

REVIEW PAPER

Responsive Web Design

Fiona Fui-Hoon Nah

Department of Business and Information Technology,
Missouri University of Science and Technology,
101 Fulton Hall, Rolla, Missouri 65409,
USA E-mail: nahf@mst.edu
PROFESSOR

Deepak Baghel

Department of Business and Information Technology,
Missouri University of Science and Technology,
101 Fulton Hall, Rolla, Missouri 65409,
USA E-mail: dbwfz@mst.edu
Personal E-mail: baghel.deepak42@gmail.com
MASTER STUDENT

Abstract

Due to having rapid adoption of mobile devices nowadays, there are growing demands for tool and technologies that can create a unique set of standard code. This code will help to fit the screen according to the device width. More devices mean more demand of various resolution of a single product in the market. Responsive web design is an approach and technique and has some standards by which we can achieve the website that fits-to-all resolution available in the market.

keywords: Responsive Web Design, Progressive Web apps, mobile websites

Introduction

Responsive design is an approach/philosophy/method to implement a design which reshapes according to the device layout. The main goal of making the Responsive design is to keep open the application to maximum possible devices available in the market. It improves the overall UX of the application at various resolutions. In the today's time, most of the user use mobile as their primary computing devices so it is mandatory to give a proper viewport to their applications. In this approach, the code is made to be intelligent enough to find the screen resolution and fit according to that.

Responsive Web Design

Description

RWD is the web design concept/approach in which the User interface appears according to the request made by the screen size. CSS (Cascade Style Sheets) media queries find the size of the screen and adjust the properties of the web content according to it. It solves the different resolution problems automatically. Using this approach the web page in the HTML format will be capable to fit in the devices like tablet, mobile, large desktops and smart TVs. There are certain coding styles and standards in the HTML markup language and CSS languages. Media queries that are the main role play to achieve the responsive behaviour.

But nowadays there is the concept of CSS3 Flex by which we can also lead to achieve a responsive web page.

There is an initial article about this approach written by Ethan Marcotte

"Recently, an emergent discipline called "responsive architecture" has begun asking how physical spaces can respond to the presence of people passing through them. Through a combination of embedded robotics and tensile materials, architects are experimenting with art installations and wall structures that bend, flex, and expand as crowds approach them. Motion sensors can be paired with climate control systems to adjust a room's temperature and ambient lighting as it fills with people. Companies have already produced "smart glass technology" that can automatically become opaque when a room's occupants reach a certain density threshold, giving them an additional layer of privacy."

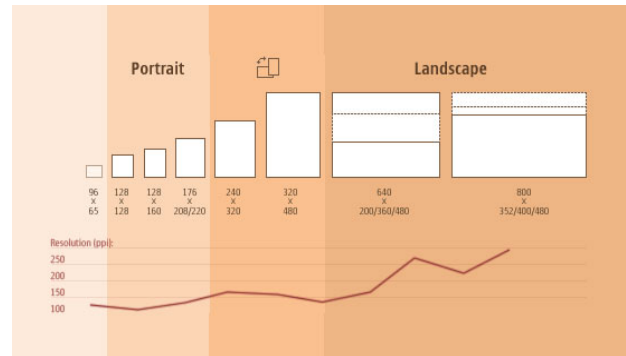


Fig. 1. (Source <https://www.smashingmagazine.com>)

Examples of Flexible layouts



Fig. 2. (Source <https://www.smashingmagazine.com>)

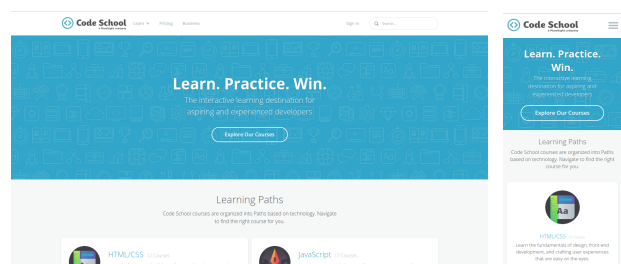


Fig. 3. (Source codeschool.com)

One other way to achieve the Responsive capabilities within the webpage is JavaScript. JavaScript is scripting language which is responsible for dynamic behaviour in the HTML content along with CSS.

