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A Survey Paper on Full Stack Web Development

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***Abstract*-The complexity of Web sites is increasing and transforming into Web applications that contain business logic, interactivity, transaction handling and states. This phenomenon forces the Web developers to adapt more traditional software engineering techniques to keep the Web applications error free, maintainable, reusable, well documented etc. Many Web developers do not use any engineering techniques at all and design mainly to create as fashionable applications as possible with no regards on the application's functionality. This results in applications that are hard to maintain and with poor functionality. The purpose with this thesis was to see if the use of a more traditional software engineering technique, namely the Unified Modeling Language with the newly added Web Application Extension, resulted in a Web application with good design regarding the maintainability of the application. To investigate the maintainability of an application, the maintainability was further divided into three sub criteria: extensibility, reusability and documentation. These three criteria were then applied on a case study where a Web application was designed. From the analysis of the final design, using the three criteria, the maintainability was derived. This paper examines the four components of MEAN stack (Mongo DB, Express.js, Angular.js &Node.js) and how they go well together, their benefits as a complete stack in web development. This paper also describes the work flow and server architecture in detail to understand the working of these four technologies employed in the MEAN stack web development. This paper mainly focuses on roles of these four technologies in MEAN stack and how they are popularly implemented in present times.**

***Keywords*- AngularJS, Full stack web development, Nodejs, Express.JS, MongoDB, Amazon S3(Simple Storage service).**

I.INTRODUCTION

To research and understand the working and intricacies of the modern technologies employed in the MEAN (Mongo DB, Express.JS, Angular, NodeJS) stack web development practices. The practicality of FULL-STACK development employs the MEAN Technologies and their ease-of-use characteristics for the modern developer.

The four Technologies comprising the MEAN stack are Mongo DB as database, Express as the Server Framework, Angular for front-end and Node.js as an event-driven I/O(input/output) server-side JavaScript environment. The main characteristic of the MEAN stack is that all four technologies are based on java script and JSON (JavaScript Object Notation) which is used to exchange data across these technologies saving potential time consumption of JSON encoding.

1. Why MEAN? :
Simplicity, uniformity and most of all, performance. The learning curve is sharp as it does not require a programmer to learn multiple programming languages, just JavaScript is enough. With this we have also used some other technologies like amazon web services .in which we have used s3 bucket to store files we are getting from our website users. S3 is easy to use and secure.

This website is develop using MEAN stack and it is non-profit free to use to all students and teachers.as someone upload any study material which will immediately available to all users there is no need to pay for any document or no need to make any account

II. BACKGROUND STUDY

If you look at it from an eagle-eye view, full-stack development has existed since the beginning of programming, but the meaning of the term in its current context is not the same as it was before. The current meaning of full stack development only came to light in 2008, when designing for the web as well as mobile became mainstream. Earlier to this, the term in a different capacity was regularly used in the 1970s as well as 80s.The main reason behind this being, at that time there was not much difference between a back-end programmer and a front-end one.

Back then, a programmer was a programmer and he could handle and operate both the hardware as well as software end of operations. Slowly over time, the distinction between both these ideologies grew and two different streams of application came into the picture, frontend and backend development. In early 2008, full stack web development as a term started gaining momentum and

over the years it has come to become one of the most in-demand job roles of present times.

III. THE MEAN STACK

Currently most popular and widely used open-source web development stack is the LAMP (Linux, Apache, MySQL, and PHP) stack. Here Linux is the Operating system, Apache as the web server, MySQL as database and PHP as the programming language used for server-side scripting.A newly emerging web development stack is the MEAN stack which uses Mongo DB as database, Express as a flexible server framework that provides routing and handles request and response, Angular works at the client side.

IV. ANGULAR JS

Angular JS is framework manage by Google, it helps build responsive sites. Angular JS use to make a smooth web performance. Angular JS is a toolset for building the framework most suited to your application development. It is fully extensible and works well with other libraries. Every feature can be modified or replaced to suit your unique development workflow and feature needs. Angular JS is a JavaScript framework. It can be added to an HTML page with a <script> tag. Angular JS extends HTML attributes with Directives, and binds data to HTML with Expressions.

AngularJS extends HTML with new attributes. AngularJS is perfect for Single Page Applications (SPAs).AngularJS is easy to learn.

The idea turned out very well, and the project is now officially supported by Google AngularJS is a structural framework for dynamic web applications. It lets you use HTML as your template language and lets you extend HTML's syntax to express your application components clearly and succinctly. Its data binding and dependency injection eliminate much of the code you currently have to write. And it all happens within the browser, making it an ideal partner with any server technology.

