ReactJS: A Comprehensive Analysis of its features, Performance, and Suitability for Modern Web Development

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Abstrac*t* - ReactJS is an open-source technology used to create UIs specifically for single-page apps. Software developers may create large-scale web applications with ReactJS that can consume data and alter over time without refreshing the page. React utilizes a clever diffing computation in this manner to only recover in its DOM hub the data that needs to be retrieved while keeping the rest with no assurances. Our application may be built easily thanks to the use of reusable components. Reacts amazing design also makes UI arrangements predictable and relieves programmers of a significant burden, allowing them to concentrate on bigger goals and business thinking. Respond doesn't compel the use of a specific way to carry out a given task, either. Customers may pick from a wide range of libraries to play out a certain task thanks to this service. The ordering of events that are called during a segment's lifespan is handled by lifecycle strategies and react hooks, two additional important features. The ReactJS system's many strengths are discussed in this article, along with how these strengths are applied when creating applications. It also goes through a few of the terms that are used the most frequently, how to use them, and how to incorporate them into our program.

Keywords - *ReactJS*, Components, Architecture, Lightweight DOM, Virtual DOM, JSX, Performance, One Way Data Flow, Pro's and Con's

1. INTRODUCTION

Angular was the lone and leading challenger in the JS framework market before React entered the scene. Although Angular was a comprehensive and proper framework, developers found it to be incredibly challenging because it required a lot of writing. Even seasoned JavaScript programmers struggled with the coding process and looked for alternatives to their problems. It was never the best practice to create JS applications with AngularJS. It has additional features that the majority of developers did not need.

React JS is a JavaScript library that is free to use and was created to help create user interfaces for websites. Jordan Walke, a software engineer at Facebook, created the open-source React JS JavaScript framework in 2011, although it wasn't made available to the general public until May 2013. Giving users the best rendering performance is React JS's main goal. The emphasis on distinct elements is what gives it its power. Developers find it simple to create sophisticated user interfaces when they use reusable components. Model-View-Controller (M-V-C) model's View component is integrated with React JS. In order to make data binding simpler than before, React JS introduces a one-way data flow. React employs a virtual DOM and provides simpler programming with quicker execution.

To assist in the development of website user interfaces, the React JS JavaScript library was developed. React JS JavaScript framework was developed by Facebook software developer Jordan Walke in 2011, but it wasn't made publicly available until May 2013. The fundamental purpose of React JS is to provide users with the highest rendering performance. What gives it its potency is the concentration on distinctive components. When using reusable components, developers find it easy to build complex user interfaces. React JS is connected with the Model-View-Controller (M-V-C) model's View component. React JS adds a one-way data flow to make data binding easier than it was previously. React makes use of a virtual DOM and offers easier programming with faster execution.

FEATURES

A. *Lightweight DOM for Better Performance*

One may rapidly become accustomed to the structure thanks to ReactJS's simple and uncomplicated nature. Numerous strong highlights include React. The finest aspect of React is certainly its readability. Even those who are unfamiliar with it may understand it efficiently React accomplishes definitely the opposite of other systems, which obviates the need to understand the fundamentals of the language while requiring extensive knowledge of the structure itself. Therefore, basic levels of skill inside the system may unquestionably be improved without any obstacles or complications.

B. *JSX*

HTML and JavaScript are combined to create JSX. HTML elements allow for the insertion of JavaScript objects. Because browsers do not support JSX, the code is trans-compiled by the Babel translator into JavaScript code. Codes become clear and simple thanks to JSX. Knowing HTML and JavaScript makes learning it simple.

C. Performance

As we previously explained, react updates just the updated portions of the DOM using virtual DOM. This thereby speeds up the DOM. Because DOM runs in memory, we can design distinct components, which speeds up DOM execution.

