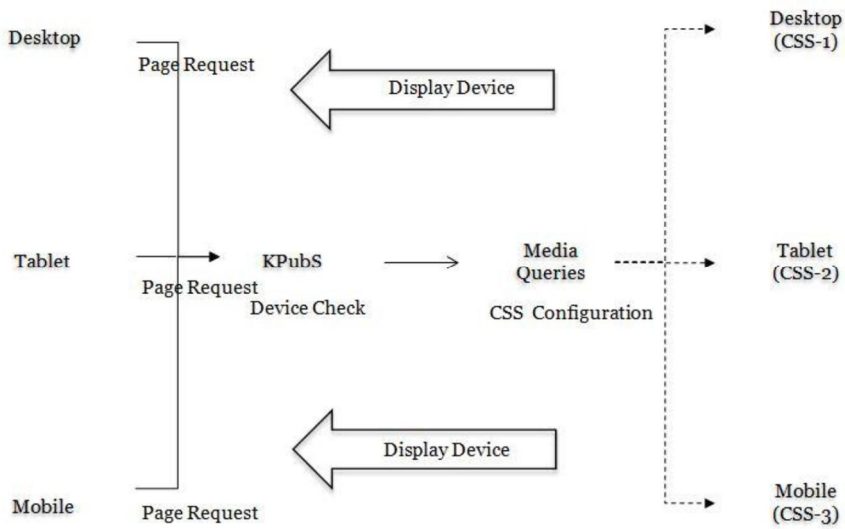

Figure 4. CSS Configuration for supporting interactive web

The following describes the media queries, applied to each device (in the order of desktop, tablet, and mobile).

```
@media all and (min-width:1281px){
#wrapper{width:1200px; height:100%; margin:0 auto; border:0px; overflow:hidden;
background-image:url(../images/pc/feat_bg.jpg); background-position:right; background-
repeat:repeat-y;}
```

```
@media all and (min-width:640px) and (max-width:1280px){
#wrapper{width:100%;; height:100%; overflow:hidden; background-
image:url(../images/pad/feat_bg.jpg); background-position:right; background-
repeat:repeat-y;}

@media all and (max-width:639px){
#wrapper{width:100%; height:100%; overflow:hidden;}
```

Figure 5. Responsive web-based user interface by device

Figure 5 shows the user interface applied with responsive web technology for each device. It is difficult to compose variably changing design elements with only images as in the past. There is a problem in that the amount of page transmission increases. In addition, a problem of speed occurs in mobile terminals with low performance. The design also applies the concept of progressive improvement. Since the browser supports the function itself, relatively high performance can be expected.

4. DISCUSSION

Media queries are not perfect. The biggest drawback of media queries is performance. You need to download a larger image than the image actually used. Resizing images requires more CPU of the device. You may have to download resources (e.g., images, CSS) that are not actually used. You may also have to download unnecessary contents. Still, many users make use of browsers that do not support media queries.

We can consider traffic optimization, as a way to overcome such limitations: for example, user agent sniffing, which is a method to identify a device by the browser's agent string; device description repository, which is a method to identify a device using information in the device information storage; RESS (responsive design and server side components, which is a method of transmitting the optimized module for each device using a content module; dynamic script loading, which a method of additionally loading content when there is user interaction without preloading the content.

Websites/webpages can't look the same in every single browser. Web users are in charge of how they view the sites. But these days they have even more control [9, 10]. Because user contexts vary so much, not all browsers will look the same on web pages. The way it is displayed is ultimately chosen by the user. For this, we can consider Wroblewski's strategy [11]. The strategy is to design the mobile environment first. If you design the mobile environment first, you can create a more effective and creative design. The result designed

in this way can provide an excellent user experience even when applied directly to the desktop environment. Responsive web design can also take a strategy of designing a mobile environment first and extending the design through media queries. Beyond a specific technology, it should be thought of as encompassing all approaches that consider the user's environment [9].

5. CONCLUSION

In this study, we introduced a case of a national open access scholarly information website, which was designed and developed by implementing responsive web technology to enhance the user experience in accessing and using research outcomes in the field of STEM. The Internet has basically changed the ways of distributing scientific information. Most of all, practical and economic realities should be reconsidered in the context. Since the Berlin Declaration on Open Access in 2003 [12], the main concern has been about access and use barriers in a world of changing scholarly communication. It is also important to increase scholars' awareness of open access. The benefits of open access include improved sharing and visibility of research outcomes [12, 13].

As wrapping up this paper, it would be worthwhile to recall W3C's mission, 'One Web', "… W3C's vision of One Web … Web for all … Web on Everything" [14]. Our goal is to provide one true web for people to use in their environment. Device makers need to provide products identical to the desktop environment as much as possible. Service providers should also provide services optimized for each device in hyper-connected environments.

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