It was originally developed by Misko Hevery and Adam Abrons. HTML is great for declaring static documents, but it falters when we try to use it for declaring dynamic views in web-applications. AngularJS lets you extend HTML vocabulary for your application.

The resulting environment is extraordinarily expressive, readable, and quick to develop.

1. Advantages of Angular JS:

The advantages of AngularJS are:

- Angular JS provides capability to create Single Page Application in a very clean and maintainable way.
- Angular JS provides data binding capability to HTML. Thus, it gives user a rich and responsive experience.
- Angular JS code is unit testable.
- Angular JS uses dependency injection and make use of separation of concerns.
- Angular JS provides reusable components.
- With Angular JS, the developers can achieve more functionality with short code.
- In Angular JS, views are pure html pages, and controllers written in JavaScript do the business processing. On the top of everything, Angular JS applications can run on all major browsers and smart phones, including Android and iOS-based phones/tablets.

V. BOOTSTRAP

Bootstrap is the popular HTML, CSS and JavaScript framework for developing a responsive and mobile friendly website. Bootstrap is the most popular HTML, CSS and JavaScript framework for developing a responsive and mobile friendly website.

It is absolutely free to download and use. It is a front-end framework used for easier and faster web development. It includes HTML and CSS based design templates for typography, forms, buttons, tables, navigation, modals, image carousels and many others.

It can also use JavaScript plug-ins. It facilitates you to create responsive designs.

1. Why Use Bootstrap?

- Mobile first approach − Bootstrap 3, framework consists of Mobile first styles throughout the entire library instead them of in separate files.
- Browser Support − It is supported by all popular browsers.
- Easy to get started − with just the knowledge of HTML and CSS anyone can get started with Bootstrap. Also, the Bootstrap official site has a good documentation.
- Responsive design − Bootstrap's responsive CSS adjusts to Desktops, Tablets and Mobiles. More about the responsive design is in the chapter Bootstrap Responsive Design.
- And best of all it is an open source

VI. MONGODB

MongoDB is a schema-less NoSQL document database. It means you can store JSON documents in it, and the structure of these documents can vary as it is not enforced like SQL databases. This is one of the advantages of using NoSQL as it speeds up application development and reduces the complexity of deployments.

Example:

{
"id": 110,
"language": "JavaScript",
"price": 1900,
}

1. Why MONGODB?

MongoDB is an object-oriented, simple, dynamic, and scalable NoSQL database. It is based on the NoSQL document store model. The data objects are stored as separate documents inside a collection — instead of storing the data into the columns and rows of a traditional relational database.

The motivation of the MongoDB language is to implement a data store that provides high performance, high availability, and automatic scaling. MongoDB is extremely simple to install and implement. MongoDB uses JSON or BSON documents to store data. General distributions for MongoDB support Windows, Linux, Mac OS X, and Solaris.

VII. PROS

- Document oriented
- High performance
- High availability — Replication
- High scalability – Sharding
- Dynamic — No rigid schema.
- Flexible – field addition/deletion have less or no impact on the application
- Heterogeneous Data
- No Joins
- Distributed
- Data Representation in JSON or BSON
- Geospatial support
- Easy Integration with Bigdata Hadoop
- Document-based query language that's nearly as powerful as SQL
- Cloud distributions such as AWS, Microsoft, RedHat, dot Cloud and SoftLayer etc.: -In fact, MongoDB is built for the cloud. Its native scale-out architecture, enabled by 'sharding,' aligns well with the horizontal scaling and agility afforded by cloud computing.

VIII. CONS

- A downside of NoSQL is that most solutions are not as strongly ACID-compliant (Atomic, Consistency, Isolation, Durability) as the more well-established RDBMS systems.
- Complex transaction
- No function or stored procedure exists where you can bind the logic

IX. NODEJS

Web based applications are increasing its popularity as they become easier to develop, maintain and secure. Also, they are easily reachable to the clients and does not require additional installations in most cases and are quickly customizable. Web application is derived from web-based system, which have additional functionality to execute business logic of an organization.

These applications are totally web based instead of requiring to install a separate application on the operating system. Google Docs, Web based retail stores, Google Maps, and the web-based email applications are kind of Web applications. The Web development industry will find two kinds of developers. i.e., Front-end developers and Back-end developers. Front-end developers require to have knowledge of HTML, CSS, and a programming language to add effects and more to the front – end i.e., JavaScript. They build the web sites display and effects which are shown to the clients by converting the designer's design. Back-end Developers build the business logic behind any web application.

