



# MERN Stack – Based Social Media Web App: A Comparative Study on Performance and User Experience

<sup>1</sup>Ashish Das, <sup>2</sup>Ashika Jaiswal, <sup>3</sup>Ananya Maitra, <sup>4</sup>Neeraj Kumar Jha, <sup>5</sup>Mohit Kumar Jha

<sup>1</sup>Assistant Professor, <sup>2</sup>Student, <sup>3</sup>Student, <sup>4</sup>Student, <sup>5</sup>Student

<sup>1</sup>Computer Science & Engineering

<sup>1</sup>Durgapur Institute of Advanced Technology and Management, Durgapur, India

**Abstract:** The summary provided describes a full-stack responsive social media application built using the MERN stack (MongoDB, Express.js, React, and Node.js). The application follows a three-layered architecture and includes unit tests for each layer. The application offers user registration with comprehensive validation, including the ability to upload a user image for their profile. Users can register, sign in using their email and password, and access a clean and user-friendly home page with various widgets. The user profile details are displayed, and the current user can create, edit, and delete posts, as well as add images to their posts. Users can view a news feed of all posts, like and dislike posts, and view comments. Friend functionality is provided, allowing users to add and remove friends, view their friends' profiles, and write posts for other users. The application supports a light and dark mode, and it is fully responsive, ensuring optimal user experience on different screen sizes. The frontend utilises React as the framework, React Router for navigation, Formik and Yup for form and validation, Redux Toolkit for state management with Redux Persist for local storage, and React Dropzone for image uploads. On the backend, Node.js serves as the runtime environment, while Express.js acts as the backend framework. MongoDB is used as the database, and Mongoose is employed for managing database operations. Authentication is handled using JSON Web Tokens (JWT), and Multer is used for file uploading. Middleware is implemented to authenticate HTTP requests before sending them to the server. The frontend is built using HTML, CSS, and JavaScript, with extensive use of Bootstrap templates. On the backend, Node.js and its packages, such as Express.js and JWT, are employed, and Mongoose is used to write more readable code.

**IndexTerms – MERN Stack, React Router, Formik, JWT, Dropzone, Authentication.**

## INTRODUCTION

It is a full stack responsive social media application using MERN stack that implements CRUD operations based on the three-layered architecture. Programs at each layer have their own unit test. The social media application consists of a register page with complete validation along with functionality to upload a user image for their profile. Any user can register and can then use the registered email address and password to sign in. The home page has a very clean UI with a number of different widgets. There is also a box that shows the complete user profile details. The current user that's signed in will be able to make posts as well as add an image for the post. They can edit, delete and actually make the post. They can also see the user's news feed of all the posts that have been created. The users can also actually like and dislike any posts that they want. They can view the comments as well. They can add a friend if they would like and the friend list will be updated over. The users can add any number of friends and can remove them if we want to. They can also view the profiles of other users and can see the other person's friends. The person also has the ability to write a post for another user and then can see their user post as well. We can change from light mode to dark mode and vice versa and more importantly everything is going to be completely fully responsive so the user can see the exact same website on smaller screens with modified adjustments for everything most importantly. Everything on the frontend, all the information comes from backend APIs which are retrieving information from the databases (MongoDB). The project is done on the MERN stack which includes Mongo database, Express.js, React and Node. Specifically for the front end, React is used as a framework. React router for navigation. Formic and YUP for form and form validation. Redux toolkit for state management with Redux Persist to store in local storage and React Dropzone for image uploads.

For the back end, Node.js is used as the runtime environment. Express.js as the backend framework. Mongoose for managing the database. JSON Web Token (JWT) for authentication and Multer for file uploading. There is also an implementation of middleware that authenticates the http request before sending it to the server. Front-end of the website is made using html, CSS, JavaScript. Bootstrap templates are used extensively. For the back-end we are using nodejs and its packages such as Express js, JWT (for authentication and security). Its library Mongoose is used to write more readable code

## SYSTEM OVERVIEW

To create testable, structured, clean and maintainable web applications by using industrial best practices. To apply the knowledge about the technologies thought to us thus far and gain practical experience. To apply industrial best practices and create a fast, scalable and secure web application. To learn and apply the knowledge of front-end development in real life projects and to understand the in-depth working of MERN Stack applications.

