

# Understanding Web Front-end Development Technology based upon Responsiveness, Optimization and Interactive Nature

Anushka Mohane<sup>1</sup> and Kartik Ghate<sup>2</sup>

<sup>1</sup>Department of Computer Engineering, Narsee Monjee Institute of Management Studies, Mumbai, Maharashtra, India

<sup>2</sup>Department of Computer Engineering, Narsee Monjee Institute of Management Studies, Mumbai, Maharashtra, India

\*\*\*

**Abstract** - With the rapid transformation towards the online mode, web developers are able to create websites that can be accessed from anywhere. However, the goal to deploy a website is not just creating an attractive front-end, it is to achieve responsiveness, compatibility across different browsers/devices, selection of right frameworks and optimization in terms of loading time, response speed, and user internet experience. This paper studies Web front-end development technology and discusses the key technologies used to achieve responsiveness, analyzes three popular JavaScript frameworks (Angular, Vue, and React), methods to achieve better optimization, and concludes with the idea that the Web front-end technology is an evolving field with a large scope of developments and introduction of new methods and technologies.

**Key Words:** Responsive, Front end framework, Web frontend development technology, Optimization technology.

## 1. INTRODUCTION

In this current generation, the time is quick and driven by new trends of technology in which the need to have evolving solutions has become a necessity. The world was already progressing over adapting to online measures and the current pandemic sped it up to an extent where all activities from education, government and private sectors were conducted online. Therefore, front-end plays a vital role in creation of websites as it is the face of a website or application which can attract users by its features, feasibility, and ease. Responsiveness of a website plays a very important role in building of a website as its essence is to design a web content display mechanism in perfect layout for any device. It changes the page-layout considering the size of the viewport along with subverting the current methods. A webpage should be automatically able to adjust itself to the user's screen size, browser and orientation. That means no matter what screen size of the device is being used, we should be able to switch the page resolution, picture size and related scripting capabilities automatically, to adapt to different devices [1]. Optimization of Web front-end development technology has important practical significance as it has a major influence over online and user experience along with enterprise development [2]. Therefore, developers and researchers must consider optimization of Web front-end development technology

important to unlock various technical paths in the development technology. Also, in order to provide users with smoother online experience and requirements for surfing the internet, the developers should work on optimizing existing Web front-end technologies. One of the most important aspects in development of a website is to choose right front-end frameworks. Generally, JavaScript frameworks are used make a website interactive and scalable. They are an important part of contemporary front-end web development, helping technical developers use tried and approved modern tools [3].

This paper is organized into sections which discuss related work, existing web front-end development technologies, techniques used in achieving responsiveness, optimization direction of core front-end technologies, and JavaScript frameworks used in achieving interactive front-end.

## 2. RELATED WORK

Vinuta Hutagikar and Vinay Hegde [4] analyzed few of the most popular JavaScript frameworks mainly Vue.js, React and Angular. These frameworks were analyzed on the criteria of DOM manipulation, Start-up time and Data allocation and were ranked accordingly. They suggested that the development of websites and web-based applications is based on the use of a certain framework for better performance.

Fernando Almeida and José Monteiro [5] inspected the important advantages and limitations associated with responsiveness through their study. With their quantitative approach they were able to recognize the cause that led many skilled developers choose responsiveness along with the limitations that came along with it. They discussed about compatibility of older versions of web browsers, technologies used to achieve responsiveness (media queries, fluid grids and flexible images), and the need to give more importance to loading time of a website.

Wenhui PENG and Yaling ZHOU [6] analyzed some solutions (fluid grid, liquid image, media queries and bootstrap navigation) that could be used to solve the given problems such as mismatch between mobile resolution, adjustment, page layout and page operation. The study concluded by saying that although responsive web design

maybe is not the best, but it is worthy of much attention for researchers to improve the future web design.

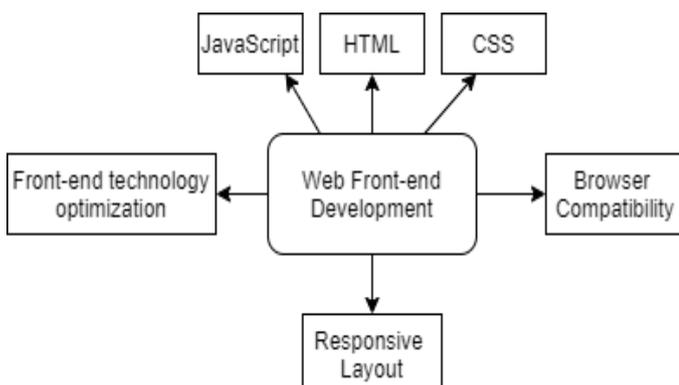
Wang Xiaoshu [7] discussed about the need to optimize web front-end development technologies in order to keep up with the evolving trends in order to provide better user experience. The paper provided optimization direction towards main technical languages (HTML, CSS and JavaScript). Furthermore, countermeasure analysis of optimizing the development of front-end web technology was discussed in which it was suggested that with the help of technical optimization HTTP errors and requests, useless response, and amount of DNS queries could be reduced.

