**Chapter 2: Survey of Technologies**

**2.1 Front End Technologies**

**2.1.1 ASP.NET**

**ASP.NET** is a Microsoft framework for building dynamic, scalable web applications and services. It supports various models like Web Forms, MVC, and Web API, and integrates with **C#** for backend logic. With **ASP.NET Core**, it has become cross-platform, offering improved performance and modularity. It provides essential features like security, caching, and a strong ecosystem, making it a popular choice for modern web development.

**Advantages:**

1. High performance with features like just-in-time compilation and caching.
2. ASP.NET Core allows for development on Windows, macOS, and Linux.
3. Supports building large, scalable applications with load balancing.
4. Built-in security features, including authentication and authorization.
5. Seamless integration with other Microsoft technologies and tools.
6. ASP.NET Core's modular architecture allows for lightweight applications.

**Disadvantages:**

1. Can be complex to learn and set up, especially for beginners.
2. ASP.NET Framework (not Core) is limited to Windows.
3. Can introduce overhead in performance due to abstraction layers..
4. While the framework is free, development tools and licenses for Microsoft products may have costs.
5. Frequent updates and changes, especially with ASP.NET Core, can require significant adjustments.

**2.1.2 React.js**

**React.js** is an open-source JavaScript library developed by Facebook for building user interfaces, particularly single-page applications with a focus on delivering a fast and interactive user experience. It simplifies the process of creating dynamic and responsive UIs by utilizing a component-based architecture and efficient rendering techniques. React.js provides a powerful and flexible approach to building modern web applications with a focus on reusable components and efficient UI updates. Its virtual DOM and declarative syntax make it well-suited for dynamic and interactive user interfaces, though developers should be prepared for its learning curve and the complexity of managing state and integrations in larger applications.

**Advantages:**

1. Encourages modular, reusable components, enhancing maintainability.
2. Uses a virtual DOM for efficient updates and rendering.
3. Simplifies UI development by describing the desired state.
4. Large community and extensive ecosystem support development.
5. Offers an intuitive way to write and visualize UI components.

**Disadvantages:**

1. JSX and component-based architecture can be challenging for beginners.
2. Requires additional setup and configuration, which can be cumbersome.
3. Rapid updates necessitate continuous learning and adaptation.
4. Integrating with other libraries or frameworks can be complex.
5. Client-side rendering may pose SEO challenges, though SSR can help.
6. Managing complex state may require additional libraries or patterns.
   * 1. **Bootstrap**

Bootstrap is a popular open-source front-end framework created by Twitter engineers Mark Otto and Jacob Thornton. It simplifies the development of responsive, mobile-first websites with its comprehensive set of CSS and JavaScript components, like buttons, navigation bars, and modals. Its responsive grid system ensures layouts adapt across various screen sizes. Highly customizable through SASS variables, Bootstrap also includes JavaScript plugins for interactive features. Extensive documentation and strong community support make it a favored choice for modern web applications.

**Advantages:**

1. Bootstrap provides pre-designed components and templates, which speeds up the development process.
2. Its grid system and media queries make it easy to create layouts that work well on various screen sizes and devices.
3. Offers a unified look and feel with consistent design elements across different pages and applications.
4. Includes built-in plugins for interactive components like carousels, modals, and tooltips, simplifying implementation.
5. Ensures consistent appearance and functionality across major web browsers.
6. Provides comprehensive and well-organized documentation, which helps developers understand and use the framework effectively.
7. Large community and numerous resources, such as tutorials and third-party themes, are available to assist with development and troubleshooting.

**Disadvantages:**

1. Default styles may lead to similar-looking websites unless significant customization is done.
2. Although Bootstrap is user-friendly, there’s a learning curve to fully understand and leverage all its features and customization options.
3. Including the full Bootstrap library can increase the size of your project’s CSS and JavaScript files, potentially affecting page load times.
4. Some of the built-in JavaScript plugins rely on jQuery, which may add unnecessary dependencies if you’re not already using jQuery.
5. Using Bootstrap’s full suite of components might lead to unused CSS and JavaScript, contributing to code bloat if not carefully managed.
6. The built-in components might not always meet specific design requirements without extensive customization.
   * 1. **Hyper Text Markup Language (HTML)**

HTML (HyperText Markup Language) is the most basic building block of the Web. It defines the meaning and structure of web content. Other technologies besides HTML are generally used to describe a web page's appearance/presentation (CSS) or functionality/ behaviour (JavaScript). "Hypertext" refers to links that connect web pages to one another, either within a single website or between websites. HTML uses "markup" to annotate text, images, and other content for display in a web browser.

**Advantages:**

1. It’s easy to learn and use.
2. It is a popular language, it’s widely used.
3. It can integrate easily with other languages.
4. Every browser supports HTML language.
5. It is a free and open-source markup language.
6. It is light weighted and fast to load.

**Disadvantages:**

1. Dynamic Pages - Creating dynamic pages are hard. By default, all HTML pages are
2. static.
3. Complexity - A lot of code can be complex to handle
4. Not Centralized- Each page should be programmed separately.
5. Limitations - Alone HTML does not have many capabilities, it alone can create basic web pages nothing much.
   * 1. **Cascading Style Sheets (CSS)**

Cascading Style Sheets (CSS) is a standard (or language) that describes the formatting of markup language pages. CSS enables developers to separate content and visual elements for greater page control and flexibility. A CSS file is normally attached to an HTML file by means of a link in the HTML file. In December 1998, the World Wide Web Consortium (W3C) published the first CSS specification (CSS1).

**Advantages:**

1. CSS saves time by reusing the same sheet in multiple HTML pages.
2. It improves page loading speed.
3. It has multiple device compatibility.