Examples of Responsive Web Design

E-Commerce Category

- <https://www.indochino.com/>
- skinnyties.com
- fitforaframe.com
- www.unitedpixelworkers.com
- tattly.com
- ca.nixon.com

Design and Advertising

- www.justinaguilar.com
- www.tilde.io
- alwayscreative.net
- www.teehanlax.com
- www.fantassin.fr

Technology

- salesforce.com
- www.squarespace.com
- www.hubspot.com
- kinhr.com
- mobify.com
- www.sony.com
- www.microsoft.com

Blogs

- 24ways.org
- thinktraffic.com

Non-Profits, Education and Government

- worldwildlife.org
- Ucsd.edu
- teamtreehouse.com
- www.khanacademy.org
- www.aids.gov

Other

- disney.com
- dressresponsively.com
- myrainbownursery.co.uk
- www.starbucks.com

How to check the responsive behaviour of a web page

1. You can resize the web browser window to different sizes and check the behaviour of the web page on the different resolutions.

2. Developer mode can be used

Mozilla Firefox browser (version 58.0.2)

Open any of the responsive websites and press F12 key then click on the small mobile icon of responsive design mode at right bottom corner of the browser also there is shortcut ctrl+shift+M. Different size of devices and custom resolutions modes are available.

Google Chrome (version 66.0.3359.117)

Open the responsive page in the browser and then press F12. You will have the option in the left bottom corner namely "Toggle device toolbar".

3. Open the responsive web page URL in the specific physical device like i pad, i phone, any android phone or any large desktop available in the market.

4. Third party web plugin

Google Chrome

[Mobile/Responsive Web Design Tester](#)
[Responsive Web Design Tester](#)

5. Website that checks responsive behaviour of URL.

- <http://responsivedesignchecker.com/>
- <https://www.responsinator.com/>
- <http://quirktools.com/screenfly/>

Advantages of RWD

Low maintenance/Cost

One design that fits to all resolutions. As one code and different view the low maintenance cost to the stakeholders also provides a different UX to the end user. It is more important to keep the option to open products in the various medium to explore. The development team will be maintaining the only single set of code and it will be manageable for making one code standard rather than two separate code, one for mobile and other for the web version. Less time on the code management can give the opportunities to think about other marketing strategies to sell the product. No redirection for the mobile and web version of the website. CSS media queries calculate the width of the requesting terminal and adjust the frame according to that and layout changes for the display the web content.

Increasing Mobile traffic

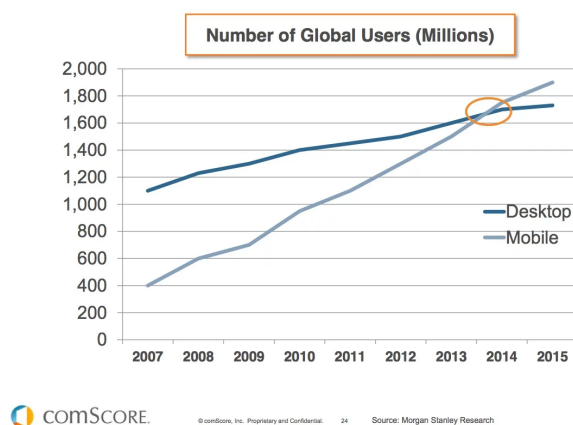


Fig. 4. Source <https://www.comscore.com/>

According to the report of SimilarWeb, there are more mobile devices request in the U.S. than of the desktop devices. Then it is the necessity to have an optimal mobile version of having the better fit layout in the mobile version. One approach can be the separate mobile app but for the blog and

information categories of the webpage it is very hard to maintain the mobile application in terms of time and cost. Also, the end user has limited space in the mobile and can't download each and every mobile app for different purposes.

SEO

No need to take care of SEO (Search Engine Optimisation) as the one HTML markup code works for all the different resolution terminals.

Fast access

Fast loading can lead to growing the attention on the product so it is mandatory to maintain the webpage loading speed as minimum as can possible with the large image. More loading time can make frustration to the user and user can leave at that moment. RWD approach gives the better and minimum load time to web pages. SAAS and LESS technologies are helping to keep the minimum code and minimum code means less size of the file and fewer size files means faster the response time.

