**Chapter 2: Survey of Technologies**

**Introduction:**

A web application is application software that runs on a web server, unlike computer-based software programs that are run locally on the operating system of the device. Web applications are accessed by the user through a web browser with an active network connection.

The following project at hand is made in regard with various web-based architectures and frameworks available for different programming languages. The Frameworks used are mainly those which offer server-side solutions to handling requests and are integrated with database if necessary. The languages used for the following projects differ with respect to individual projects, and are completely independent in regard with the server-based architecture that they run in. Hence, there are multiple programming languages used in this project along with differing frameworks and architectures.

In the following session we will see various frameworks and technologies that can be used for both front end and backend development.

**Front-End Development:**

Front-end web development is known as the client-side web development and is the practice of producing interactable interface for a website or web application, so that the user can see and interact with them directly. The challenge associated with front end development is that the tools and techniques used to create the front end of a website change constantly with the programming languages and frameworks that are used.

Let us see the languages used for the front-end development in this project.

Hyper Text Markup Language (HTML)

HTML is used extensively for the structuring of web pages. It helps with adding components such as tables, links, buttons, and content that is to be displayed using the specified tags. All websites and web applications make use of html file, even if html is not used directly while programming the interface.

Advantages:

* HTML is widely used.
* Every browser supports HTML Language.
* Easy to learn and use.
* HTML is light weighted and fast to load.
* Loose syntax (although, being too flexible won’t suit standards).
* HTML is easy enough to write
* HTML is that it is easy to code even for novice programmers.
* HTML is increasingly used for data storage as like XML syntax.
* Free – You need not buy any software.
* HTML is present in every window by default so you not need to buy the software which cost too much.
* HTML has many tag and attributes which can short your line of code.

Disadvantages:

* It cannot produce dynamic output alone, since it’s a static language.
* Making the structure of HTML documents becomes tough to understand.
* Errors can be costly.
* It can create only static and plain pages so if we’d like dynamic pages then HTML isn’t useful.
* Required to write a lot of code for just creating a simple webpage.
* We must check up the deprecated tags and confirm not to use them to appear because another language that works with HTML has replaced the first work of the tag, and hence the opposite language needs to be understood and learned.
* Security features offered by HTML are limited.
* If we need to write down long code for creating a webpage then it produces some complexity.
* HTML can create only static and plain pages so if we’d like dynamic pages then HTML isn’t useful.
* Security features are not good at HTML.

Cascading Style Sheets (CSS)

CSS is used along with html either internally or externally to make the website look more appealing to the users, and in turn makes the website user friendly. The layout as well as the colour and size of different html components can be easily manipulated using CSS. Bootstrap that is precompiled CSS code is also used to manipulate html components. Bootstrap based code is available on websites and can be added to our html using the class name for the given tag.

Advantages of CSS:

* It is less complex therefore the effort are significantly reduced.
* It helps to form spontaneous and consistent changes.
* CSS changes are device friendly. With people employing a batch of various range of smart devices to access websites over the web, there’s a requirement for responsive web design.
* It has the power for re-positioning. It helps us to determine the changes within the position of web elements who are there on the page.
* These bandwidth savings are substantial figures of insignificant tags that are indistinct from a mess of pages.
* Easy for the user to customize the online page
* It reduces the file transfer size.

Disadvantages of CSS:

* With CSS, what works with one browser might not always work with another. The web developers need to test for compatibility, running the program across multiple browsers.
* There exists a scarcity of security.
* Browser compatibility (some styles sheets are supported, and some are not).
* CSS works differently on different browsers. IE and Opera supports CSS as different logic.
* There might be cross-browser issues while using CSS.
* There are multiple levels which creates confusion for non-developers and beginners.

Java Script (JS)

JS is used for both front-end as well as backend development. This project also makes use of JS for the same. JS is used for front-end development mainly to handle client-side requests and interactions with the web page. It also helps with making the website more feature rich and enhances the user’s experience.

JS can be used to handle server-based requests and events such as rendering and fetching data from the user also since JS is used in almost all web apps it becomes an excellent language for backend development. We can also integrate JS to use different API’s and make the process of coding simpler for developers.

Advantages of JavaScript

* Speed. Client-side JavaScript is very fast because it can be run immediately within the client-side browser. Unless outside resources are required, JavaScript is unhindered by network calls to a backend server.
* Simplicity. JavaScript is relatively simple to learn and implement.
* Popularity. JavaScript is used everywhere on the web.
* Interoperability. JavaScript plays nicely with other languages and can be used in a huge variety of applications.
* Server Load. Being client-side reduces the demand on the website server.
* Gives the ability to create rich interfaces.

