Muscle Shark: Your 24*7 Personal Guide

PROJECT SYNOPSIS

OF MAJOR PROJECT

BACHELOR OF TECHNOLOGY

COMPUTER SCIENCE AND ENGINEERING

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INTRODUCTION

Muscle Shark is based Web App that aims to help people to maintain physical
activity and make it as a part of their daily routine. In today's world, maintaining a healthy lifestyle has become increasingly crucial. However, achieving and maintaining optimal posture, especially during exercise, can be challenging. To address this concern, our project focuses on the development of a Smart Gym web app which recommends exercise and use Real Time Posture Detector leveraging the capabilities of the open pose library.

This system leverages the power of OpenPose with torsion angle and various machine learning model to recommend and analyze the exercise or workout performed by individual. The system can:

- Recommend Exercise: This system recommends exercise and workout to be performed by individual using their weight, height, level of fitness.
- Recognize incorrect postures: The system identifies deviations from proper body alignment, alerting users to potential risks of injury by visual prompts.
- Classification of Exercise: This Webapp classify level of fitness as Beginner, Intermediate and Advance and recommends exercise as per that such that more number of Bicep for advance level than intermediate.
- Exercise guidance: The system can recognize and analyze specific exercises, providing real-time feedback on whether the user is performing them correctly. This can help prevent injuries caused by improper form. It also provides information about various parameters such as calories burn, total time taken by user to complete exercise.
- Flexibility and Autonomy: One of the key attributes of this project is its ability to empower users to engage in exercise anywhere, at any time, and without the need for a coach.
- Personalized feedback: The system can be tailored to individual needs and fitness levels. By understanding the user's goals and limitations, it can provide targeted feedback and personalized recommendations for improving posture and optimizing exercise routines.

Technology Framework

- Pose Estimation Technology: At the core of the project, the OpenPose library is leveraged for state-of-the-art pose estimation, enabling accurate analysis of body movements in real-time.
- Custom Machine Learning Algorithm: A custom machine learning algorithm is implemented to recommend exercise and workout routines.
- WEB Technology: Various Web technologies are used to create a interactive interface for user and linkage to model and Pose Estimation module.

Objective for E-commerce Supplement Website with Admin Page

The primary objective of the e-commerce supplement website is to provide customers with a seamless and convenient platform to purchase high-quality dietary supplements, health products, and wellness items. The website will offer an extensive range of supplements with detailed product descriptions, customer reviews, and easy navigation to enhance the shopping experience.

Additionally, the platform will include a secure and efficient admin page, enabling administrators to manage inventory, track orders, update product listings, process customer data, and generate reports for analytics and business insights. The admin page will serve as a tool to ensure smooth operations, enabling timely product updates, effective stock management, and personalized customer service to maintain high satisfaction levels.

Key Objectives:

1. Provide a user-friendly, responsive, and secure e-commerce platform for customers to explore and purchase health supplements.

2. Offer a wide range of supplements with detailed product descriptions and reviews to help customers make informed decisions.

3. Implement an easy and efficient payment and checkout process to enhance the customer experience.

4. Develop an intuitive admin panel to efficiently manage product listings, track orders, and update inventory in real time.

5. Ensure seamless integration between the customer-facing site and the admin dashboard for real-time inventory and order management.

6. Provide a reliable and secure platform with data protection to ensure customer privacy and safety.

7. Generate detailed reports to track sales performance, customer behavior, and product demand, aiding in informed business decisions.

8. Enhance customer satisfaction by providing efficient support through integrated tools and easy return/exchange processes.

ABSTRACT

The web development industry has grown significantly with the evolution of technology. Software technology is improving at the same rate as hardware. Increasingly, electronic devices with the Internet and real-time capabilities have made performance essential. Unfortunately, despite their general use and long history of developing and maintaining traditional technology, some fail to meet today's customer performance expectations. The MERN stack was recently built to overcome this performance issue.

E-commerce has exponentially risen over the last decade, offering more benefits and conveniences than traditional businesses. Furthermore, the COVID-19 era has irreversibly changed how businesses interact with customers, allowing merchants to approach clients more promptly. By recognizing this need, an E-commerce web application is created as an online bookshop.

