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Development of Web Applications by Integrating Frontend and Backend Tools

Abdul Rahaman[1], Viyyapu Gayatri[2], Ch. Sai Kiran[3], K. Sai Pavan[4], B. Bhumika[5], V. Sateesh[6]
Department of Electronics and Communication Engineering
Vignan's Institute of Information Technology, Duvvada, Visakhapatnam, India.
rahaman1546@gmail.com

Abstract- The web is a resource that is widely and steadily usable across many platforms. In this paper, the advanced features of components required for students to develop basic web applications and web services are discussed. Mainly frontend and backend development using HTML, CSS, JS, MySQL, PHP, and Bootstrap are prioritized. Integration of both frontend and backend development can be described as full stack development. Also, some vendors have created proprietary technologies that offer more features than web standards, such as the ability to create sophisticated online applications.

Index Terms- Back-end Development, Front-end Development, Full-stack Development, HTML, CSS.

1. INTRODUCTION

Everything that goes into making a website is referred to as web development. In contrast to this web design, it is referred to as the coding and programming side of website development. It can range from a simple HTML text page to large, rich-featured applications that can be accessed from a large variety of internet-connected devices [1]-[5].

In general, web-based applications differentiate from other traditional applications in many ways considering different parameters[6]. The parameters include reliability, scalability, security, compatibility, maintenance, performance, etc.

The proper integration and application of tools with enough knowledge is highly important for the successful creation of a web page and further the web design. In this paper, the significance and application of tools, be it front-end or back-end are well described.

The front-end tools include HTML, CSS, and JS while the back-end tools include MySQL and PHP. The basic, as well as intermediate level of a web design, can be designed using the above-mentioned tools. whereas the advanced level requires additional knowledge of the latest technologies.

The front-end tools are in charge of what one can see and interact with the web page.[8] Tools like MySQL and PHP are used for back-end development. MySQL saves information (database) and uses PHP functions to submit SQL queries to the database. PHP is the commander here.[15]

HTML is the base of all data provided to a web browser, be it static HTML or dynamically generated HTML content via a CMS (Content Management System). The code is written in HTML with which one can create a web page and a web design with one's requirements whether to have buttons, tables, text boxes, images, etc. This kind of work can be handled using HTML.

CSS (Cascading Style Sheets) is a DDL (Declarative Descriptive Language) which

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describes an element by various parameters like tag name, attribute, id, or other means and applies styling to it using a selector. CSS is a stylistic component that is often supplied alongside HTML data when an HTTP request is made.

MySQL is a relational database management engine that gives users access to a store data, in this case, a SQL (Structured Query Language) database.

In PHP, a SQL query is initiated to the MySQL database, and data is returned, in the form of an array or associative array usually. [16] PHP can also be used to format the data so that it can be used to transfer as HTML content. Finally, the produced dynamic HTML data is provided to a user's web browser via an Apache HTTP Server communication.

2. FRONT-END DEVELOPMENT

The front end of a website is everything that one can view and interact with through a browser. The term Front-end development is used to describe the process of generating the visual component. Front-end engineers work on the front-end development of a web design. It is a GUI (Graphical User Interface) by the usage of HTML, CSS, and Java script.[9] The basic front-end developing tools are represented in Fig. 1.

The front-end developer is responsible for the following factors:
1. Create a blueprint for the web page design and structure.
2. Should be able to develop more features to improve user experience.[4]
3. Balance must be maintained between functional and traditional design.
4. The web design must be compatible with all the devices irrespective of the size and shape.
5. Code must be developed in such a way that it must be reusable for further development.
6. Ensuring optimization for better speed, reliability, and scalability.

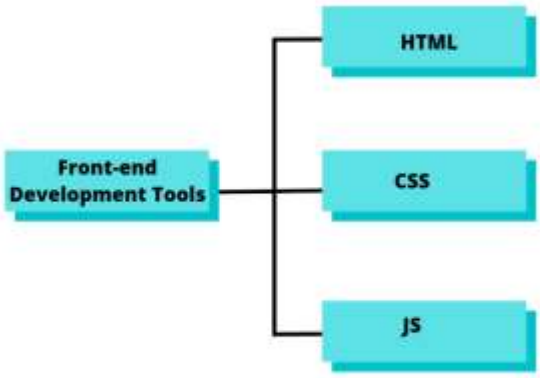

Fig. 1. Front-end development tools

- HTML

HTML is an abbreviation that stands for HyperText Markup Language, which is a programming language that's used to make websites and applications. It is the basic building block of the web.