D. One-Way Data Flow

As the name suggests, one-way data binding is a one-direction flow. In the react programming language, the data is transferred from top to bottom, or from parent components to child components. The child component's properties (props) cannot return data to its parent component, but they can communicate with the parent components to change the states in accordance with the inputs given. This is how one-way data binding operates. This keeps things quick and modular.

E. Virtual DOM

The document object model is commonly referred to as DOM. Due to the fact that it separates into modules and runs the code, it is the most crucial component of the web. JavaScript Frameworks typically update the entire DOM all at once, which slows down the online application. However, react employs virtual DOM, a perfect replica of actual DOM. The entire virtual DOM is updated initially whenever there is a change to the web application in order to determine the difference between the real DOM and virtual DOM. When it does, DOM updates only the portion that has recently changed, leaving the rest unchanged.

APPLICATION OF REACTJS

A. Creation of dynamic application with ease

Developers may more easily construct dynamic web apps with React JS since it requires less coding and has greater capabilities.

B. Open-sourced library

React JS is the fastest-emerging JS library among the communities and organizations of front-end developers, and one of the reasons for this is that it is a JavaScript open-sourced library.

C. Use of reusable components

Components are the core of React JS. Any React JS application relies heavily on its components. Application development times might be sped up by the presence of several reusable components.

D. Easy Debugging tool

Facebook published a Chrome addon to help with react application debugging, which makes the process quicker overall. The open-source JavaScript library has a Chrome addon called React Developer Tool.

E. Backed by a large development community.

One of the top firms using React JS in their online apps is Facebook, which created and published the framework. Other notable users of the framework include Instagram, Reddit, and Netflix.

2 RESULTS / LITERATURE REVIEW
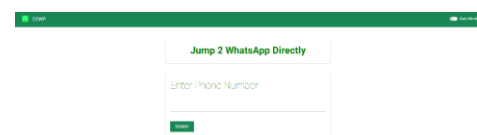
A. Direct 2 Whatsapp

Fig 1: Direct 2 WhatsApp

About the Project: Using our own React and CSS components, we completely rebuilt this app from the ground up. This program was created in response to a real-world issue, which is that users must first store contacts before they can send messages over WhatsApp. Therefore, the user of this app may immediately input the number, and transmit app will jump to WhatsApp to that contact accordingly. It also has a dark mode that the user can toggle on or off and even store to local storage, all of which enable the user to use this program away from home.

Repository Link: https://parekhkunal.github.io/d2Wp

B. Notes

Fig 2: Notes

About the Project: This app is built from scratch writing our own CSS and react components. We have added cool features like adding a character count when the user types, we also added a search bar that lets the user search for a note we will add dark mode they can toggle on or off and even save to local storage so that user can use this app in real life.

Repository Link: https:/parekhkunal.github.io/Notes

C. Cheat Chat (Web Chat App)

Fig 3: Cheat Chat App

About Project: The project is an example of a web chat app. The main purpose of this project is to provide multi-user chatting functionality through the network/cloud. It is made up o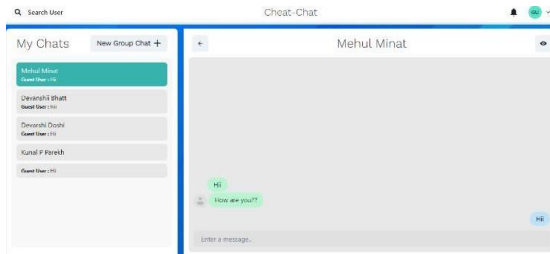f applications - the client application which runs on the user's mobile and the server application which runs on any pc on the network. To start chatting our clients should get connected to a server where they can do Group and private chatting. Client Server Architecture has been implemented in this project.