Increase Adoption

The dramatic increase in the adoption and the mobile usage demands the fast access of website in the iPad and mobile devices. Traditionally the mobile request redirects to the mobile app download page but the user doesn't want to be like this case and this force to development of web responsive web page. Tablet and the mobile devices are more popular nowadays and demanding the optimised view of the desired product's website. So increasing demand is forcing to the product owner to adopt the solution and RWD that fits in the all size of pocket and all types of devices size demands. One solution to all device needs.

Tools used for Implementing RWD

For Non Coder

These tools are kind of drag and drop tools and you can start making your RWD by simply arranging the elements like a puzzle game.

Webflow (limited free features)

This tool helps to start making RWD from the ground and have some good templates to start with.

Froont (limited free features)

This is another tools that helps to make responsive site

For Coders

CSS frameworks

Bootstrap (Open Source)

This framework is very popular by Twitter itself and have better capabilities to develop Responsive web design. Based on my personal experience after having little core concept we can make 10-15 web pages without any difficulties.

Foundation (Open Source)

This is also a CSS framework but with more mobile specific content to make the app like native mobile app.

JavaScripts frameworks

Intention

This resource is the JS project which provides responsive utilities with the help of JavaScript scripting language.

Menu-Aim

This is a JQuery based framework which support responsive capabilities to code through JQuery (Framework of JS)

Other Resources

Top tools

<http://bradfrost.com/blog/post/the-top-25-responsive-design-tools/>

Tutorials

List of all the resources to learn more about the RWD

- <https://tutorialzine.com/2014/12/50-useful-libraries-resources-responsive-design>
- <https://responsivedesign.is/resources/>

Full Resource

- <https://bradfrost.github.io/this-is-responsive/resources.html>

Factors considering while development of RWD

Old browser support

Not 100% but all CSS3 media queries along with HTML5 support the responsive properties to the older version of browsers. There are some projects based on the CSS like [Normalize.css](#) that helps to render them all the HTML elements with consistently with all modern needs. It works to normalize the styles which is needed to make support to all the old browser support.

Mostly Internet Explorer creates the problem to some specific CSS styles rule but there is some alternative to bypass this problem like `respond.js` and `modernize`.

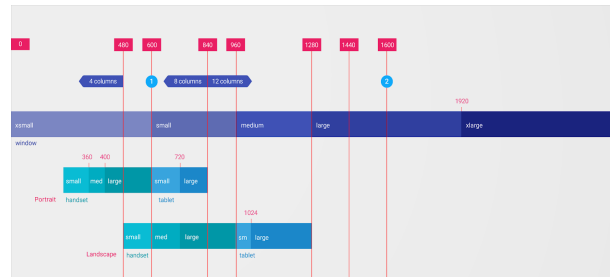
Standard resolutions

There are some standard resolution you may get from the different sources but if you prefer any of them then you will find your exact requirement and you can mould it according to the situations and the need. There are some standards by the Bootstrap's that fits all various requirements by various resolutions. Some standard breakpoint by Bootstrap

```
// Extra small devices (portrait phones, less than 576px)
// No media query for `xs` since this is the default in Bootstrap
// Small devices (landscape phones, 576px and up)
@media (min-width: 576px) { ... }
// Medium devices (tablets, 768px and up)
@media (min-width: 768px) { ... }
// Large devices (desktops, 992px and up)
@media (min-width: 992px) { ... }
// Extra large devices (large desktops, 1200px and up)
```

```
@media (min-width:1200px) { ... }
```

Google's Material Design Breakpoints



Source Fig. 5. <https://material.io/guidelines>

Mobile First Strategy

It is said that you can make a big building if you have the small one by enhancing some features but the reverse is not true. The same concept fits into the RWD approach that it is more difficult to convert the code that currently developed for large desktop devices but not for small devices. Based on my experience it is very difficult to fit the large page into the mobile. The better approach can be the mobile first design. In this approach first, decide the component in the mobile and then gradually increase the visibility of the other components in parallel to the large devices views. Use paper prototype for avoiding confusion and consistency problem within the RWD development. Some of the previous experience with HTML and CSS can be good for the new RWD adoption.

Selection of Right Tool

It is more important to first choose the tools and technology wisely. We shouldn't choose the right away any of the technology. Each and every 6 months there is new software technology comes with the different concept but we need to choose with care. We should see the community support behind that new project.

Limitations

Extra Code structure

There are some amount of extra code comes with the responsive behaviour of the page and these CSS styles and JavaScript files in the form of code, download to the user's browsers thus browser gets slow in the response time and sometimes gets block.