"Text within Text" is what "HyperText" is all about. A hypertext is a fragment of text that consists of a hyperlink. When a click is made on a link that leads you to a new webpage, it means that the click is made on a hypertext. The technique used for linking two or more web pages together (HTML documents) is hypertext.

HTML uses "Markup" to annotate text, images, and other content that is to be displayed in a web browser. HTML markup includes special elements such as <head>, <title>, <body>, <header>, <footer>, <article>, <section>, <p>, , , <img>, <aside>, <audio>, <canvas>, <datalist>, <details>, <embed>, <nav>, <output>, <progress>, <video>, <ul>, <ol>, <li> etc., which can be better termed as tags.[5] A markup language is a programming language used for applying formatting and layout concepts to the created text documents. To make the web page more interactive and dynamic, the markup language is essential. It is capable to convert text into visuals, tables, and links etc.[1]

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A document that is written in HTML and then translated by a web browser is a web page.[2] A URL is a unique identifier for a web page. The sample HTML web page creation code is represented in Fig. 2. It is possible to locate a static or dynamic web page. HTML can be used to construct static web pages fully. The sample HTML web page output is represented in Fig. 3. The technologies other than HTML are used to describe a web page's appearance and presentation using CSS and then functionality and behavior using Javascript.[10]

HTML has the following features:

1) It is very simple and easy to learn the language and easy to modify the language.
2) It offers a huge number of formatting tags, making it very easy to create an effective presentation of the web page. [3]
3) Customizable design of web pages and the text can be done since the language is a markup language.
4) It can run on any operating system, that includes Windows, Linux, and Macintosh featuring this as platform-agnostic.
6) It can be designed to be more interactive according to the user's requirements.[3]

```
<!DOCTYPE html>
<html lang="en">
    <head>
        <meta charset="utf-8">
        <title>Page Title</title>
    </head>

    <body>
        <h1>Heading</h1>
        <p>Paragraph</p>
        <p>Another paragraph</p>
    </body>
</html>
```

Fig. 2. Basic HTML document

Fig. 3. Adoption form using only HTML

- CSS (Cascading Style Sheets)

CSS is a styling language used for presenting an HTML or XML document (including XML dialects such as SVG, MathML, or XHTML). CSS usually specifies how elements should appear on a screen when a website is opened and is being used.[12]

According to W3C guidelines, CSS is the main and basic language of the open web and is standard across web browsers. Previously, distinct portions of the CSS specification were developed simultaneously, allowing the development of newer versions based on the most recent recommendations. You must have heard about CSS1, CSS2, and CSS3. CSS4 on the other hand has never been an official version of CSS because previous versions of CSS contained every possible CSS property which worked well as there wasn't much to detail apart from what is currently being used.

Since CSS3, the scope of standards has quickly expanded, and development on different CSS modules has become so diverse that it is more efficient to produce and publish recommendations for each module independently. Rather than versioning the CSS standard, the W3C now regularly takes a snapshot of the most current stable state of the specification.

You'll run into a situation where you'll be working on a project and the CSS you

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wrote should be applied to an element that isn't working. Typically, the issue is that you've established two rules that could both apply to the same element. When there is a disagreement in cascading, as well as the closely related concept of specificity, are processes that regulate which rule should be applied. It's possible that the rule styling your element isn't the one you expect, therefore you'll need to know how these methods function to make complete use of it.

The concept of inheritance is also important here, which implies that some CSS attributes inherit values specified on the current element's parent element by default, while others do not and it may cause some behavior that you might not expect.[12]
Stylesheets cascade - at its most basic level, this implies that the order in which CSS rules are applied matters; when two rules with equal specificity apply, the one that appears last in the CSS is utilized.

When multiple rules have different selectors but potentially apply to the same element, the browser uses specificity to determine which rule applies. The sample CSS web page creation code is represented in Fig. 4 It's essentially a metric for how specific a selector's choice will be:

A lower score is given to an element selector because it is less particular — it will choose any elements of that kind that appear on a page. Applying the styling techniques the Fig. 5. Represents a sample web page using HTML and CSS.