This project will demonstrate and comprehend each MERN stack technology's essential concept before building a functional E-commerce web application to help small companies formulate their business strategy. The functionality and browser capabilities tests were all conducted on various platforms. The outcome was satisfactory since the web application fulfilled all of the objectives.

Finally, an operational and production-ready web store application was successfully constructed and deployed. Additionally, the application's results and potential enhancements were discussed. The thesis can be utilized as a reference on the MERN stack, aimed at novices and anyone enthusiastic about exploring the technology stack.

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[CHAPTER – 1: - INTRODUCTION]

INTRODUCTION

1.1 PROBLEM DEFINITION:-

Nowadays, technology is growing incredibly fast. The rapid innovation of hardware devices makes software technologies advance as well, automatically taking the place of old technologies. Because of the significant expansion in the number of electronic devices that use the Internet and real-time feature, performance is key. By tradition, web development has been carried out by technologies such as JAVA servlets, ASP.NET or PHP. While those technologies are quite widespread and have good features with many years of development and are supported by a large community, they still have some limitations concerning today's need which is performance. The MERN stack (MongoDB, Express, React and Node) with their simplicity and uniformity, has been recently developed to become a better solution for this performance issue.

The objectives of this thesis were to illustrate and understand the fundamental concepts and usage of each technology in the MERN stack, as well as their compatibilities and advantages as a complete stack in web application development. The thesis achieved that goal by utilizing these modern technologies and implementing a web application. The idea of this web application was for a startup run by the author's parents as they decided to open a book retail store. By researching, the author realized how e-commerce – an enormous platform is emerging at an extraordinary speed over the last decades all over the world and providing more advantages and conveniences as compared to physical stores. E-commerce has changed permanently the way businesses and consumers interact, which allows users to connect with their favourite shops and brands whenever and wherever they want and also helps stores to more actively approach consumers. It is believed that the growth of e-commerce for the next incoming years is increasing beyond measure rate with the release of modern technologies. Understanding this need, the author's solution was to create an e-commerce web application as an online bookstore in order for the startup to develop its business strategy.

This document structure was organized as follows. The first section brought in the goal of the thesis and the technologies used. Next, essential concepts and theoretical background of each technology in the stack were introduced along with the example, followed by the third section which demonstrated carefully and thoroughly the application development process, from back-end to front-end. In the end, this paper provided a discussion of the project with further improvements and gave a conclusion about the final product.

1.2 PROJECT OVERVIEW :-

The 'Online E-commerce Web application' Services department strives to provide solutions to develop and transfer easy and efficient ways in the digital age and to help reduces human pressure and time. To help support shop collections, digital initiatives, and external partner institution digital projects, It provides services that include the digitization of analogue objects, metadata management, digital preservation, and discovery and access of digital collections. "KameStore" is a web application written for all operating systems, designed to help users maintain and organize shop virtually. This software is easy to use for both beginners and advanced users. It features a familiar and well-thought-out, attractive user interface, combined with strong searching Insertion and reporting capabilities. The report generation facility of the shop system helps to get a good idea of which are the various items brought by the members, making it users possible to get the product easily. The 'Online E-commerce Web application' Services department strives to provide solutions to develop and transfer easy and efficient way in the digital age and to help reduces human pressure and time. To help support shop collections, digital initiatives, and external partner institution digital projects, It provides services that include the digitization of analogue objects, metadata management, digital preservation, and discovery and access of digital collections. "KameStore" is a web application written for all operating systems, designed to help users maintain and organize shop virtually. This software is easy to use for both beginners and advanced users. It features a familiar and well-thought-out, attractive user interface, combined with strong searching Insertion and reporting capabilities. The report generation facility of the shop system helps to get a good idea of which are the various items brought by the members, making it users possible to get the product easily.

The system aims to achieve the following objectives:
• To design an online e-commerce system.
• To provide a solution to reduce and optimize the expenses of customer order management.
• To create an avenue where people can shop for products online.
• To develop a database to store information on products.