The actions for instance adding and retrieving news highlights to and from a web application, or sending email from a web-based forms, or authenticating a visitor or client's credentials are all part of back-end developers. A backend developers need to know languages like PHP, .NET, Java, and others. Back-end developers should also have knowledge of databases like My SQL, Oracle, and SQL Server, or should hire or entrust a database administrator to work with the flow.

A database administrator will take care of database server and ensure its smooth performance. Full stack developers are jack of all trades, and they are the one who do all. Mostly back-end developers are required to have skills of front-end developers and vice versa and have extra burden on them of learning additional skills set [4]. So, it is clear that for a developer to become full stack, he has to have expertise in languages of three kinds, i.e., Client-Side languages such as Java script along with HTML and CSS, Server-Side Languages such as PHP, .NET, Java, Ruby, etc., and database expertise such as SQL Server, MySQL Server, and Oracle.

1. Advantages of Node.JS Over Others:

Node.js is built from ground for the purpose of handling asynchronous I/O as it is built of JavaScript and JavaScript is built as event loop. Like the on click event for a button in client-side JavaScript is and event loop. While other environments do have this feature, they have it with using third party libraries or are not built from ground for the same purpose like the Node.js and hence they are often slow, or lags and does not belongs as a standard feature to them. Some of the examples are Event Machine – built for Ruby, twisted – licensed under open-source MIT License, it is introduced for Python and is available since Python 2

onwards, and network framework library for Apache named as Apache MINA which is also called "Networking Socket Library" and is another example of providing event-driven and asynchronous limited to APIs only.

Similarly, Apache Async Web is built using Apache MINA and Perl's Any Event. Similarly, an edge of Node.js over others will be that it will be capable of handling multiple requests while it will act like a client towards the third-party services by executing only a single thread. Other languages in this regard will block the processing until the remote server responds first for their initial request as a result, they will be requiring multiple threading for executions.

Comparatively in Node, all that you will use is asynchronous as it will become quite hard if you are to write non-asynchronous code in it. Also Node.js will never force to buffer data before outputting while the others like Event Machine, forces buffering in many cases to buffer the data. Being server-side JavaScript, another admirable edge of Node.js over others is that a developer will be required to only have knowledge and experience of a single language i.e., JavaScript, no matter if he is developing client-side scripts or scripts for server side.

The developer is not required to swap his brain cycles from for one language at client side and then for another language at server side. Hence JavaScript end-to-end as depicted in the Figure. Here the database of JavaScript also store date like a JavaScript Object. Adding to this, it is also worth considering that Node.js is new and thus have benefit of taking precautions against the mistakes which other languages had come across in the past such as the mistake of backward compatibility.

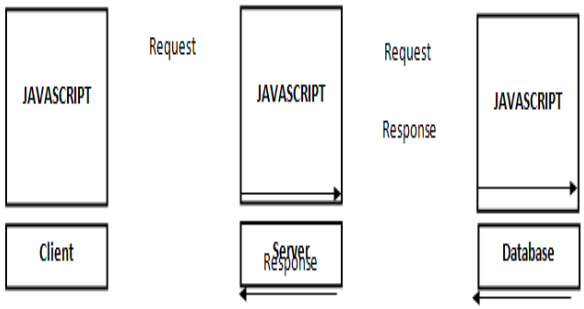

Fig 1. JavaScript end-to-end.

Figures shows that about 47% of web surfers wants a website to be loaded within 2 seconds and a 3 second delay drops the customer satisfaction by 16%. Here the Node.js leads as the interpreter of Node.js is smaller and fast compared to other languages like PHP. Here the server-side apps are permanently kept ON unlike other languages where every initiation of the application will follow cycles consuming steps of for example loading configurations, followed database connectivity, acquire required information and finally render the markup language. Node.js on other hand reduces these steps by keeping an app permanently ON.

2. Disadvantage of Node.JS Over Other:

A code in Node.js becomes fast growing, along with making it difficult to debug due to the fact that it is using event-driven/callback approach. Big drawback currently is the unavailability of ready hosting for Node.js environment. Complex topics of JavaScript language such as prototypical inheritance, anonymous function, callbacks make the language hard to learn, and thus becomes the choice to be learnt when one has mastered another easy language first. Node.js is not a mature language still and thus faces so much hesitation to get joined by expert programmers. Another issue is that being single-threaded, other requests are stopped if in case the CPU is occupied even for some parts of a second. And so, the developers are also forced to think in asynchronous which is not easy to get used with.