## RESEARCH METHODOLOGY

The front-end of this website is developed exclusively using React js. Material-ui is used for styling instead of plain CSS. This combination allows faster development and scalability. Each component can be developed simultaneously and error in one component won't affect other components. The project is done on the MERN stack which includes Mongo database, Express.js, React and Node. Specifically for the front end, React is used as a framework. React router for navigation. Formic and YUP for form and form validation. Redux toolkit for state management with Redux Persist to store in local storage and React Dropzone for image uploads.

For the back end, Node.js is used as the runtime environment. Express.js as the backend framework. Mongoose for managing the database. JSON Web Token (JWT) for authentication and Multer for file uploading. We have used Express js for making APIs and MongoDB as a database. Mongoose is a framework for MongoDB and Express Js.

Executing HTTP requests is React's responsibility. They can set up dynamic data downloads in this way without having to reload the website. This makes the website significantly faster than usual.

Full-stack developers are in greater demand than ever before in the modern world. The biggest demand is accompanied by an amazing average income of \$110,770 in the US, according to a poll conducted by Indeed. [1] A person who is technically capable of working on the front-end and back-end development of a dynamic website or web-based apps is referred to as a "full-stack developer."

The foundations of the modern commercial internet were laid in 1990. Tim Berners-Lee developed the fundamental ideas of the World Wide Web as well as other tools for effective web usage at the end of 1990.

These include the Hyper Text Transfer Protocol (HTTP), the Hyper Text Markup Language (HTML), the first web browser and code editor, the first web server, and the first web page that introduced the concept of the world wide web as well as a technique for creating one's own web page [8]. Since 1990, the internet has rapidly developed, and four generations of development may be identified [11]. Users could only browse web material on the first generation's static, infrequently updated web sites.