Disadvantages of JavaScript

* Client-Side Security. Because the code executes on the users’ computer, in some cases it can be exploited for malicious purposes. This is one reason some people choose to disable JavaScript.
* Browser Support. JavaScript is sometimes interpreted differently by different browsers. This makes it somewhat difficult to write cross-browser code.

React JS (R-JS)

React JS is an open-source frontend framework that is based on JavaScript, developed by Facebook, and best known for its virtual DOM feature. Virtual DOM helps with making the HTML and CSS part of the code easily modifiable and makes it easier for programmers to make changes to the website without having to physically change the already existing layout and design. The virtual DOM feature makes react a very viable and preferred choice for frontend development.

React has been recently used in many corporations as it is a very powerful tool as well as makes the process of making dynamic websites and web apps easier. React also is very secure and makes use of all the latest ES6 JS components.

Advantage of ReactJS

* Easy to Learn and Use
* Creating Dynamic Web Applications Becomes Easier
* Reusable Components
* Performance Enhancement
* The Support of Handy Tools
* Known to be SEO Friendly
* The Benefit of Having JavaScript Library
* Scope for Testing the Codes

Disadvantage of ReactJS

* The high pace of development
* Poor Documentation
* View Partition
* JSX as a barrier

Python Streamlit

Streamlit is a Python library-based framework that allows people to build frontend user interface for our machine learning and data science apps by writing all the code in Python. Beautiful user interface can easily be designed through numerous components from the library. It is mainly used in machine learning projects or projects that display graphical content.

Streamlit is extensively used for data science projects and hence the web apps that are using streamlit have an advantage in regard with the interface of the web app. Streamlit web apps have a certain level of abstraction that makes programming and developing apps very simple.

Streamlit's Features:

* Free and open source
* Build apps in a dozen lines of Python with a simple API
* No call-backs
* No hidden state
* Works with TensorFlow, Keras, PyTorch, Pandas, Numpy, Matplotlib, Seaborn, Altair, Plotly, Bokeh, Vega-Lite, and more

Angular JS

AngularJS is an open-source web application framework. It was originally developed in 2009 and is now maintained 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 must write. And it all happens within the browser, making it an ideal partner with any server technology.

Advantages of Angular:

* MVC Architecture implementation
* Enhanced Design Architecture
* Many supported Modules

Disadvantages of Angular:

* Limited SEO options
* Angular is verbose and complex
* Steep learning curve

**Back-End Development:**

Backend Development is also known as server-side development. It is everything that the users don't see and contains behind-the-scenes activities that occur when performing any action on a website. It focuses primarily on databases, backend logic, APIs, and Servers. Backend development languages handle the ‘behind-the-scenes’ functionality of web applications. It’s code that connects the web to a database, manages user connections, and powers the web application itself. Backend development works in tandem with the front end to deliver the final product to the end user.

Let us see the languages used for the back-end development.

PHP

PHP is a popular general-purpose scripting language that is especially suited to web development. Fast, flexible and pragmatic, PHP powers everything from your blog to the most popular websites in the world.

 Advantages:

* Most important advantage of PHP is that it’s open source and freed from cost. It is often downloaded anywhere and readily available to use for event of web applications.
* It is platform independent. PHP based applications can run on any OS like UNIX, Linux and windows.
* It has less learning curve because it is straightforward and straightforward to use. If a private knows C programming can easily work on PHP.
* It is more stable from a few years with assistance of providing continuous support to various versions.
* It helps in reusing an equivalent code and no got to write lengthy code and sophisticated structure for event of web applications.
* It helps in managing code easily.
* It has powerful library support to use various function modules for data representation.

Disadvantages:

* It is not that secure since it is open source, because the ASCII text file are often easily available.
* It is not suitable for giant content-based web applications.
* It has a weak type, which can cause incorrect data and knowledge to user.
* PHP frameworks got to learn to use PHP built-in functionalities to avoid writing additional code.
* Using more features of PHP framework and tools cause poor performance of online applications.
* reference documentation, there are easier programming languages for web apps.
* It’s highly tough to manage because, it’s not competent modular. It already imitates the features of Java language.