**Disadvantages:**

1. Sometimes CSS can be messy and can create complications in code.
2. In CSS, there is no interaction with databases.
3. CSS has cross-browser issues. It has multiple levels like CSS1, CSS2, CSS3, that are sometimes confusing for beginners.
   1. **Back-End Development** 
      1. **C#**

C# is pronounced "C-Sharp". It is an object-oriented programming language created by Microsoft that runs on the .NET Framework. C# has roots from the C family, and the language is close to other popular languages like C++ and Java. The first version was released in year 2002. The latest version, C# 11, was released in November 2022.One of the key features of C# is its development environment and tools. C# is developed by Microsoft, and it is integrated with a range of tools and frameworks for building server-side applications. These tools and frameworks include .NET, Entity Framework, and ASP.NET, which provide comprehensive set of tools and libraries for building server-side applications.

**Advantages:**

1. It is easy to learn and simple to use
2. It has a huge community support
3. A programmer does not need to pay much concentration to problems such as memory loss, which is a worrying problem for the C ++ programmer.
4. The assembly concept resolves the issue of version control well.
5. Easy to develop, the rich class library makes many functions easy to implement.
6. Cross-platform. An application will run fine only if the machine installed the .NET Framework.
7. C # is purely object-oriented, but C ++ is a combination of object-oriented and procedure oriented.

**Disadvantages:**

1. A programmer cannot do low-level things like interacting directly with hardware through drivers and firmware.
2. It does not come with an independent compiler that can straightforwardly interpret the maximum levels of language to the underlying hardware architecture of a pure assembler. It uses its byte code and the JIT compiler that is hugely incorporated into the .Net framework and is the backbone of the .Net structure as a go-between to the machine code in the place of communicating directly with the hardware.

**2.2.2 Java**

Java is a widely-used programming language for coding web applications. It has been a popular choice among developers for over two decades, with millions of Java applications in use today. Java is a multi-platform, object-oriented, and network-centric language that can be used as a platform in itself. It is a fast, secure, reliable programming language for coding everything from mobile apps and enterprise software to big data applications and server-side technologies. One major advantage of developing software with Java is its portability. Once you have written code for a Java program on a notebook computer, it is very easy to move the code to a mobile device. When the language was invented in 1991 by James Gosling of Sun Microsystems (later acquired by Oracle), the primary goal was to be able to "write once, run anywhere”.

**Advantages:**

1. Java is easy to learn and familiar because java syntax is just like c++.

2. Write once, run anywhere (WORA).

3. Java provides multitasking facility with the help of lightweight processes called threads.

4. JVM can execute byte codes (highly optimized) very fast with the help of Just in time (JIT) compilation technique.

**Disadvantages:**

1. Java program consumes more memory since it runs on top of Java virtual machine.

2. Java lacks when it comes to interacting directly with machines, making it less viable for the software that needs to run quickly and run directly with the machine, as explicit pointers are also missing in Java.

3. Java programming language is a bit costly due to its higher processing and memory requirements. We need better hardware to run the Java program.

4. Java needs to be interpreted during runtime, which allows it to run on every operating system, but it also makes it perform slower than the languages like C and C++.

* + 1. **Microsoft SQL Server**

**Microsoft SQL Server** is a relational database management system (RDBMS) developed by Microsoft, designed to store, retrieve, and manage data efficiently for enterprise-level applications. It supports a wide range of data management and analysis features, making it suitable for both small-scale applications and large-scale enterprise environments.

**Advantage:**

1. Integration: Seamlessly integrates with other Microsoft products and services, enhancing productivity.

2. High Performance: Offers advanced indexing, query optimization, and in-memory processing for efficient data management.

3. Security: Provides robust security features, including data encryption, auditing, and role-based access control.

4. Scalability: Supports large-scale databases and high transaction volumes with features like partitioning and clustering.

**Disadvantage:**

1. Cost: Licensing and support can be expensive, particularly for enterprise editions.

1. Resource Intensive: Requires significant hardware resources and can be resource-heavy on large deployments.
2. Complex Configuration: Advanced features and setup can be complex, requiring specialized knowledge.
3. Platform Limitation: Primarily optimized for Windows environments, though it is available on Linux in recent versions.
   * 1. **MYSQL**

**MySQL** is an open-source relational database management system (RDBMS) developed by Oracle Corporation. It is widely used for managing and organizing data in a structured format, allowing for efficient storage, retrieval, and manipulation of data. MySQL is known for its reliability, ease of use, and performance, making it a popular choice for web applications and various other types of software.

**Advantage:**

1. Free to use with a large community contributing to its development and maintenance.
2. Simple to install, configure, and manage with extensive documentation and user-friendly tools.
3. Optimized for high performance, handling large databases and high transaction loads efficiently.
4. Proven reliability and stability, used by many high-profile web applications and companies.
5. Supports various storage engines and can be tailored to different use cases.

**Disadvantage:**

1. Lacks some advanced features found in other RDBMSs like PostgreSQL.
2. Setting up replication and clustering can be complex and require advanced knowledge.
3. Write operations can become a bottleneck in highly concurrent environments.
4. Advanced features and support in the enterprise edition require a paid license.

**Technologies used in this project**

In the Online Library Management System project**, ASP.NET** is used to build and manage the web application's server-side functionality, ensuring dynamic and interactive features. **Bootstrap,** which utilizes HTML and CSS, is employed to create a responsive and visually appealing frontend that works well on various devices. **C#** is chosen for the backend due to its efficiency and seamless integration with ASP.NET, enabling the development of robust and maintainable code. **MySQL** is selected as the database solution for its reliability, high performance, and ability to handle large volumes of data while ensuring data integrity. This combination of technologies provides a comprehensive, user-friendly system that effectively manages library operations, ensuring both a smooth user experience and efficient data management.