1.3 THEORETICAL BACKGROUND :-

The e-commerce application is constructed based on the MERN stack as the primary full-stack technology. This chapter will briefly discuss each technology in the MERN stack as well as its third-party support library Mongoose to develop the project

1.3.1 THE MERN STACK:-

MERN is one of the notable variants based on the MEAN stack. Basically, the MEAN stack was initially established in 2013 by a MongoDB engineering team as a JavaScript-based stack in order to aid in the development. MEAN comprises four open-source components: MongoDB acts as the database, Express serves as the server framework, Angular as the client framework, and Node works as the environment for running JavaScript. By substituting the popular framework Angular with React – a client-side library – and combining them as the

MERN stack, React can become a companion to the other technologies for developing JavaScript and JSON-oriented applications. Figure 1 below illustrates the architecture of the MERN stack technology:
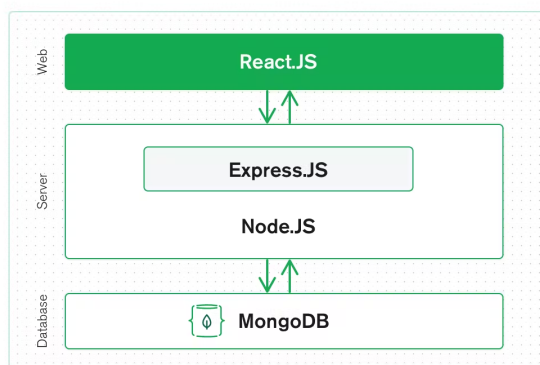

Figure 1. The architecture of the MERN stack

As illustrated, the MERN stack is constructed based on the well-known 3-tier architecture, which confirms that the MERN stack is full-stack application development. The MERN stack consists of three components: display layer powered by React, application layer with NodeJS and Express, and database tier provided by MongoDB.

1.3.1.1 THE MERN STACK :-

MongoDB is a cross-platform, open-source, NoSQL database that is mainly used for scalable large-volume data applications and tasks that do not function well in a relational database. It utilizes a document storage format known as BSON (Binary encoded JavaScript Object Notation). It is a non-relational database management system created by Dwight Merriman, Eliot Horowitz, and Kevin Ryan and became popular in the mid-2000s. MongoDB's design is based on collections and documents, as illustrated in Figure 2 below, which replace the usage of tables and rows in conventional relational databases.
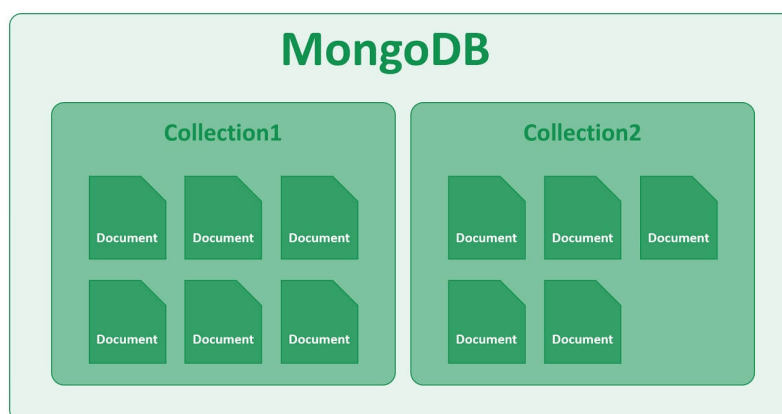

Figure 2. The architecture design of MongoDB

MongoDB also supports a variety of document operations, including adding, querying, updating, and deleting. MongoDB is suitable for various use cases due to the diversity of field values and powerful query languages. In addition, its ability to scale out to accommodate larger data volumes horizontally has contributed to its increasing success as the world's most popular NoSQL database.

There are some crucial features of MongoDB:

• Scheme-less Database: This feature allows a single collection to store numerous documents, each of which contains a varied amount of fields, content, and size. Therefore, MongoDB offers tremendous flexibility to databases thanks to this fantastic feature.

• Document Oriented: All the data is kept in fields containing a clear structure with key-value pairs rather than rows and columns, which provides more flexibility than RDBMS.

• Indexing: Each field in MongoDB documents is indexed using primary and secondary indices, making retrieving and searching for data more straightforward and faster. Without accurate indices, the database must manually search each document for the matching query, which is time-consuming and inefficient.