Asmita Kharat, Priyanka Bhosale, Sonali Gupta, Shweta Barshe [8] discussed about the methods used to achieve responsiveness (Media Queries, Bootstrap responsive navigation, and layout of streaming technology). They also provided advantages of responsive design along with analysis of browser compatibility.

Nian Li and Bo Zhang [9] discussed about the responsive web technology based on HTML5 and CSS3. Some techniques of responsive web design for HTML5 and CSS3 were also listed and explained. They concluded by saying that enterprises developed based on HTML5 and CSS3 can adapt to different screen sizes and be responsive.

### 3. EXISTING WEB FRONT-END DEVELOPMENT TECHNOLOGIES

In Web Development, front-end plays a vital role in creation of websites as it is the face of a website. Over the past few years, the way in which developers create websites has drastically changed despite which HTML, CSS and JavaScript continue to be the backbone of the front-end development languages. Front-end development languages have optimized over time yielding better results although, further optimizations are still needed. Currently, developers use various frameworks to achieve responsiveness, interactive behavior and improved efficiency. Fig.1 depicts the main web front-end development components involved in creation of a good front-end.



**Fig -1:** Web Front-end Development Components

### 3.1 HTML

Hypertext Markup Language (HTML) is a standard markup language and is not to be confused as a programming language as it is unable to create dynamic functionalities due to which it is widely used for creation of static pages. HTML is limited to creating structure of a webpage although, when combined with CSS and JavaScript it can achieve styling, responsive and interactive features.

### 3.2 CSS

Cascading Style Sheets (CSS) is a language that is used for styling of a website or web application. It helps in making the website or the web application more presentable. CSS is one of the most popular frameworks used to design a website. It is generally embedded in HTML script.

### 3.3 JavaScript

JavaScript is a scripting language having object-oriented ability which when implemented, can make a webpage dynamic and interactive. This language can be implemented on both client-side (front-end) and server side (back-end) among which it is popular for client-side development. It can be directly embedded in the HTML page.

## 4. TECHNIQUES USED TO ACHIEVE RESPONSIVE FRONT-END

Responsiveness helps attaining a perfect layout capable of adjusting to different screen sizes and orientation enabling the layout to switch the page resolution, media and animation size automatically. Responsiveness is one of the key factors involved in developing front-end as it makes the website more user friendly, requires less maintenance, and cuts the need of additional domain names.

### 4.1 Bootstrap

Bootstrap is one of the most popular front-end frameworks used in achieving a user-friendly and responsive layout. It supports compatibility for most browsers- Chrome, Safari, Firefox, and many more. It consists of a responsive fluid grid system which fittingly scales until twelve columns according to different devices and their screen sizes [10]. This grid system uses a combination of sequenced rows and columns used in creating responsive layout of the page.

### 4.2 Media Queries

Media queries is a module of CSS3 used to achieve responsiveness when applied to CSS styles. It is generally used to easily alter the styles such as height, width and orientation depending upon the device type or specific features like screen resolution or browser viewport.

### 4.3 Flow Layout

At the point when a user limits the browser window, particular contents which were visible when maximized are not displayed and the user then needs to navigate in order to view the content using the horizontal or vertical bars causing unnecessary inconvenience. Flow layout can be used to overcome this by floating all involved DIV modules to the left and then express the width in percentage [1].

## 5. OPTIMIZATION DIRECTION OF CORE FRONT-END TECHNOLOGIES

There have been a lot of obstacles like Hypertext Transfer Protocol (HTTP) errors, slow loading time, unresponsiveness in the present Web Development Technologies which affects the user's experience. Thus, the developers must focus on the development and optimization of the current Web Front-end Technologies in order to improve user experience and increase internet traffic. In this study, we discuss optimization in the direction of HTML, CSS and JavaScript.

### 5.1 HTML

HTML code should be clear and refactored according to the development needs. DOM nodes and redraw should also be reduced. There should not be any empty attributes. JavaScript should be placed in the header and footer.

### 5.2 CSS

Duplicate codes in CSS should be removed in order to reduce loading time. YAG tags should be deleted if there is an application of ID or CLASS [7]. There should be efficiency in writing the code.

### 5.3 JavaScript

There is a vast scope of development and optimization in JavaScript. In order to optimize JavaScript, there should be a minimum number of global variables and duplicate JavaScript code should be deleted. The use of eval function should be avoided. Also, targeting and scope chain searches should be reduced as much as possible.