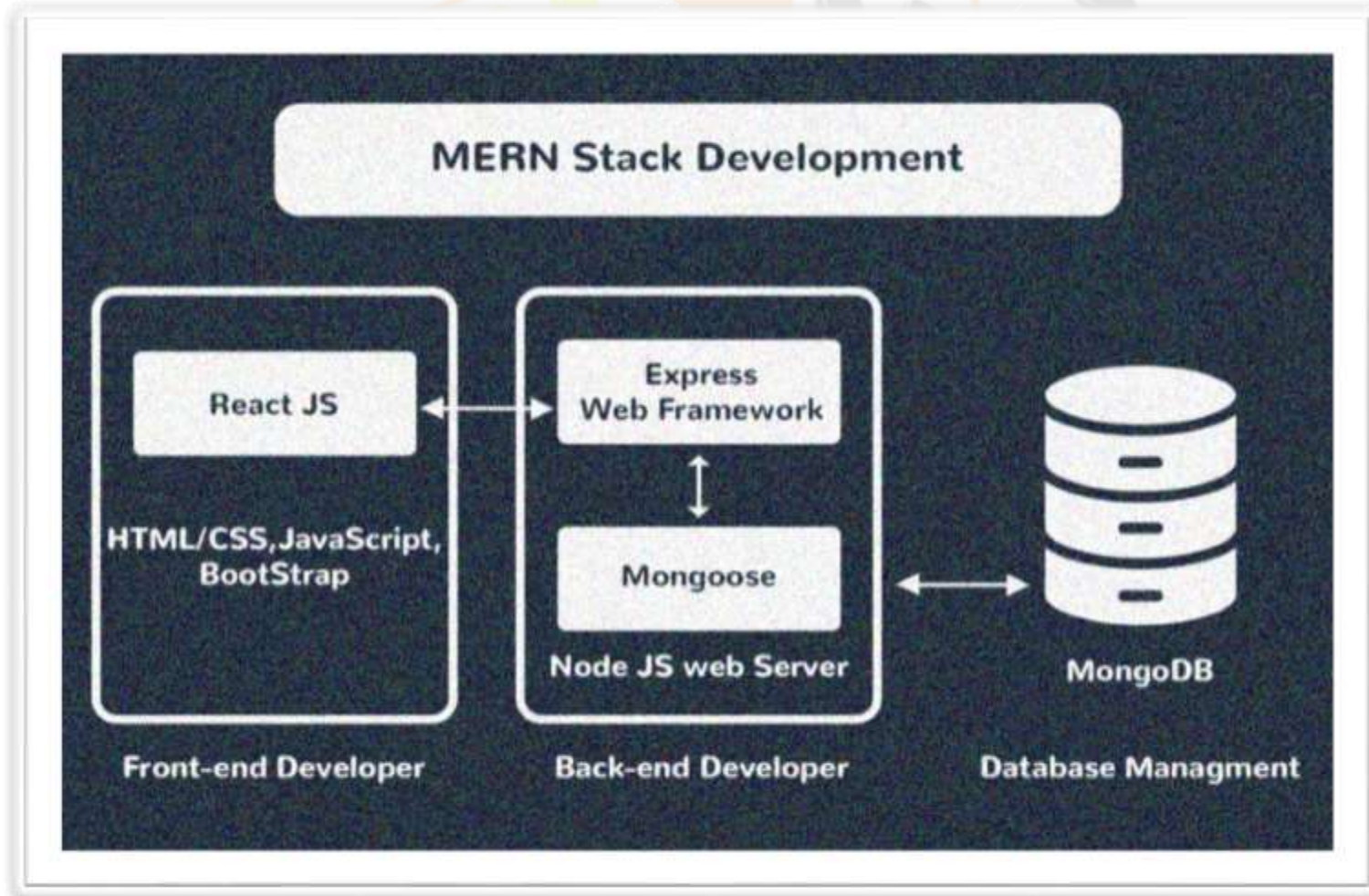


Figure: Methodology diagram

The basic tenet was to read just the web. All web sites were created using HTML, and HTTP was the primary communication mechanism [11]. Beginning in 2004, the second generation is characterised by phrases like diverse social networks, blogs, the ability for users to create web page contents, and improvements to the user experience when navigating web interfaces. Famous social

networks like Facebook, Twitter, LinkedIn, and others have emerged throughout that time. These social networks allowed user connection on a worldwide scale. New technologies that enable the presentation and delivery of web services without issues with web distribution also emerged at that time, including JavaScript, Document Object Model (DOM), Ajax, Cascading Style Sheets (CSS), eXtensible HTML (XHTML), eXtensible Markup Language (XML), eXtensible Stylesheet Language (XSL), and Flash. 2010 marks the beginning of the third web generation, which is characterised by the semantic web (which adds semantics to the web), content personalisation, intelligent search, and computers' ability to create a variety of material. Ontologies are employed in the representation and justification of meaning. In addition to ontologies, technologies like Web Ontology Language (OWL), Resource Description Framework (RDF), and others are employed in the third generation of the web.

People could be able to refer to Internet 4.0 as the active web for the fourth generation. The usage of search engines is still essential in the present web 3.0, which provides us with knowledge in its most comprehensive online applications that we may utilise as needed. In contrast, Web 4.0 will be different. While completely developed, it won't require many of the processes that are required while using web 3.0, making use of it simpler and more undetectable. The LAMP stack, which consists of Linux, Apache, MySQL, PHP or Perl, and Java (Java EE, Spring), which includes a variety of programming languages, was the major foundation for web development in the past. With the advent of the MERN stack, JavaScript facilitates web development by having the ability to operate on both the client-and server-side. There are four main technologies in the stack: MongoDB, Express.js, React.js, and Node.js. Studying the nature of each component in the stack and developing a social platform that can link individuals were the main objectives of this project. The outcome is a platform that has sufficient features to demonstrate the connections of each of the components in the MERN stack.

The goal of the project is to implement the fundamental elements of the MERN Stack [4,6] technology, including MongoDB, Express JS, ReactJS, and NodeJS platform. Using the fundamental features of an e-commerce web application, such as sign-up and sign-in, dashboard display, and product and shop category display, building a web application with a payment gateway and product stores using MERN Stack technology. Implement website administration tools including user management, store management, analytics, and reporting. The user interface of a web page is referred to as web design. Design is the global language of the visual world. The design's primary objective is to focus on the content so that consumers can access and use it with ease [15]. Web design has undergone significant change as a result of various technological advancements and fashion trends. From the first web generation, which displayed contents using a straightforward text page, to the second generation, which used lots of graphics and vibrant colours to create memorable web pages, and finally to the simple and user-friendly web design we see today. The design and content of a website should always be current. Node.js is a system application, a server environment, and it is open source. Using the NodeJS platform, which was independently developed using JavaScript from Chrome, we can create network apps rapidly and easily. To run the code, use the JavaScript engine on Google. Additionally, a significant portion of necessary modules are written in JavaScript.