Tools Used: Postman, MongoDB Cloud DB, Heroku, VM on Azure, Nginx Server

Technology: MERN (MongoDB, Express, React, NodeJS), Bootstrap, ChakraUI

Live URL: https://mern-cheat-chat.herokuapp.com/

Year	Author	Title	Paper Overview
2022	Iida Kainu	Optimization in ReactJs	This study explores the strategies, approaches, and resources available in the React.js ecosystem for enhancing online application performance.
2021	Anal Roy	React Js for web developer	The objective of this paper was to create and study various technologies created by various open-source groups.
2021	Vijaykumar Pawara, Poonam Potrajeb, Sunny Paththarwalac, Himanshu Vermad, Akshay Yadave	Travel booking system using react.js	The aim behind our system is to provide a perfect travel framework in which clients may book their rooms according to their budget utilizing a system created using the React framework.
2021	Kowalczyk, Joanna	Analysis of React.js library and its popularity	The article provides a description of the React.js library, along with an analysis of its key ideas, syntax, and assets. The history of web development is considered, demonstrating the areas where React.js is most useful.
2020	Archana Bhalla, Shivangi Garg, Priyangi Singh	Present Day Web Application with ReactJs	The fundamental introduction, DOM, JSX, one-way date flow, etc. are provided in this work.
2020	Mohit Thakkar	Introducing React.js	But there is a much more effective method to begin a React project. To get started, we'll utilize the react node module "create- react-app."
2019	Stuart Boaler	ReactJS a Viable Career Option?	The conclusion is that ReactJS will continue to play a significant role in the market for the foreseeable future due to its cross-platform development capabilities and ease of use.
2019	Hung Thanh Lay	Developing a Web Application with ReactJS	Because React is open-source, there are no restrictions on its uses. As stated on Reacts home page, react makes it simple to

Table I: Literature Summary

3. METHODS

A. Installation

On a variety of operating systems, including Macintosh, Windows, Unix, etc., React JS may be installed. Any React JS application must be developed on a platform like Node JS & NPM.

Installing Node JS and the NPM package manager is possible using the following link: https://nodejs.org/en/download/.

The following are a few steps to install and develop a React application, taking into account the most recent version of React JS, 17.0.2, which was published on March 22, 2021:

a. Launch the command prompt to install React. npm install create-react-app is the command we use.

b. To build a ReactJS project, use the npx create-react-app command (application name here)

c. Lastly, we use the npm start command to start the project.

The program is executed at the default server, http://localhost:3000, by the package manager NPM.

4. RELATED WORK

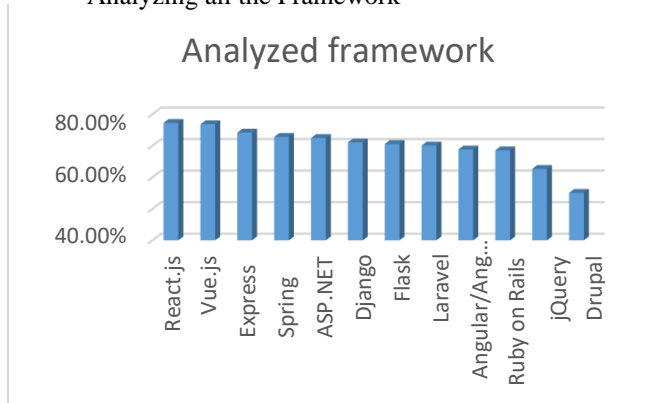Analyzing all the Framework

Fig 3: Analyzed framework

Keep your text and graphic files separate until after the text has been formatted and styled. Do not use hard tabs, and limit use of hard returns to only one return at the end of a paragraph. Do not add any kind of pagination anywhere in the paper. Do not number text heads-the template will do that for you.

Pro's & Con's

A. Easy to Learn

ReactJS is a JavaScript library backed by Facebook. It is released as an open source library, and being open source, any developer can create training, tutorials for it which are helpful to other new developer who ever making their learning curve easier. Developer who are well versed with JavaScript and have used any of their frame work / library they usually get grip over React in few days as compared to a complete beginner Since it is open source, more community is engaged with it, supply of developers is sufficient enough. Hence HR

Manager, Business Hirer don't have tough time to find developer to get their work done. As mentioned, react is an open-source library, improvements are made consistently by the community it is backed by, so developers need to stay up-to-date on the latest improvements.