• Scalability: The horizontal scalability from MongoDB was offered through sharding, which refers to the process of distributing data across numerous servers. By utilizing the shard key, a significant quantity of data is divided into data chunks, and these data chunks are equally spread among shards that involve multiple physical servers. Moreover, it will add new machines to an existing database.

• Replication: With the benefit of replication, MongoDB enables high availability and redundancy by producing several copies of data and storing them on a separate server to protect the database against hardware failure, ensuring that the data can be recovered from another if one server fails.

• Aggregation: procedures on the dataset are enabled to provide a single or calculated output with three distinct aggregating methods, including pipeline aggregation, map-reduce function, and single-purpose aggregation.

1.3.1.2 EXPRESS:-

Representing the letter "E" in the MERN stack, Express is a lightweight and versatile web application framework built on top of NodeJS. Thanks to the large community of support, it includes a rich collection of functionality for developing web and mobile applications. Even though a large number of support packages along with the functionality for better software creation, Express does not affect the performance of NodeJS.

Based on the GitHub repository, Express was established on May 22, 2010, by T.J. Holowaychuk. After that, StrongLoop acquired the project management rights in June 2014 until IBM owned the company in September 2015. Then, in January 2016, the NodeJS Foundation took over the management of Express, and Express is now the primary function of the NodeJS platform.

Express.js is a routing and middleware framework for managing the many routing options for a website. It operates between the request and response cycles. Middleware is invoked after the server receives the request and before the controller actions transmit the response. One or more pieces of middleware are executed to perform particular tasks, such as authorizing requests or parsing request content. Express applications are composed of a sequence of middleware function calls. Typically, the first middleware executed to process the request initiates the task pipeline. The initial middleware can either complete the request and provide it to the users or call the subsequent middleware to continue the request. The same approach will be continued until the pipeline's last middleware takes the result of the preceding middleware as input.

1.3.1.3 REACT:-

React, representing the letter 'R' in the MERN stack, focuses on creating the View Layer, which is well-known for all visible parts of the page of an application. React is a multi-purposed, open-source JavaScript library used for building user interfaces based on UI components.

Since React was established to cope with sophisticated, large-scale user interfaces combined with real-time dynamic data and data binding, it has been steadily improving its single-page application development and frontend utilities for programmers of all levels.

Compared to other popular libraries and frameworks such as jQuery, Angular, and VueJS, React is considered the most popular framework for web development. Along with offering reusable component code, which reduces development time and the likelihood of bugs and errors, Reacts introduced many essential characteristics that contribute to its developer appeal, which are discussed below.

JSX:-

JSX (JavaScript XML) is a syntactic extension to JavaScript that is similar to HTML. Because JSX optimizes the translation to standard JavaScript and leverages its full power, it is much faster than the regular one. Even though React does not need the usage of JSX to construct React-based applications, it is suggested as it simplifies the development for developers whenever markup components and binding events are required. Rather than dividing markup and logic into different files, JSX enables developers to generate cleaner and more manageable codebases for their websites by combining rendering logic and user interface logic in the same components.

VIRTUAL DOM:-

Virtual DOM (or VDOM) is an abstract representation of DOM (Document Object Model), and its solutions are constructed on top of the regular DOM. DOM represents the UI of the program, and its model portrays the document as a collection of different nodes and objects to interact with the structure, layout, and content of the website through programming languages. Figure 3 below indicates an example of the DOM structure.