Image Resolution Problem

It is almost impossible to show the high resolution images on the small devices. And it is very difficult to show the images with proper device size. Some of the alternatives are available with some CSS frameworks like bootstrap and Foundation but without it, not possible to have better image size that fits to all the variant sizes.

One alternative option can be the if-else conditions that is recommended by CSS framework that serve images according to the size that means that load all the images on the client side from the server but show only if criteria matches with the size of device. But the load time of page increased that also a major problem with the RWD approach. Long and unoptimised images can destroy the overall look and feel of the webpage also may degrade the quality of the representation of the content. For the developers point of view, for a single image to take from server to clients counts to one request, So we can imagine that how many request will complete the overall page loading. There are some solutions are available like instead of having image use Icons and gradient property of CSS.

Conversion Efforts

If the current version of the webpage is not based on the RWD concept then it is very hard to put another layer of the responsive property is very hard also its kind of the situation where we are changing the basement of a long tower

without changing the upper floors.

Cross Browser problems

HTML5 Version of HTML comes with responsive utilities but this newer version is not fully supported by all browsers. The old version of the browser can be the main problem of this new approach. These factors are not in the hand of the development team of the website. There are certain ways by which the website can remind the user to update the browsers.

Standard Resolution Problem

Each and every week there is new

The device comes in the market so this is the most challenging task to know the resolution to make the web page fit according to that also its impact on the cost of testing the product on that resolution. Although there are certain standards still there are major exceptions are there. There is the almost impossible state in which a web page can completely fit into the series of the terminals of the devices. Also, it is more difficult to cover all of the devices into one standard code. There may be some compromised that need to be taken while development of the RWD also there is always challenging situations for the developers to take care the functionality not to be broken on any resolution.

Alternatives of RWD

Mobile website

A mobile website is m version of any of the web page which is completely different code base with respect to the desktop version. Some of the transformations like the link on the desktop version will be the button in the mobile version for better usability. The URL will be completely different from the desktop version URL. It looks like the native mobile app but you only can access through the web browsers. One of the major challenges with this mobile website approach is consistent with the desktop version. Synchronisation with the same functionality on the different version is quite a tedious and time-consuming work. This m-site concept was more popular by 2014 and consumer quickly adopted because the adoption of mobile and their native apps was low at that time.

Native Mobile Apps

This is the major alternative of RWD. This is the far better approach instead of adopting the mobile website. Today's era there are a large number of people who carry a mobile phone with the good amount of memory space inside it then the native mobile app is one appropriate solution to the small device applications. Native mobile is the fast in terms of all the available solution in the market in terms of the small version of the products. There is certain code that needs to install in the mobile natively so the client-server request will be less and less response time means faster the application. Android and IOS application platform by Google and Apple are there to help in making the mobile app very easily. Also, Hybrid application development is in hot topic nowadays. By these available resources, mobile development is the cup of tea for all.

Progressive Web Apps

These apps are the simpler version of the existing web version of any website. This is the modern approach not fully based on the responsive web applications but with the new one. This approach used the web application feels like the app on the mobile. It looks like the native app but it is not. It is fast reliable and all browser support these kinds of applications. Some of the frameworks like Angular, React and Vue JS is required to implement it. PWAs are considered as powerful tool and alternatives to the native and mobile version of the applications. It is kind of so popular that the apple browser safari is not supporting these apps because of competition with other brands.

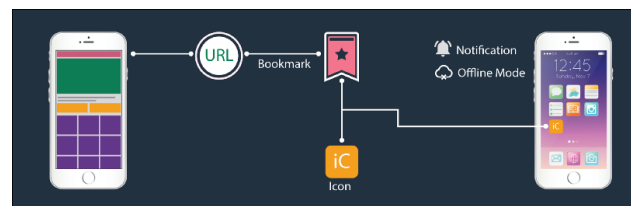


Fig. 6. <https://medium.com/learnwithrahul/>

Adaptive Websites



Fig. 7. <http://imagerystl.com>

An adaptive version of website based on the different layouts. The difference between both is when we resize the window the responsive website stretch or shrink itself according to the size of the browser so it is more likely response at client side but with the adaptive design it changes when we change the size of the browser then a server hit reload the page according to the best-fit resolution.