B. Virtual Dom

Real or standard DOM (Document Object Model) constructs have the downside of rewriting the entire DOM tree when they process modifications. DOM trees on trendy, interactive websites and applications are dense and complicated. Standard DOM must rewrite the entire page whenever inputs or queries are made, which in turn slow down performance, use up memory and also count to new work bandwidth cycle for resources.

The virtual DOM operates much more quickly, is substantially more productive, and eventually results in a superior User Interface. A virtual DOM just updates the element or component that is being changed, as opposed to rewriting the complete DOM tree each time a user makes a modification. Let's say, for reference, that your checklist contains ten items. Once one item on the list is checked, a real DOM will rewrite and re-render the entire ten-item list. Instead of rewriting the entire list, a virtual DOM simply changes the one item that was checked and update the state of that component only.

You can see how a virtual DOM construct would be far more effective at producing a high-performing User Interface than standard DOM given that interactive websites are significantly more sophisticated than basic lists. ReactJS's virtual DOM is primarily responsible for this JavaScript framework's ability to build fast and responsive user interfaces.

C. Reusable Component

Writing and maintain large scale projects is time - consuming as well as tedious task. Because modifications to one code component would affect all copies of that component, developers have historically been unable to reuse code components effectively.

The advantages of design reuse are not always relevant to programming and web development projects. A component's copy elsewhere may be impacted by minor modifications made to one instance. To overcome this ReactJS isolates all components. This in turn updates or modifies to one instance of a component and don't affect all other instances of that component. React enables developers to efficiently reuse design components, saving them time and improving the accuracy of their code and hence making them more productive.

D. One Way Data Flow

JavaScript frameworks have multi-directional data flows, which means that changes in one element can affect the data of another. This issue can lead to unstable code. One of the main reasons why this issue is considered a threat is that it can affect the larger parent element.

ReactJS makes this issue simpler by associating all data with downward motion. Changes to the child elements cannot impact the parent data in this structural architecture. As a result, developers have better control over complicated and large-scale projects and the resulting code is more stable and durable.

E. SEO Friendly

For business owners, search ranking is a vital component of site creation. In order t attract users and drive business goals the websites need to perform well in organic search results on all major search engines and must have low latency while fetching and serving content. Projects that use JavaScript extensively, they face issue of not getting index as search engines face difficulty in crawling them. And this is major issue brought to front by ReactJS helps to solve the issue of heavy JavaScript website and make them enough readable by Google and other search engines. Still for those who have concern about reach and everything. They Use Google search console to check how google crawls their website. Light house audits can also give some rough idea about it.

While making your web app more discoverable for users around the world requires that you rank your React apps on search consoles like Google. JavaScript pages are not as easily indexed by Google and other crawlers as static HTML pages are. React supports server-side rendering, which helps crawlers because they can easily crawl content and don't have to wait for all other JavaScript file dependencies to load. This hence leads to faster crawling and indexing.

F. Scope of Testing Code

The key to utilizing the TDD (Test Driven Development) with React is choosing the appropriate toolset and framework for testing, whether you're performing unit testing, integration testing, or end-to-end testing. Testing React applications is quite simple. al scope It provides a environmental scope where programmers can test and debug their codes using native tools offered.

G. Tools that can be used are

    a) *Jest*

    b) Enzyme

    c) Chai-enzyme

    d) React-testing-library

    e) React-hooks-testing-library

    f) Majestic

    g) React-unit

    h) Ui-harness

    i) Carte-blanche

    j) Unexpected-react Redux-test-recorder

The key to developing a seamless yet adaptable workflow that can change as you upgrade, extend, and modify your code is to combine the appropriate testing framework (like Jest, etc.) with the appropriate assertion/manipulation libraries (like Enzyme, etc.). Additionally, by essentially isolating components from their projects, you raise the bar for modularity and TDD.