A class selector gets a higher score because it is more particular — it will only choose components on a page that have a specified class attribute value.

```
<style>

body {background-color:lightblue; text-align:center;}
h1 {color:blue; font-size:40px;}
p {font-family:verdana; font-size:20px;}

</style>
```

Fig. 4. Basic CSS format

Fig. 5. Adoption form using HTML along with CSS

- JAVASCRIPT

JS is one of the three cornerstones of web development, with HTML and CSS. Because each language has its unique strengths and features that are relevant to online content, a savvy web developer should understand all three languages. HTML code allows browsers to read a website by displaying text and media in the browser. CSS is a language that specifies how HTML elements should be displayed in a browser.[10] JS, on the other hand, is a markup language that is commonly used to construct online applications and interactive Web sites.

There are several benefits to learning JS and using it in a regular HTML document.

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From interactive buttons to games, JS will genuinely set a website apart from the many basic HTML5-based and CMS-built websites that are now accessible

JavaScript offers interesting features that include various operations like the show and hiding HTML elements and changing HTML styles, attributes and content.
JS can show the hidden HTML elements by changing the display style.[2] Similar is the case with hiding the HTML elements.
As mentioned earlier, JS can change HTML styles i.e., by making a change in the style of an HTML element, which is proportional to that of making a change of HTML attribute.
Also, JS can change the attribute values that can be better briefed using the following example:

Fig. 6. HTML document with JS showing dynamic and interactive features.

In the above code, fig. 6. it can be seen that JS can be used to change the HTML attribute values in an HTML document.

Snippet output:

Fig. 7. Image representing when bulb is off.

Here from fig. 7. and fig. 8. initially one image source is shown then later clicking on the button changes the image source that is stored in the image id.

Fig. 8. Image representing when bulb is on.

3. BACK-END DEVELOPMENT

Back-end development is the process that occurs behind the scenes when a user makes an action on a website is referred to as back-end web development, it is also known as server-side development. This action can include things like logging into one's account or buying a watch from an online retailer like Amazon, Flipkart, etc.,

These days, several websites and online apps only require front-end development. For example, a single-page information website. While on the other hand, Back-end development is normally essential for every functional project. As a result, front-end development is in charge of everything that you see on the website, as well as anything that occurs on the user's computer.

Back-end development encompasses anything that receives data from a server. The back-end developing tools are represented in Fig. 7. When an app is in use, requests are made from the front-end (the page) to the back-end (i.e., server), which subsequently transmits information in plain format. The front-end styles it before rendering it, whereas the backend is

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server-side programming that communicates with the database.

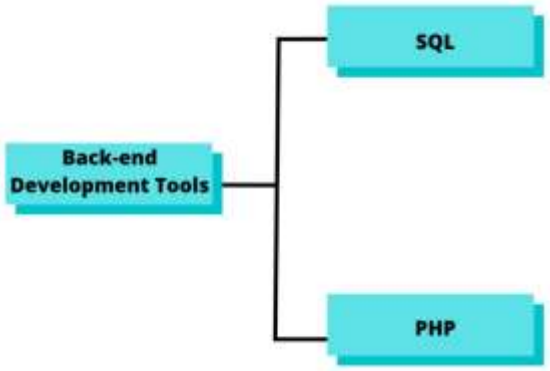

Fig. 7. Back-end development Tools

In the back-end, the working of the database management system is done by using SQL Servers for data storage.

- SQL Server

MySQL is a widely used open-source relational database management system (RDBMS), which is suitable for both small and large applications. MySQL Server is developed, distributed, and supported by Oracle Corporation and it is fast, dependable, scalable, and simple to use.

3.1 MySQL is a database management system:

The Collection of data in structural format is known as a database. A management system database, such as MySQL server, is required for anything from storing large image data to adding, accessing, and processing data saved in an IT database. In computing data, database administration is crucial.

3.2 MySQL databases are relational:

Rather than storing all data in a single large warehouse, a relational database stores it in discrete tables (i.e., in the format of rows and columns). The logical model of a relational database, which includes objects like databases, tables, views, rows, and columns, provides a flexible programming environment. You can define one-to-one, one-to-many, unique, required, or optional relationships between data fields, as well as "points" between two or more tables. Because the database enforces these principles, your application will never be inconsistent, duplicate, out-of-date, or missing data if it is well-designed.

3.3 MySQL database is fast and easy to use:

MySQL can run on any desktop and laptop comfortably, its server was developed to handle large databases and its server offers a useful set of connections. Its speed makes the MySQL server perfectly suited for accessing huge databases on the internet

3.4 MySQL Server works in Client/Server Systems:

MySQL database software is a client/server system that includes a multi-threaded SQL server that supports a range of backends, administration tools, and several different APIs.[13]

How does MySQL work?