Best Practices of Responsive Web Design

There are several factors can lead to your site as best responsive

Vector Graphics

Use of image in the vector format instead of having units in the pixel format. Because of pixel changes according to the resolution and the type of the device's material for displaying colours. Fixed size images can't adopt the different resolution on changing the size of the screen. Scalable vector maintains their properties according to the viewport.

Use of Icon

For each and every image in a single web page, there is separate server request hit by the web browser. So instead of having the image, use the icon as much possible that way the server request hit will be less and the time for request-response will be less automatically.

Some of the good resources for icons

<http://www.transformicons.com/>

<http://evil-icons.io/>

<https://icomoon.io/>

<https://iconstore.co/>

<http://fontello.com/>

<https://icons8.com/>

<https://icons8.com/>

<http://www.alessioatzeni.com/meteocons/>

Use CSS3 Gradients

Some of the website use images for showing the colour so the same concept of images to make separate server request and response happens here and the load time increases. There are properties in the CSS by which we can achieve the gradient or colour in the web pages and also if there is no image then we don't need to take care of the responsive behaviour of that image

Image resolution

For the coder or programmer, there are ResponsivImages.org resources available to create responsive images for the product development. Some of the alternatives are available in the CSS framework Bootstrap to achieve the responsive behaviour of an image. But still my recommendation is that use less images as much as possible or you can use optimised images for different viewports. There is lazy loading concept in which we show the less quality image first and then on click the higher quality of images shown to the users. Some of the other concept like SPA (Single page application) In which only the required content with the page is requested by the browser and other parts only be there on the client side by the user request. So overall speed of the page increase.

Statistical Figures (Source <https://www.activemedia.com/blog/20-statistics-make-case-responsive-web-design>)

- Global mobile data traffic grew 74% in 2015. Cisco.
- That means that more and more people will be browsing your website on their mobile devices. In fact, half of the world's population now has a mobile subscription. An additional one billion subscribers are predicted by 2020, too. When that happens, the global penetration rate of mobile subscriptions will be approximately 60%. GSMA.
- By some estimates, 60% of all Internet access is mostly mobile. InMobi.
- The usage of mobile devices is also growing rapidly. In 2015, 68% of U.S. adults owned a smartphone. In 2011, that number was 35%. Pew Research Center.
- Some experts estimate that nearly 2.6 billion people — over 1/3 of worldwide consumers — will use smartphones by 2018. eMarketer.
- 45% of all U.S. adults owned a tablet computer (like an iPad) in 2015. Pew Research Center.
- Globally, consumers use an average of 5 different devices per person. That's a lot of different screen sizes and device types! On average, they also use 2.23 devices simultaneously. Adobe.
- 38% of people will stop engaging with a website if the content/layout is unattractive in its layout or imagery (and when a website isn't responsive, it can very easily become unattractive on certain screens.) Adobe.
- If your website pops up in a search engine query, and it isn't mobile friendly, 40% of online users will go back and choose a different result.
iAcquire and SurveyMonkey.
- Despite these strong user preferences for mobile friendly websites, some reports estimate that 91% of small businesses don't have a responsive, mobile optimized website. BaseKit.
- 65% of consumers surveyed ranked display as the "most important aspect" when it comes to consuming content in their personal life. Display even mattered more than layout (54%) and personalization (49%). Adobe.
- Nearly 8 out of every 10 consumers would stop engaging with a piece of content if it didn't display well on the device they were using. Adobe.
- Google has prioritized responsive website in it's search engine results pages since April 2015. Google.
- Responsive design can help with emails, too. Responsive email templates get higher click rates on all devices. This is especially true for mobile device users —
- MailChimp discovered a 5% - 15% increase in actual clicks with responsive design. MailChimp.

Survey for RWD websites (Source <https://marketingland.com>)

1. According to the survey there were 652 votes and responded with 82% majority have responsive web design. 6 % has mobile website and 7% said there website doesn't support mobile compatibility.