H. Ability creating cross-platform products

This is an important consideration when talking to clients, especially small businesses, who wish to develop cross- platform solutions. We can easily build web apps with React, but we also have React-Native, which allows us to write code in React with the same syntax as for web. The changes are to made for mobile specific components only that too in syntax used in react web app. Because the client only requires React engineers, he saves a lot of money by not having to recruit several different types of developers, i.e. Android and iOS.

Complete SSR/SSG Framework

SSR - Server-Side Rendering

SSG - Server-Side Generator

Many technologies in the programming industry are based on React. Among all of these things, there are frameworks that enable us to create React applications that are either rendered by a server or just produce HTML files using React. Among all of these things, there are frameworks that enable us to create React applications that are either rendered by a server or just produce HTML files using React. Gatsby is an SSG example that makes creating quick and SEO-friendly websites with React. Next.js another JS framework using which in addition to SSG provides facility to generate pages rendered in React by the server, which helps to create dynamic and SEO-friendly web apps.

Con's

A. JSX

While some developers view the JSX syntax extension to be a benefit to React, yet there exist developers in who believe it to be a drawback. The JSX code is too complex and challenging for new developers and web designers to understand.

JSX is a challenge for many beginning developers in learning ReactJS. Although some developers may find this to be a drawback, it is vital to remember that JSX also has advantages and helps shield the code from other injections intoit.

The main issue with JSX is how challenging it is. ReactJS's performance and user interface capabilities are unaffected by JSX. This drawback is resembling to more of a personal taste.

Actually, using Babel for trans-compiling improves code readability.

B. Learning curve

Although opinions among developers on this matter are mixed, it is reasonable to conclude that React.js is a challenging language to master for React.js beginners. Before employing React in their projects, aspirants who wish to learn how to code will need to develop other coding abilities. As React uses JSX, which requires a strong foundational knowledge in HTML and JavaScript. In addition to it having good about CSS is also required.

C. Verbose Code.

With React, developers have complete freedom in selecting their method and approach. Despite being primarily viewed as a benefit, it can sometimes be a serious restriction. There is no explicit development roadmap for web apps in React. Due to the lack of restrictions or rigid guidelines on how to carry out a specific task, the proficiency of developers will directly affect the outcome of your React project. It can be challenging to transfer a project from one firm to another or switch the development team if the teams have different perspectives on the same issue.

D. Based on 3rd party libraries

It has both a benefit and a drawback. o official libraries are available to handle typical aspects in frontend applications, such as routing, http requests, etc., and React is "simply a JS Library." Being free to choose the finest tools for your purposes and being a knowledgeable JS developer give you an advantage. Additionally, the fact that React doesn't come with many basic tools is a drawback. You could encounter React versions conflicts between the latest library version and your React app version even if you only utilize the most widely used and popular libraries (it is mostly about legacy apps).

The third-party libraries that are maintained by single contributing organization may also need to be updated if you want to keep your app up to date with the React version. While React has excellent backwards compatibility, some libraries—even those that are extremely well-liked—might undergo breaking changes.

E. Development Pace

ReactJS is always developing and evolving. Depending on who you are, you can consider Reacts development velocity as a benefit or a drawback. React is continually being enhanced, according to developers who regard this surge in development as a benefit. This makes their work easier. The developers who view the rapid rate of development as a drawback contend that it is challenging to keep up with because they continually have to learn how to deal with ReactJS.

One notable drawback of ReactJS is its rapid development, but it should be emphasized that Reacts core API has become much more reliable in recent years. Today, most upgrades concern the library and fresh features. Some developers are uncomfortable attempting to keep up with new innovations and are not pleased with the rate of change. Even if it's typical to say that React evolves too quickly, it's crucial to remember that new innovations enhance the framework and help it function at a higher level.

F. Documentation

The criticisms regarding Reacts development pace are related to this drawback. Due to the quick development, there may not be enough instructional resources and documentation to cover the most recent revisions.