X. EXPRESS.JS

Express.js is a free and open-source web application framework for Node.js. It is used for designing and building web applications quickly and easily. Web applications are web apps that you can run on a web browser. Since Express.js only requires JavaScript, it becomes easier for programmers and developers to build web applications and API without any effort.

Express.js is a framework of Node.js which means that most of the code is already written for programmers to work with. You can build a single page, multi-page, or hybrid web application using Express.js. Express.js is lightweight and helps to organize web applications on the server-side into a more organized MVC architecture.

It is important to learn JavaScript and HTML to be able to use Express.js. Express.js makes it easier to manage web applications. It is a part of a JavaScript based technology called MEAN software stack which stands for MongoDB, Express.JS, AngularJS, and Node.js. Express.js is the backend part of MEAN and manages routing, sessions, HTTP requests, error handling, etc.

The JavaScript library of Express.js helps the programmers to build efficient and fast web apps. Express.js enhances the functionality of the node.js. In fact, if you don't use Express.js, then you have to do a lot of complex programming to build an efficient API. It has made programming in node.js effortless and has given many additional features.

1. Why Should You Use Express.Js?

Express.js supports JavaScript which is a widely used language that is very easy to learn and is also supported everywhere. Therefore, if you already know JavaScript,

then it will be really easy for you to do programming using Express.js.

With the help of Express.js, you can easily build different kinds of web applications in a short period of time. Express.js provides a simple routing for requests made by clients. It also provides a middleware that is responsible for making decisions to give the correct responses for the requests made by the client

Without Express.js, you have to write your own code to build a routing component which is a time consuming and tedious task. Express.js offers simplicity, flexibility, efficiency, minimalism, and scalability to the programmers. It also has the advantage of powerful performance as it is a framework of Node.js.

Node.js carries all the executions really fast with the help of Event Loop that avoids any kind of inefficiency. The powerful performance of Node.js and the ease of coding using Express.js are the most popular features loved by web application developers. Since Express.js is written in JavaScript, you can build websites, web applications, or even mobile apps using it.

2. Features of Express.Js:

- Faster server-side development
- Middleware
- Routing
- Templating
- Debugging

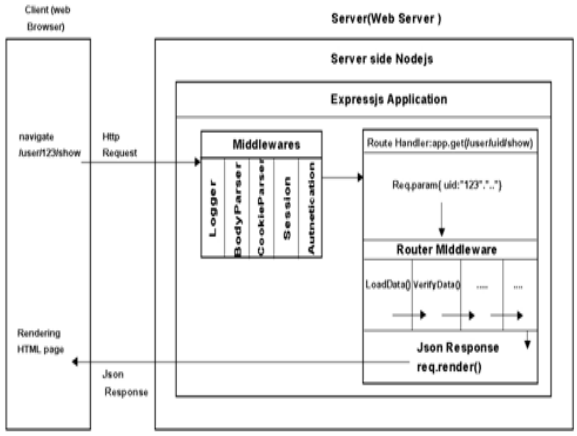

Fig 2. Server Architecture of Express.JS.

XI. AMAZON S3(SIMPLE STORAGE SERVICE)

Amazon Simple Storage Service (Amazon S3) is storage for the Internet. It is designed to make web-scale computing easier.Amazon S3 has a simple web services interface that you can use to store and retrieve any amount of data, at any time, from anywhere on the web. It gives any developer access to the same highly scalable, reliable, fast, inexpensive data storage infrastructure that Amazon uses to run its own global network of web sites. The service aims to maximize benefits of scale and to pass those benefits on to developers.

This introduction to Amazon Simple Storage Service (Amazon S3) provides a detailed summary of this web service. After reading this section, you should have a good idea of what it offers and how it can fit in with your business.

XII. IMPLEMENTATION AND EASE-OF-USE

JavaScript started as a simple script that's meant to be run by the browser. Now, however, JavaScript is everywhere. It can be found running on smartphones, servers, Arduino, Raspberry and in many more technological developments. The Edge that JavaScript has over other languages is that, it is Non-blocking.

A single non-blocking thread in JavaScript is more efficient than using threads in languages like java. JSON is the common format used to exchange data between all 4 layers. Since JSON is native, no parsing is required at all. JSON is light-weight and easily consumed by JavaScript. The most common and efficient way to use the MEAN stack is to use express to create a RESTful API, while angular handles the client-side routes taking full advantage its SPA characteristics. Only when data from the database is required, will the application be required to make use of the API. This way most of the business logic can be applied and executed on the client side. Illustration can be found in fig.1 In the Express side of things, app handlers are used to handle the requests and give responses. These handlers receive the request and start request-response cycle with middleware's.