Node.js includes a built-in framework that enables programmes to act as Web Servers similar to Apache HTTP Server. Express.js A framework developed over NodeJS is called Express.js. It offers a wide range of cutting-edge features for web and mobile development. Because HTTP is supported by Express.js, the API is incredibly robust, dependable, and simple to use. Without slowing down NodeJS, Express adds more tools for developers that aid in creating a better programming environment [6]. The most popular NoSQL [6] database today, MongoDB, is free source and used by thousands of users. It was created using one of today's most widely used programming languages. Additionally, MongoDB is a cross-platform data store that utilises the notions of Documents and Collections, offering great performance with high availability and flexibility in terms of extension. Since this database was created using the JavaScript Framework and the JSON data type, it is a source database format that does not utilise Transact-SQL to access data [7]. With its introduction, it has been able to improve operating speed and functionality while overcoming the drawbacks of the RDBMS relational database management system concept.

Additionally, MongoDB is a cross-platform database that uses a collection- and document-based strategy to create sharp output, enormous availability, and simple scalability [11]. A scripting, object-oriented, and cross-platform programming language is JavaScript. Host environment objects can be linked to JavaScript and set up in a way that makes it operable. JavaScript includes common libraries like Array, Date, Math, and the core elements of programming languages including managers, control framework, and statements objects. React is built around components. A component can be created by creating a Class function of the React object, the starting point of accessing this library. ReactJS creates HTML tags unlike we normally write but uses Component to wrap HTML tags into objects to render. Among React Components, render function is the most important.[9] It is a function that 104 International Journal for Modern Trends in Science and Technology handles the generation of HTML tags as well as a demonstration of the ability to process via Virtual-DOM. The web application will develop and function more effectively with more research and understanding of new technologies, frameworks, and testing tools. Web development employing various technologies would be beneficial to many businesses in India and throughout the world in the future since it fosters a digital ecosystem and makes doing business easier for everyone.

## Architecture Design

MERN, or MongoDB, Express, React, and Node.js, are acronyms. With MongoDB as the database, React.js is a web client library, Express.js is a web server framework, and Node.js is a server-side platform. It enables programmers to create Web applications that only use full-stack JavaScript.

Since MERN combines four cutting-edge technologies, including Facebook's strong support, it eliminates the need for developers to learn other platforms like .NET, PHP, or Java. Learning new technologies for application development saves developers time and effort. The stack is supported by a large number of open-source packages and a committed community of programmers to boost scalability and maintain software due to the same JavaScript platform. The foundation of the MERN stack is Node.js, which is a server-side technology with extremely high performance and quick response to all tasks, including massive and complex data. TypeScript is not required for MERN; all that is required is the adaptable React framework, which is now the most well-liked and influential front-end technology.

## RESULTS AND DISCUSSION

The development of the MERN stack social media web app resulted in the successful creation of a scalable, secure, and user-friendly platform that can handle the dynamic needs of social interaction. The app was built using the MERN stack (MongoDB, Express.js, React.js, Node.js), which ensured an efficient and responsive user experience across devices. A primary feature of the app is the robust authentication and authorization system, which uses JWT for secure login and bcrypt for password hashing. This security measure ensures that user data remains protected, and the authorization logic restricts access to sensitive user information based on roles.

A key aspect of the app's user experience is its intuitive interface, which was designed with React.js and styled using Tailwind CSS. The inclusion of a dark mode feature allows users to customize their viewing experience, a design choice that aligns with current trends in web applications. The real-time features of the app, such as the ability to post, comment, and like content, were implemented with WebSockets, ensuring seamless interaction and immediate updates across the platform.

The app also incorporates an age verification system during registration, which helps maintain compliance with legal requirements and ensures the safety of younger users. This feature, while simple, is a critical component in adhering to regulations around content sharing on social media platforms.

In terms of database management, MongoDB provided a scalable solution for storing user data, posts, comments, and interactions. The NoSQL structure of MongoDB made it easier to handle unstructured data and support the scalability required for social media applications. The use of Mongoose for data modeling further streamlined the management of the app's data operations.

From a performance perspective, the app was designed to handle a high number of concurrent users through the efficient use of Node.js, which is well-suited for event-driven, non-blocking applications. The integration of caching mechanisms also contributed to improved performance under load, ensuring that the app remains responsive even as traffic increases.