Python Flask

Flask is a popular Python web framework, meaning it is a third-party Python library used for developing web applications. Flask is a micro web framework written in Python. It is classified as a microframework because it does not require tools or libraries. It has no database abstraction layer, form validation, or any other components where pre-existing third-party libraries provide common functions.

There are many modules or frameworks which allows to build your webpage using python like bottle, Django, flask etc. But the real popular ones are Flask and Django. Django is easy to use as compared to Flask, but Flask provides you the versatility to program with.

**Various features of flask:**

* WSGI: Web Server Gateway Interface (WSGI) has been adopted as a standard for Python web application development. WSGI is a specification for a universal interface between the web server and the web applications.
* Werkzeug: It is a WSGI toolkit, which implements requests, response objects, and other utility functions. This enables building a web framework on top of it. The Flask framework uses Werkzeug as one of its bases.
* jinja2: jinja2 is a popular templating engine for Python. A web templating system combines a template with a certain data source to render dynamic web pages.

Django

Django is python-based Framework that is used to develop complete web-apps that includes front-end as well as back-end. For front-end you can use HTML, CSS, bootstrap, JavaScript. Great thing is that Django supports Jinja templates (if you are not aware of Jinja templates. Please Google…). With the help of Django, you can develop dynamic web-apps. As Python has tons of library with good readability and for the rest of the things Django is there to help you out. Another great thing is that you can develop REST API with the help of Django REST Framework and further that REST API can be consumed by any client-side apps, let it be web-app, android, or iOS app. So basically, REST API is used to serve common backend or business logic to every client-side app.

Advantages Of Django

* **Fast**: This has been designed in a way to help the developers make an application as fast as possible. From idea, production to release, Django helps in making it both cost effective and efficient. Thus, it becomes an ideal solution for developers having a primary focus on deadlines.
* **Fully Loaded**: It works in a way that includes dozens of extras to help with user authentication, site maps, content administration, RSS feeds and much more such things. These aspects help in carrying out the web development process completely.
* **Secure**: When you are doing it in Django, it is ensured that developers don’t commit any mistakes related to security. Some of the common mistakes include SQL injection, cross-site request forgery, clickjacking and cross-site scripting. To manage effectively usernames and passwords, the user authentication system is the key.
* **Scalable**: To meet the heaviest traffic demand, the benefits of Django framework can be seen. Therefore, the busiest sites use this medium to quickly meet the traffic demands.
* **Versatile**: Content management, scientific computing platforms, and even big organizations, all these aspects are very efficiently managed using Django.

Disadvantages of Django:

* Uses routing pattern specific to its URL
* Django is too monolithic
* Everything is based on Django ORM
* Components get deployed together
* Knowledge of full system is required to work.

Ruby on rails

Ruby on Rails is an open-source software used to build web applications. Rails is a framework used to create websites using the general-purpose programming language Ruby. Ruby ranks amongst the top ten programming languages predominantly because of the vogueishness of Rails.

As we know that most of the languages like Java, HTML, CSS, etc. do not cover the front end and back end. They either only for the back end or for the front end but Ruby on Rails is used for both front end back end, it is like a complete package to develop a web application.

Advantages of Ruby on Rails

* Tooling: Rails provides tooling that helps us to deliver more features in less time.
* Libraries: There’s a 3rd party module(gem) for just about anything we can think of.
* Code Quality: Ruby code quality significantly higher than PHP or NodeJS equivalents.
* Test Automation: The Ruby community is big into and test automation and testing.
* Large Community: Ruby is large in the community.
* Productivity: Ruby is incredibly fast from another language. Its productivity is high.

Disadvantages of Ruby on Rails

* Runtime Speed: The run time speed of Ruby on Rails is slow as compared to NodeJS and Golang.
* Lack of Flexibility: As we know that Ruby on Rails is ideal for standard web applications due to its hard dependency between components and models. But when it comes to adding unique functionality and customization in apps it is challenging.
* Boot Speed: The boot speed is also a drawback of ROR. Due to the dependence upon the number of gem dependencies and files, it takes some time to start which can obstruct the developer performance.
* Documentation: To find good documentation is hard for the less popular gems and for libraries that make heavy use of mixing.
* Multithreading: Ruby on Rails supports multithreading, but some IO libraries do not support multithreading because they keep hold of the global interpreter lock. So it means if you are not careful enough, your request will get queued up behind the active requests, and you will face performance issues.
* Active Record: Due to the access use of Active records in the ROR and hard dependency, the domain becomes tightly coupled to your persistence mechanism.

