

# Dynamic Web Application Development with ASP.NET, Bootstrap and Entity Framework

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## I. Introduction and Background

Websites have been deemed one of the most popular tools to deliver not only information, knowledge but even services to end-users. Have been in existence for approximately two decades, websites have seen many changes in the way it looks, works and along with that how the development process have changed (MacDonald, 2012). From the early 1990s, when the basic HTML browsers were made available to the public after the introduction of “Internet over the phone”, to the recent adoption of “Internet of Things” and cloud services, there have been many tools invented to aid the web developer in their quest of developing a well-designed and efficient webpage (ibid.). Within the recent years, adoptions of rapid web developing frameworks such as HTML5, Bootstrap, JQuery and AJAX have been used to aid web developers designing responsive mobile-friendly web applications (Shahzad, 2017; Xing et al., 2019)(MacDonald, 2012; Shahzad, 2017; Spurlock, 2013).

However, the appearance (front-end) only constitute one part of the web developing. While basic HTML and front-end frameworks can be used to populate static websites that persist information over a long time without the need of changing (Ahmed, 2013). Dynamic web applications require database linking as well as a managing mechanism for scalability issues such as connection pooling and resource managing (MacDonald, 2012). Frameworks such as ASP .NET from Microsoft are one of the tools that help developers to implement web applications without the worry of low-level implementations of security, data managing, network communication while Entity Framework allows quick and customised interaction with database layer without the need of complex SQL queries (MacDonald, 2012; ZZZ Projects, n.d.).

Within this report, a range of front-end and back-end technologies would be compared contrast to determine an optimal combination for designing and implementing a mobile-friendly responsive web application efficiently and effectively.

## II. Literature Review & Discussion

### A brief review

#### Cascading Style Sheets

Cascading Style Sheets or CSS syntax is widely used to control the appearance of HTML contents in terms of layout, colour and also display adaptation for a variety of screen sizes (W3S, 2020a). CSS was introduced as a mean to separate style formatting from HTML scripts by targeting and grouping contextual similar HTML tags for a coherent and concurrent style formatting (ibid).

#### Javascript and JQuery and AJAX

Javascript or JS is a scripting language that has been used to develop webpages by dynamically manipulate their behaviours (W3S, 2020b). While plain JS is mainly used for client-side scripting, other application can be found at server-side such as Node.js (ibid). JS can be used to manipulate CSS properties, HTML elements and their content, hence, very powerful and useful in web development (ibid.).

As the dynamic web programming evolves, jQuery was introduced as a library for an effective way of managing JS functions and simplify JS usage (W3S, 2020c). jQuery works by grouping

commonly used JS code and provide a simpler wrapper method to ease the developing process (ibid.).

While jQuery is a simplified wrapper library for client-side JS, AJAX was introduced as a tool to elevate the web development process with the ability to send and receive data from web servers without the need of web reload (W3S, 2020d). AJAX stands for Asynchronous Javascript and XML, is a method that makes use of JS, HTML Document Object Models (DOMs) and XMLHttpRequest objects from browsers to transport data not only by XML but also JSON or plaintext so it can be used in a variety of scenarios to update webpages content (ibid.).

### Bootstrap Framework

Bootstrap was introduced as a unified framework that combines HTML, CSS and JS, AJAX to develop responsive webpages that are optimised for mobile devices (W3S, 2020). Bootstrap4 is the most recent version that implements more responsive features including scaling and compatibility.

### Plain SQL Database Connection and Entity Framework

SQL stands for Structured Query Language Has been developed to allow access and manipulation of database objects (W3S, 2020e). Although all SQL languages support basic database operations (CRUD operations) as a part of ISO standard, they all, at the same time, have different syntaxes (ibid.). Entity Framework is a framework developed by Microsoft to liberate web developers from having to learn different SQL syntaxes when having to connect their front-end to a different database (ZZZ Projects, n.d.).