While regular DOM manipulation is slow due to the re-rendering of both the updated element and its children after getting new data, the Virtual DOM rerenders only the components that need updating, which fastens the rendering process and increases the performance. In order to further understand why Virtual DOM is fast and practical, the functionality of Virtual DOM must be discussed. The state of the DOM tree hierarchy is stored when Virtual DOM is utilized to render a page. Instead of constructing a new tree, a diffing approach is employed when UI modifications are necessary. At that point, the React library employs the Virtual DOM, which allows it to do the calculations inside this domain without involving the actual DOM. Therefore, whenever a component's state changes, React keeps track of it and updates
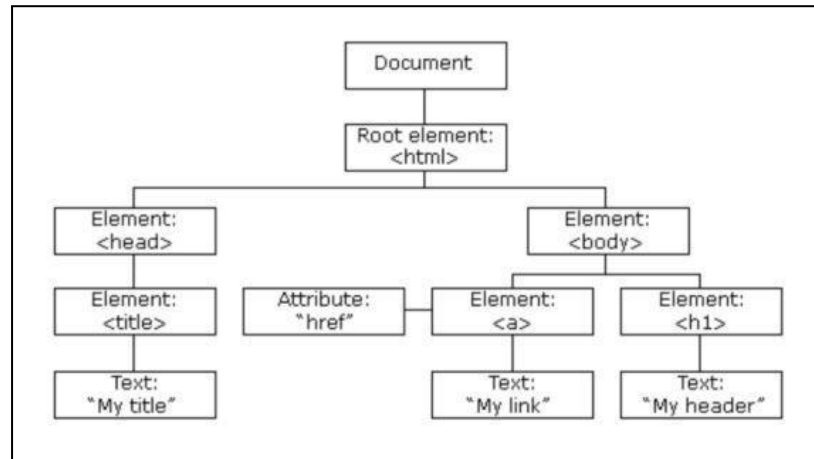

Figure 3. An example of tree-structure of Document Object Model

The Virtual DOM tree by comparing the current version to the prior one. This comparison employs a diffing algorithm to reduce the number of DOM operations/refreshes, leading to considerable boosting speed. The whole procedure is titled Reconciliation.
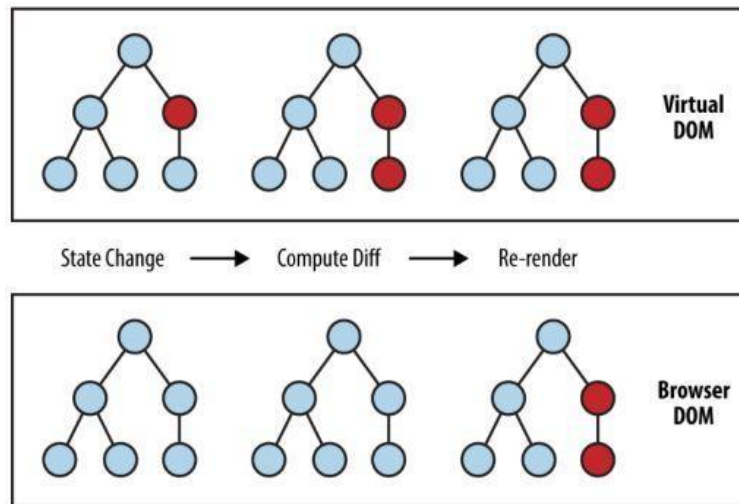
Figure 4. The difference between Virtual DOM and real DOM update process

COMPONENTS:-

Components are the primary concept of React, which encourages developers to separate complicated user interfaces into reusable and independent parts. React components are classified into two types: class-based components and functional components. The functional component is considered the most straightforward method to construct as it can be implemented as a JavaScript function to return JSX. The class-based component is constructed using the ECMAScript6 class syntax combined with the built-in React library class "Component".

Components can refer to one another, which means one component can be a parent component containing several child components with no restriction on the amount of complexity. Moreover, both functional and class-based components adhere to one strict rule assigned by React: all React components must be pure functions in which their props are immutable. Props, which stands for Properties, are a collection of inputs passed as parameters to a component, while pure function depicts the state in which the function performs the logic without affecting the arguments. As a result, a React component behaves like a pure function while respecting its inputs and rendering the same result for the same props.

HOOKS:-

Prior to version 16.8, the majority of React components were class-based as class-based components offer life-cycle methods for component state management. Since version 16.8, however, React has introduced a new notion called Hooks, which provides a new method to leverage state and other React capabilities inside a functional component. By using Hooks, a component's stateful logic can be isolated, tested separately, and reused without affecting the component hierarchy. In addition, Hooks enables the developer to break down a component into separate functions based on the relationship instead of life-cycle methods.

There are two built-in React hooks that should be discussed. First, the State hook, commonly known as the use State hook, enables component-level state management. It hooks into

React's state by creating a state variable that React maintains. useState hook accepts and returns two results: the current state and a function to alter it. The component state can be efficiently initialized, utilized, and modified using the useState hook. The second hook is the Effect hook, also known as the use effect hook. useEffect hook assists programmers in managing component life cycles. The difficulty of separating related functionality and data into several class life cycles, such as componentDidUpdate, componentDidMount, and componentWillUnmount, has been thoroughly addressed by Effect Hook. A React component can support multiple effects to isolate data manipulation issues.