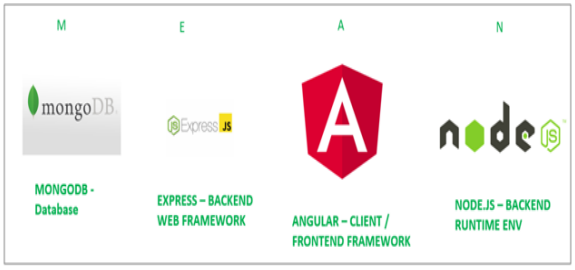

Fig 3. MEAN stack Architecture.

User management, authentication, session management and the CRUD operations on mongo DB are handled by express. Technologies can be hindered in their development if it is too hard to learn and the costs outweigh the benefits. However, in the MEAN stack, these 4 technologies seamlessly integrate with each other e.g., express response object can directly be supplied to angular within any need for parsing. MEAN.io and MEAN.js are popular Node packages that have all 4 technologies

already pre-compiled and can be used directly without needing separate setup for them. This makes it especially easy for the developers since some part of the integration is already automated straight out-of-the-box.

XIII. FUTURE OF FULL STACK DEVELOPMENT (MEAN STACK)

Most popular Technologies stackoverflow's 2019 developer survey

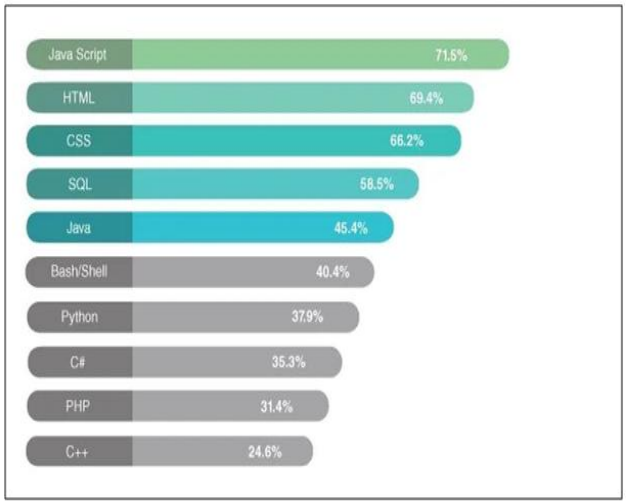

Fig 4. Stack overflow Developer Survey 2019 (Top languages) Stack overflow Developer Survey 2019.

XIV. CONCLUSION

AngularJS can do everything that jQuery does and much more, yet is roughly equivalent in download size. It is easy to both write and run unit tests and end-to-end tests for AngularJS applications. Dependency management is effortless and intuitive. Binding dynamic data to your views is straightforward and powerful. directives, routing, services, validation, resources, animation and localization - are equally thought out and useful tools. AngularJS is a solid foundation for building testable web applications that scale.

Cloud storage services offer a fast and convenient way to archive and share objects of different nature. The high-level management interface however, while guaranteeing ease of use, hides system implementation details and performance figures. In this work we have performed an experimental study about the performance of the cloud-to-user network for the Amazon S3 cloud-storage service, as it is perceived by a set of home users distributed all over the globe. Thanks to the dataset obtained leveraging the Bismark platform we report a general assessment of the performance of this service. We found that the US and EU cloud regions are able to offer better performance in terms of goodput (+45.5%, on average) even at a lower cost, although sometimes this choice leads to suboptimal performance. Enabling CF leads to an average performance improvement (+144.11%). However, a number of cases has been found for which relying on the CDN service is detrimental, generating up to a −43% performance decrement, even in presence of higher costs.

By incorporating all the parts, we can interpret what full stack was, how it has evolved and why has it evolved. The efficiency of workers can also be calculated and the approximation of time taken to complete a project, and finally people either see Full Sack Development to be dead or overrun. However, it can be seen from the pretext that it has been evolved and has been drastically optimized to meet the user's needs.

Bootstrap allows for rapid, responsive development that is consistent and well supported by the development and design community. As the framework continues to develop, the reasons to use Bootstrap keep mounting. If you've overlooked this framework, it's probably time to give it a try. As you can see, there are several benefits to using Bootstrap. The framework allows for rapid, responsive development that is consistent and well supported by the development and design community.

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