### PHP and ASP.NET MVC

Both were introduced as a way to programme dynamic web applications, PHP and ASP.NET MVC are among the most popular framework (Hur and Ubelhor, 2017). PHP is one of the popular open-source web development scripting languages that can be employed to dynamically output HTML, hence, providing a basic feature of dynamic web application (Mehdi Achour et al., 2020). While ASP.NET is a Microsoft-developed framework as a server-side programming platform that provides high-level sophisticated functionalities for dynamic web development (MacDonald, 2012).

## Front-end Frameworks Comparison

To continue from the above analysis, while plain CSS can provide basic control over the HTML element formatting, it can only do element by element by refer to each element id or have a basic grouping of the same tag, for instance, a style can be defined for all HTML `<p>` tags or all `<b>` tags within `<p>` tags (W3S, 2020a). The issue for plain CSS is that it is only effective for a single or limited amount of contexts and this is where Bootstrap comes in. Packed with pre-compiled CSS and JS functions, bootstrap has a well pre-defined classes that are suitable for different settings and contexts. Moreover, all bootstrap functionalities come in simplified class names that ease the learning curve in studying and implementing front-end designs. Another issue of plain CSS that have been solved by Bootstrap is responsiveness and mobile-friendliness design. With the built-in JS functions, Bootstrap is capable of detecting different client-side configurations such as device type, touch capability, screen size to enable different CSS contexts, hence, providing the same user experience regardless of the user's devices (W3S, 2020).

On a different aspect, JS while being a well established client-side scripting language, similar to plain CSS, limited in code reuse and multiple context adaptiveness. jQuery as a wrapper was designed to simplify common tasks that require a much more considerable amount of programming using plain JS (W3S, 2020c).

With websites getting more and more complex, it is required for more programming and more sophisticated functionalities and in this scenario, jQuery and Bootstrap framework is one of the better ways to design websites front-end.

## Back-end Frameworks Comparison

Regarding the back-end, as mentioned above, there is an apparent issue for SQL that is fragmentation. Using plain SQL requires web developers to have to learn different SQL syntaxes may that be MySQL, MSSQL or Postgre, they all require extra time and effort (W3S, 2020e). This can also lead to another issue when it comes to database migration. When hardcoded for a database back-end, it would require recoding the whole database-specific

code should the client decided to move to another database back-end/engine. Entity Framework, which was introduced by Microsoft, is an alternative to this issue by handling low-level implementation of data-specific classes using abstract class mapping within the ADO.NET framework (Microsoft, 2020a). Another issue of using plain SQL string to communicate with the database back-end is that it can be a security threat if the user input is not sanitised (removing or escaping dangerous SQL injection scripts). Entity Framework by design is not susceptible to SQL injection if correct parameter passing was used (Microsoft, 2020b; ZZZ Projects, n.d.).

PHP and ASP.NET as mentioned above are among the most popular web programming techniques. While PHP is open-source, it is considered as a hypertext pre-processor, unlike ASP.NET MVC which employs C# as its backbone (MacDonald, 2012; Mehdi Achour et al., 2020). C# is a fully established programming that is well-defined, object-oriented with full class inheritance support that allows a high level of customisation (Bill Wagner, 2020). Plain PHP provides basic dynamic web programming with the ability to generate dynamic content, send and receive cookies (Mehdi Achour et al., 2020). As an addition to being open-source, PHP is platform-independent (ibid.). This means that the server can run any operating system while this is a drawback for ASP.NET which requires a Windows-running server (with ASP.NET Framework) (MacDonald, 2012). Targeting medium and large organisations, ASP.NET MVC separates database-specific, displaying and business-logic into Model, View and Controller classes respectively for better complexity management and scalability while PHP even with additional plug-ins does not show as robust and sophisticated support for large scale projects (Hur and Ubelhor, 2017; MacDonald, 2012; Mehdi Achour et al., 2020).

### III. Conclusion

From the discussion, on the front-end developing aspect, bootstrap framework showed major advantages over plain CSS just as jQuery showed enhancement in client-side scripting compares to plain JS. With mobile application gaining more popularity, websites functionalities getting more complicated, front-end frameworks such as Bootstrap should be used to reduce the developing workload.