The MySQL kernel is the MySQL server, which handles all the statements (or commands) of the database. The MySQL server is available as a distinct program to be used in a network client-server environment and as a library that can be integrated (and linked) to separate applications. MySQL works with several software utilities that support MySQL database administration[13][16]. Orders are sent to MySQL Server via the MySQL client installed on computerized. MySQL

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was initially developed for quick management of large databases. Although MySQL is usually installed on a single machine, it is capable of sending the database to several places, as users can access it via different MySQL client interfaces[13]. These interfaces send SQL commands to the server and then display the results.

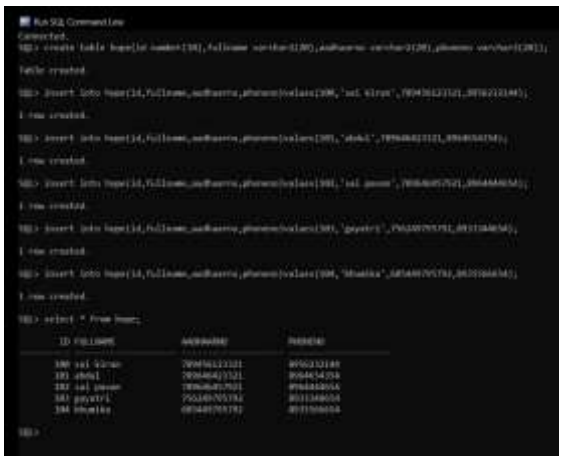

Fig. 8. Tables creation using SQL

Creation of basic database tables using SQL is shown in Fig. 8. It can be seen that first table is created then the data is inserted into it. Later on when the data is required it can be seen using an SQL query that shows the data in the tables that were created previously.

- **PHP**

PHP is an opensource programming language that makes web development more efficient and interactive for developers. PHP is far superior to other difficult programming languages due to its ease of use, ease of learning, and speed.

PHP is also very easy to run quickly because it doesn't utilize much of the system to execute your web app. The sample PHP creation code is represented in Fig. 10 As a result, web applications and web pages load quickly[15][16].

```
<html>
<head>
<title>SNIPPET</tittle>
<body>
   <?php echo "example of basic php code";?
</body>
</html>
```

Fig. 10. Basic PHP code.

Features of PHP

1. Performance
2. Familiarity with syntax
3. Platform independent
4. Database Support
5. Error Reporting
6. Web Server Support
7. Open Source
8. Embedded
9. Control
10. Loosely Typed Language
11. Security
12. Helpful PHP Community

4. FULLSTACK DEVELOPMENT

Working on both the front-end and back-end of an application is known as full-stack web development. Integration of front-end and back-end developing tools is represented in Fig. 9. It's a word that's usually associated with web developers. The developers have experience with front-end user interface and user experience, as well as a good understanding of a programming language that is used to handle the application's logic, i.e., back-end.[14]

The front-end and back-end elements of a program make up the full stack layer of software or web development. The front-end of your program is what users will see and interact with. The application logic, database, server, and other back-end components are not visible to users. A full-stack web developer is familiar with both the back-end and front-end technologies that make a website or application operate.

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Fig.10. Full-Stack Develpoment

Advantages of Full-stack

- Adaptability and Flexibility - Full stack developers may work on both front-end and back-end projects with ease.

- Possibility of employment - Knowing full-stack development may provide you with an advantage in the business because you can fill several roles.[14]

- Full-stack developers may see the complete design structure and logic, giving them a greater understanding of a program or application. In this manner, problems may be avoided throughout development.

- Full-stack development is good for small projects and small organizations since they can engage a developer that can perform both front-end and back-end programming.

5. CONCLUSION

This paper completely deals with the development of web design at the basic as well as the intermediate level. The advanced level of web development requires the advanced knowledge of some additional technologies in the front-end and back-end.[6] A brief description of front-end development and back-end development tools are presented and a sample web design is described in this paper. Front-end development is referred to as client-side development while back-end development is referred to as server-side development. The major challenge encountered in front-end development is that the tools, technologies, frameworks, etc, keep updating periodically. Back-end development focuses on databases, scripting, and website architecture.[7] The languages required for front-end development are HTML, CSS, and JavaScript. And the back-end development requires the knowledge of database, server, and API. The external part of the web design where the user can view the elements like buttons, pages, fonts, colors, design, etc. comprises the front-end development while the content of the article is rendered from a server and fetched from a database which is the back-end part of the application.

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