However, there were some challenges along the way. Issues with cross-browser compatibility were resolved through extensive testing and CSS adjustments. Additionally, as user traffic increased, the need for optimization in database queries and the implementation of caching mechanisms like Redis became apparent. Maintaining user data privacy while ensuring optimal performance was also a challenge, but encryption and secure data storage practices were put in place to address these concerns.

Looking ahead, there are opportunities to enhance the app with more advanced features, such as improved search functionality, social sharing capabilities, and push notifications to increase user engagement. These improvements could take the app to the next level, offering a richer and more interactive experience for users.

In conclusion, the MERN stack social media web app demonstrates the power of the MERN stack in building secure, scalable, and responsive web applications. The app successfully integrates key features required for modern social media platforms, and while challenges were encountered, the project serves as a strong foundation for future development and growth.

## Acknowledgment

I would like to express my sincere gratitude to Mr. Ashish Das Sir, my mentor, for his invaluable guidance, encouragement, and continuous support throughout the course of this research. His insights and suggestions played a crucial role in shaping the direction of my work on the "MERN Stack – Based Social Media Web App: A Comparative Study on Performance and User Experience."

I am also thankful to the faculty members and staff of Diatm College for providing a conducive environment and all necessary resources that made this research possible.

Lastly, I extend my heartfelt appreciation to my family, friends, and peers for their constant encouragement and motivation.

This research would not have been possible without the support and inspiration from all these wonderful individuals.

## References

- [1] Pratiksha D Dutonde "Website development technologies : A review", publisher: IJRASET, vol. 10(1), doi : 10.22214/ijraset.2022.39839, pp. 359-366.
- [2] Stonebraker, Michael. "SQL databases v. NoSQL databases." *Communications of the ACM* 53.4 (2010): 10-11.
- [3] Aboutorabi<sup>a</sup>, S.H., Rezapour, M., Moradi, M. and Ghadiri, N., 2015, August. Performance evaluation of SQL and MongoDB databases for big e-commerce data. In *2015 International Symposium on Computer Science and Software Engineering (CSSE)* (pp. 1-7). IEEE.
- [4] Chodorow, C. "Introduction to mongoDB." *Free and Open Source Software Developers European Meeting (FOSDEM)*. 2010.
- [5] Tilkov, Stefan, and Steve Vinoski. "Node. js: Using JavaScript to build high-performance network programs." *IEEE Internet Computing* 14.6 (2010): 80-83.
- [6] Boicea, A., Radulescu, F., Agapin, L. I. (2012, September). MongoDB vs Oracle--database comparison. In *2012 third international conference on emerging intelligent data and web technologies* (pp. 330-335). IEEE.
- [7] Office for National Statistics, Internet users in the UK: 2016. Retrieved September 26, 2017, from <https://www.ons.gov.uk/businessindustryandtrade/itandinternetindustry/bulletins/internetusers/2016>.
- [8] Liang, L., Zhu, L., Shang, W., Feng, D., Xiao, Z. (2017). Express supervision system based on NodeJS and MongoDB.
- [9] M. R. Solanki, A. Dongaonkar, A Journey of human comfort: web1.0 to web 4.0, *International Journal of Research and Scientific Innovation (IJRSI)*, Volume III, Issue IX, pp. 75-78, 2016
- [10] Javeed, A. (2019). *Performance Optimization Techniques for ReactJS*. 2019
- [11] J. M. Spool, Content and design are inseparable work partners, 2014. Retrieved September 29, 2017, from <https://articles.uie.com/content-and-design>
- [12] Bozikovic, H., Stula, M. (2018). Web design Past, present and future. 2018 41st International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO).
- [13] Carter, B. (2014). *HTML Architecture, a Novel Development System (HANDS): An Approach for Web Development*. 2014
- [14] Sterling, A. (2019). *NodeJS and Angular Tools for JSON-LD*. 2019 IEEE 13th
- [15] Laksono, D. (2018). *Testing Spatial Data Deliverance in SQL and NoSQL Database Using NodeJS Full Stack Web App*. 2018
- [16] Patil, M. M., Hanni, A., Tejeshwar, C. H., Patil, P. (2017). A qualitative analysis of the performance of MongoDB vs MySQL database based on insertion and retrieval operations using a web/android application to explore load balancing Sharding in MongoDB and its advantages.