On the back-end, Entity Framework showed a high number of improvements over plain SQL regarding migration issue, security issue and database engine independency. In terms of PHP

and ASP.NET MVC, a conclusion was drawn that ASP.NET MVC with scalability, robust structure and powerful programming language backbone is more suitable for medium and large-scale projects where fundings are available and efficiency, reliability are important.

## IV. Reflection

Within this project, only ASP.NET Framework was studied and implemented that is dependent on the Windows operating system. ASP.NET CORE, which is platform-independent, can be studied and used to develop platform-independent web application in future researches.

## V. References

- Ahmed, R., 2013. The Web Book - Build Static and Dynamic Websites: A Beginner's Step-by-Step Guide to Creating Static and Dynamic Websites. Riaz Ahmed.
- Bill Wagner, 2020. A Tour of C# - C# Guide [WWW Document]. Microsoft Docs. URL <https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/> (accessed 4.23.20).
- Hur, C., Ubelhor, L., 2017. Developing Business Applications for the Web: With HTML, CSS, JSP, PHP, ASP.NET, and JavaScript. MC Press, LLC.
- MacDonald, M., 2012. Beginning ASP.NET 4.5 in C#. Apress.
- Mehdi Achour, Friedhelm Betz, Antony Dovgal, Hannes Magnusson, Georg Richter, Damien Seguy, Jakub Vrana, 2020. PHP: PHP Manual - Manual.
- Microsoft, 2020a. Entity Framework Overview - ADO.NET [WWW Document]. Microsoft Docs. URL <https://docs.microsoft.com/en-us/dotnet/framework/data/adonet/ef/overview> (accessed 4.23.20).
- Microsoft, 2020b. Security Considerations (Entity Framework) - ADO.NET [WWW Document]. MicrosoftDocs.URL<https://docs.microsoft.com/en-us/dotnet/framework/data/adonet/ef/security-considerations> (accessed 4.23.20).
- Shahzad, F., 2017. Modern and Responsive Mobile-enabled Web Applications. Procedia Comput. Sci., 14th International Conference on Mobile Systems and Pervasive Computing (MobiSPC 2017) / 12th International Conference on Future Networks and Communications (FNC 2017) / Affiliated Workshops 110, 410–415. <https://doi.org/10.1016/j.procs.2017.06.105>
- Spurlock, J., 2013. Bootstrap: Responsive Web Development. O'Reilly Media, Inc.

- W3S, 2020a. CSS Introduction [WWW Document]. W3Schools.com. URL [https://www.w3schools.com/css/css\\_intro.asp](https://www.w3schools.com/css/css_intro.asp) (accessed 4.22.20).
- W3S, 2020b. JavaScript Introduction [WWW Document]. W3Schools.com. URL [https://www.w3schools.com/js/js\\_intro.asp](https://www.w3schools.com/js/js_intro.asp) (accessed 4.22.20).
- W3S, 2020c. jQuery Tutorial [WWW Document]. W3Schools.com. URL <https://www.w3schools.com/jquery/default.asp> (accessed 4.22.20).
- W3S, 2020d. AJAX Introduction [WWW Document]. W3Schools.com. URL [https://www.w3schools.com/js/js\\_ajax\\_intro.asp](https://www.w3schools.com/js/js_ajax_intro.asp) (accessed 4.23.20).
- W3S, 2020. Bootstrap 4 Tutorial [WWW Document]. W3Schools.com. URL <https://www.w3schools.com/bootstrap4/default.asp> (accessed 4.23.20).
- W3S, 2020e. SQL Tutorial [WWW Document]. W3Schools.com. URL <https://www.w3schools.com/sql/default.asp> (accessed 4.23.20).
- Xing, Y., Huang, J., Lai, Y., 2019. Research and Analysis of the Front-end Frameworks and Libraries in E-Business Development, in Proceedings of the 2019 11th International Conference on Computer and Automation Engineering, ICCAE 2019. Association for Computing Machinery, Perth, WN, Australia, pp. 68–72. <https://doi.org/10.1145/3313991.3314021>
- ZZZ Projects, n.d. Entity Framework Tutorial and Documentation [WWW Document]. Entity Framework. 6. URL <https://entityframework.net/> (accessed 4.22.20).