**Database languages, Integrations, and frameworks:**

Database Management Languages:

Database languages are used to read, update and store data in a database. There are several such languages that can be used for this purpose; one of them is SQL (Structured Query Language).

Types of DBMS languages:

* DQL (Data Query Language) is used to fetch the information from the database which is already stored there.
* DDL (Data Definition Language) is used to define table schemas.
* DCL (Data Control Language) is used for user & permission management. It controls the access to the database.
* DML (Data Manipulation Language) is used for inserting, updating and deleting data from the database.

Frameworks:

SQL Server

SQL Server is a relational database management system, or RDBMS, developed and marketed by Microsoft. SQL Server is built on top of SQL, a standard programming language for interacting with the relational databases. A database server is a computer program that provides database services to other programs or computers, as defined by the client-server model. Therefore, a SQL Server is a database server that implements the Structured Query Language (SQL). There are many different versions of Microsoft SQL Server, catering for different workloads and demands. A data centre version is tailored to higher levels of application support and scalability, while the Express version is a scaled down, free edition of the software.

Advantages

* Security Features Are Better
* Lower Cost of Ownership
* Optimized data storage
* Data recovery support

Oracle Database

Oracle database is an RDMS system from Oracle Corporation. The software is built around the relational database framework. It allows data objects to be accessed by users using SQL language. Oracle is a completely scalable RDBMS architecture which is widely used all over the world. Oracle is one of the biggest vendors in the IT market and the shorthand name of its flagship RDBMS product, that was formally called Oracle Database. The database allows you to rerun actual production workloads, including online user and batch workloads, in test environments. It can be used for read-write, reporting, testing, or backups, reducing the load on the primary database.

MySQL

MySQL was created by a Swedish company MySQL AB. The features are like support to cross-platform, stored procedures, triggers, cursors, data definition language, ACID compliance, SSL support, views updatable, partitioning, Indexing, select, commit grouping, Unicode support and many more. There are certain limitations in My SQL. In MySQL, Triggers are limited to only one action per timing. It means only one trigger can be executed on the table if any event happens on the table. Triggers cannot be defined on views as well. The other limitation is MySQL does not follow the full SQL standards. MySQL uses the ‘mysqldump’ backup tool, which supports backing up of data from all the storage engines. The other MySQL back up software program is ‘XtraBackup’, which is open source. MySQL can be run on Cloud as well as Amazon and Microsoft Azure. MySQL can be used as a service.

PostgreSQL

PostgreSQL is a powerful, open-source object-relational database system. It is free and open-source relational database management system, maintained by PostgreSQL Global Development Group and its prolific community. PostgreSQL seems to be more universal. It is widely available on multiple operating systems: FreeBSD, HP-UX, Linux, NetBSD, OpenBSD, OS X, Solaris, Unix, Windows. PostgreSQL has user-defined functions in proprietary language PL/pgSQL or with common languages like Perl, Python, Tcl etc. PostgreSQL can be driven entirely from the command line. PostgreSQL has a better concurrency management system. It handles very well the case where multiple processes can access and modify shared data at the same time

**Technologies used in this project:**

We will discuss all the programming languages and web frameworks used in this project in detail in the following section. We get to see all these languages and frameworks being used in different parts of the individual projects in this infographics project. Also, we will look at how these languages work with respect to keeping the project fragmented and independently working with the server that they communicate with.

Frontend technologies used in this project:

This project uses html in almost all the web apps that have been created, as most of the browsers support html syntax and it is easy to modify and work with. Some projects don’t need html as the underlying frameworks such as streamlit, which takes care of the html components by itself. It also uses CSS everywhere where html components have been used and makes use of bootstrap as well for the designing. The project uses JS for the crypto-graph web app and for the landing site. JS has been used for both server-side event handling as well as for loading data from API. It uses react mainly for the covid tracker web app as well as the news web app. Python streamlit is used for stocks as well as the bioinformatics web application.

Backend technologies used in this project:

The landing site and the cryptograph web app uses php for server-based functionality and integrations. This project uses Flask framework for almost all the web apps that are made in python. The project also implements different integrations using the Flask framework such as database integration and smtp request handling. Some projects use JS, react and Streamlit for backend as well.

This project uses SQLite for the database. SQL is a simple query language that helps to store and retrieve information in and from tables using English based queries written. Since this project is for infographics, it mainly uses the database connection to store data from the user.