## 6. JAVASCRIPT FRAMEWORKS USED IN ACHIEVING INTERACTIVE FRONT-END

JavaScript permits clients or users to communicate with webpages along with providing interactive touch to the frontend. There are practically no restrictions to the things you can do with JavaScript on a webpage like changing the colour of a button on the hover of mouse pointer, sliding through carousel of images, displaying a counter or a timer on a website, playing audio and video on a website. In this study, we discuss the three popular JavaScript frameworks- Angular, Vue and React.

### 6.1 Angular

Angular is an open-source framework that extends itself to HTML DOM making it more responsive and interactive to user actions. It is a structural framework used for creation of interactive dynamic websites.

### 6.2 Vue

Vue is an open-source Model-View-Viewmodel framework. It is the one of the most popular frameworks among developers as it is used in creation of progressive interactive front-end and single-page applications. Vue provides an easy integration into larger projects error free.

### 6.3 React

React is an open-source JavaScript library used in building of encapsulated segments that deal with their own state which are then composed to create interactive complex front-end layouts. It provides many features that help in creation of user-friendly and creative websites.

## 7. CONCLUSIONS

In this current age, the time is speedy and driven by new patterns of innovation in which the need to have developing arrangements has become a need. The world was at that point advancing over adjusting to online measures and the current pandemic sped it up to a degree where all exercises from schooling, government and private areas were led on the web. In this manner, front-end assumes a crucial part in making of sites as it is the essence of a site or application which can draw in clients by its highlights, possibility, and straightforwardness. This paper discusses the key aspects of front-end development advances used to accomplish responsiveness and interactive nature along with strategies to accomplish better optimization in the direction of three main technologies. Of course, the involvement of few techniques (Bootstrap, Media Queries, Flow Layout) used to achieve responsiveness are very widely used and popular among the developers but these may not be suitable for all types of websites, thus various kinds of new technologies are needed to improve it continuously as it's still not very mature and has good scope of development. To advance the improvement of Web front-end innovation we should consistently seek after the technical optimization, in order to furnish individuals with additional differentiated and customized network administrations.

## REFERENCES

- [1] W. Jiang, M. Zhang, B. Zhou, Y. Jiang, and Y. Zhang, "Responsive web design mode and application," in Proceedings - 2014 IEEE Workshop on Advanced Research and Technology in Industry Applications, WARTIA 2014, 2014, pp. 1303-1306, doi: 10.1109/WARTIA.2014.6976522.

- [2] C. Fu, "Exploration of Web front-end development technology and optimization direction," in Exploration of Web front-end development technology and optimization direction, 2016, no. Icence, pp. 153–156, doi: 10.2991/icence-16.2016.35.
- [3] "Understanding client-side JavaScript frameworks - Learn web development | MDN," <http://developer.mozilla.org/>, 2021. [https://developer.mozilla.org/en-US/docs/Learn/Tools\\_and\\_testing/Client-side\\_JavaScript\\_frameworks](https://developer.mozilla.org/en-US/docs/Learn/Tools_and_testing/Client-side_JavaScript_frameworks) (accessed Mar. 22, 2021).
- [4] V. Hutagikar and V. Hegde, "Analysis of Front-end Frameworks for Web Applications," *Int. Res. J. Eng. Technol.*, vol. 07, no. 04, pp. 3317–3320, 2020, [Online]. Available: <https://www.irjet.net/archives/V7/i4/IRJET-V7I4639.pdf>.
- [5] F. Almeida and J. Monteiro, "The role of responsive design in web development," *Webology*, vol. 14, no. 2, pp. 48–65, 2017, [Online]. Available: <http://www.webology.org/2017/v14n2/a157.pdf>.
- [6] W. Peng and Y. Zhou, "The Design and Research of Responsive Web Supporting Mobile Learning Devices," in Proceedings - 2015 International Symposium on Educational Technology, ISET 2015, 2016, pp. 163–167, doi: 10.1109/ISET.2015.40.
- [7] W. Xiaoshu, "Optimized development of web front-end development technology," *J. Phys. Conf. Ser.*, vol. 1693, no. 1, 2020, doi: 10.1088/1742-6596/1693/1/012057.
- [8] AsmitaKharat, PriyankaBhosale, SonaliGupta, and ShwetaBarshe, "Responsive Web Design," *Int. Res. J. Eng. Technol.*, vol. 05, no. 02, pp. 1888–1892, 2018, Accessed: Mar. 23, 2021. [Online]. Available: <https://www.irjet.net/archives/V5/i2/IRJET-V5I2397.pdf>.
- [9] N. Li and B. Zhang, "The design and implementation of responsive web page based on HTML5 and CSS3," in Proceedings - 2019 International Conference on Machine Learning, Big Data and Business Intelligence, MLBDBI 2019, 2019, pp. 373–376, doi: 10.1109/MLBDBI48998.2019.00084.
- [10] Bootstrap, "CSS · Bootstrap," 2014. <https://getbootstrap.com/docs/3.4/css/> (accessed Mar. 30, 2021).