Developers can generate their own support papers for ReactJS because it is an open-source framework, however since anybody can produce these resources, you might find subpar ones that provide little assistance.

Once again, your situation and your perspective on creativity and development will determine this drawback of React. Does appropriate documentation sometimes fall behind React's rapid development? Yes. But I tend to think that progress is good, particularly when it comes to developing dynamic online and UI experiences. For many of the queries or problems you could encounter while using React, you can find user-created support resources.

5. ARCHITECTURE

A. React Virtual DOM

One of React JS's key components is the virtual DOM (Virtual document object model). It is quite comparable to the DOM created by the browser; the only distinction is that the latter is kept in memory. When changes to the page's content are required, they are first reflected to the virtual DOM that is stored in memory. A diff () algorithm then compares the two DOMs, the virtual DOM and the browser DOM, and any changes are then reflected to the program's own DOM rather than having to refresh the entire DOM. This simply offers the programmer a huge boost when significant data updates need to be done.

B. One Way Data flow

Data flow, or downstream, is permitted and facilitated by the design of React JS. In an application, unidirectional flow makes sure that data only travels in one way at a time, giving states and models more control over one another. A less complicated and more comprehensible application architecture is another benefit of unidirectional flow. There are no cascade modifications or updates made in the view section.

C. React components

Small UI (User Interface) pieces known as components give the view data that can vary over time. Together, these reusable parts form the application's whole user interface (UI). Developers may divide UI into different elements and create UI in the most efficient way by using components. Similar to JavaScript functions, they carry out the same purpose using several environments and methodologies. They receive input known as props and then output.

D. JSX Syntax

JavaScript XML is what it stands for. In JavaScript, it is an a- syntax extension. For the creation of user interfaces, React JS and JSX are suggested pairings. Since the source code for JSX is converted to JavaScript, it produces an extremely efficient output, making JSX quicker, safer, and simpler. The quality of an application produced with JSX is significantly greater than an equal piece of code written in JavaScript.

6. CONCLUSION

All three frameworks—Angular, React, and Vue—are actively being developed. They maintain the current versions while releasing new ones frequently. You can utilize any of these frameworks with confidence because of the high level of support that each one currently enjoys. While Vue is a newer development, it already looks to be spreading considerably, in contrast to Angular, which is not growing as swiftly as it formerly did. Since each project is supported by a fantastic community and is continually changing, it is impossible for us to anticipate which frameworks will be useful in the long run. It was my intention to clarify the architectural distinctions, analyses the advantages and disadvantages of each framework, and, where appropriate, compare them in this essay. There are a few things to take into account before beginning a new framework. The first thing to consider when selecting a new technology is the experience of your employees. The talent in your area must also be taken into account if you want to hire developers for your project. Finally, the project's complexity and scale can have an impact on the framework you choose.
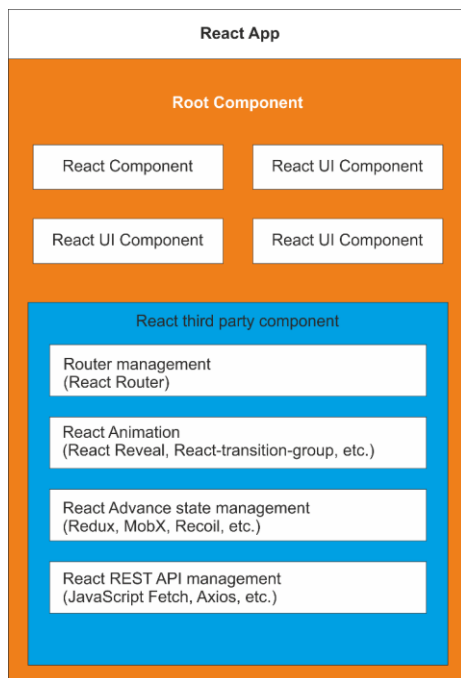

Fig 4: Architecture

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