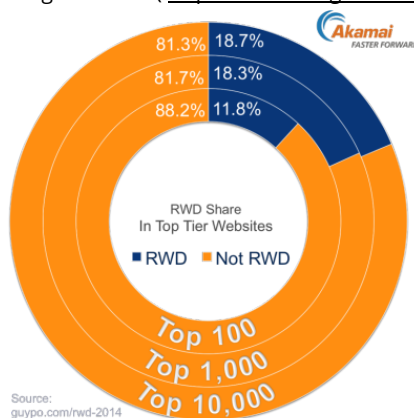
662 votes



Fig. 8 Source (<https://marketingland.com>)

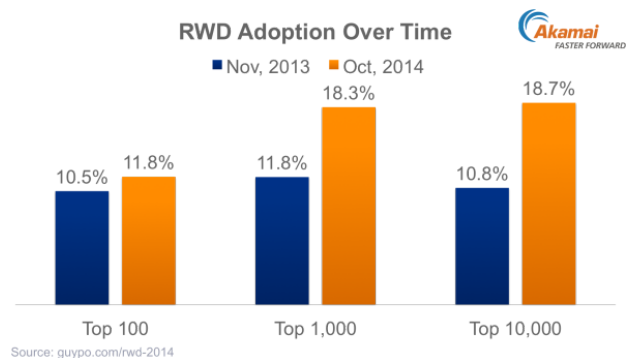
2. When it comes to the top 100 sites analyzed, only 11.8% of these sites use responsive web design. More clearly when it comes under top 100 websites then only 11.8% use the approach of responsive web design. When compare to top 1000 or top 10000 then most of the websites are very complex in the nature.

Fig. 9 Source (<https://marketingland.com>)



Source: [guypo.com/rwd-2014](https://marketingland.com)

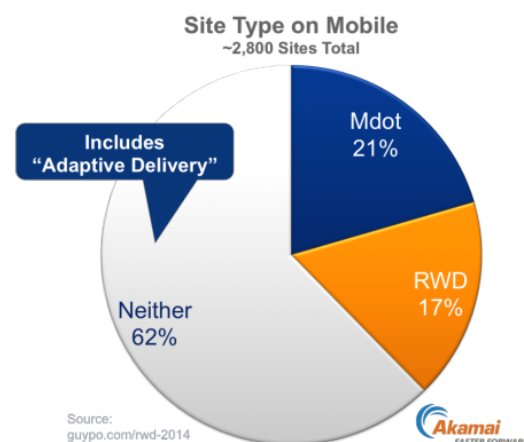
3. RWD adoption over time



Source: [guypo.com/rwd-2014](https://marketingland.com)

Fig. 10 Source (<https://marketingland.com>)

4. Mdot (Mobile website) found 20% in RWD found 17% in total and there were totaled 62% that is not mobile optimized.

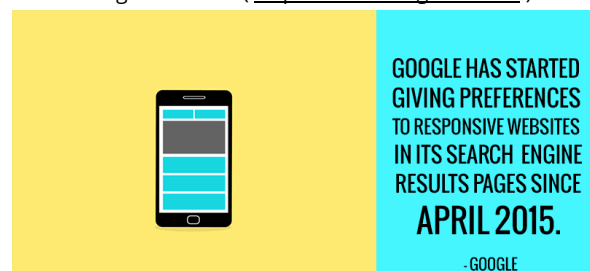


Source: [guypo.com/rwd-2014](https://marketingland.com)

Fig. 11 Source (<https://marketingland.com>)

5. Google search engine gives more preference to RWD since April 2015.- Google

Fig. 12 Source (<https://marketingland.com>)



Conclusions

Responsive web design is the very dynamic concept and most of the product owner is choosing this approach to server their product in the better way.

There is less training involved to develop the responsive web design. Although there is the era of the native mobile app but the adoption of this concept is consistently growing. Some of the industry leaders like Apple, Google and Twitter are supporting this concept and providing their research material to access them to all in the open source.

I personally recommend Twitter's bootstrap that is the most popular Responsive web design CSS framework. There are many numbers are contributors are available to help in using CSS framework. Some of the new frameworks like material by Google is also in the trend.

Most of the Responsive Web design concept is adopted by the product who don't want to waste their money in making mobile apps. Although there are certain factors by which RWD can't be same in look & feel with native one but the adoption and the popularity is increasing.

Some of the inbuilt capabilities that supporting the concept of RWD is flex. Flex box concept is popular now a days and providing the responsive strength to the web pages. This is new concept and I am looking forward to research about this concept to elaborate more about the responsive web concept.

In the end, I restate because of the certain finding and elaboration, RWD is the necessity of the today's era and going to be adopt by more.

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Style Guide by Google and Apple

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CSS frameworks

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