1.3.1.4 NODE :-

NodeJS is an open-source, cross-platform JavaScript runtime environment designed for constructing scalable applications. NodeJS is independently built on top of Google Chrome's V8 runtime engine, which is well-known for working effectively outside of a browser. By utilizing an event-driven design and operating on a single-thread event loop, NodeJS allows asynchronous and non-blocking I/O optimization to enhance web application performance and scalability, as shown in Figure 5 below. Therefore, it provides an alternative approach for developers to wait and fulfill requests for developing lightweight and real-time applications.
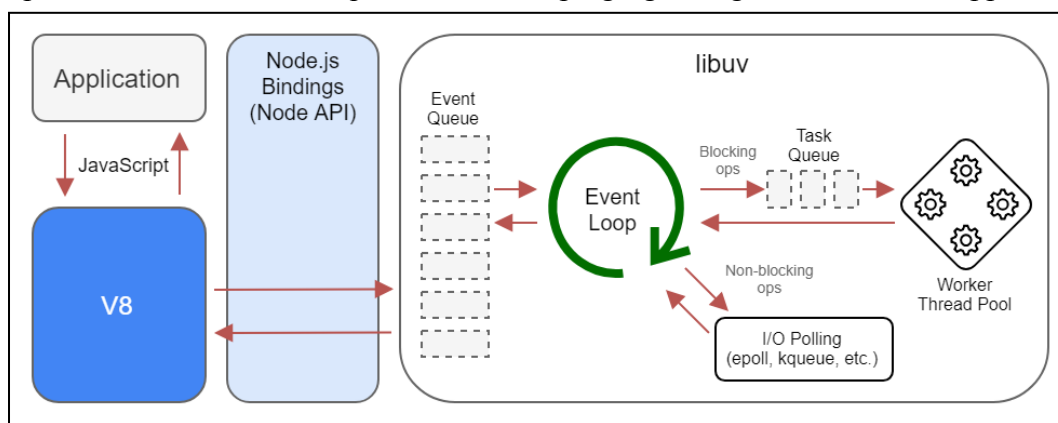

Figure 5. NodeJS event loop

Node package manager (NPM):-

Node package manager (NPM) is the NodeJS default package manager for applications, and it is utilized to maintain all of the NodeJS packages and modules along with the command line client npm. Therefore, it facilitates time-consuming manual tasks by automating managing third-party packages, allowing developers to spend more time on the development process.

NPM was first published on January 12, 2010, by Isaac Z. Schlueter. It is installed alongside NodeJS and is utilized to install the required packages and modules in the NodeJS project. It is currently the world's largest software registry, with approximately two million packages at the end of March 2022.

MONGOOSE :-

Mongoose is an object document mapping (ODM) library that is utilized for facilitating Node

and MongoDB development. It is responsible for managing data relationships, performing schema validation, and serving as a middleman between objects in code and object representations in MongoDB. In addition, Mongoose offers multiple methods and functions that effectively facilitate the communication between NodeJS and MongoDB. Figure 6 below illustrates the relationship between Mongoose, NodeJS, and MongoDB.

As shown in Figure 6, Mongoose is utilized to create the interaction between Node and MongoDB through object mapping. After that, Mongoose forms the connection with MongoDB using a Mongo Driver. Therefore, the relationship between Mongoose, NodeJS, and MongoDB ensures data capabilities.

The first step in getting started with Mongoose, like with other ODM libraries, is to create a schema. As Mongoose's documentation page described, a schema specifies the data structure and property casting, along with the following techniques: instance methods, compound indexes, static Model methods, and middlewares. Once the first stage is finished, the developed schemas will be utilized to map to MongoDB collections and shape the data documents included inside each collection. The second stage required by programmers is to construct a Mongoose model. Models are composed of builders of schemas, with the primary responsibility of producing and scanning documents in the Mongo database. Querying, deleting, and updating documents in the database are additional capabilities of models worth mentioning.
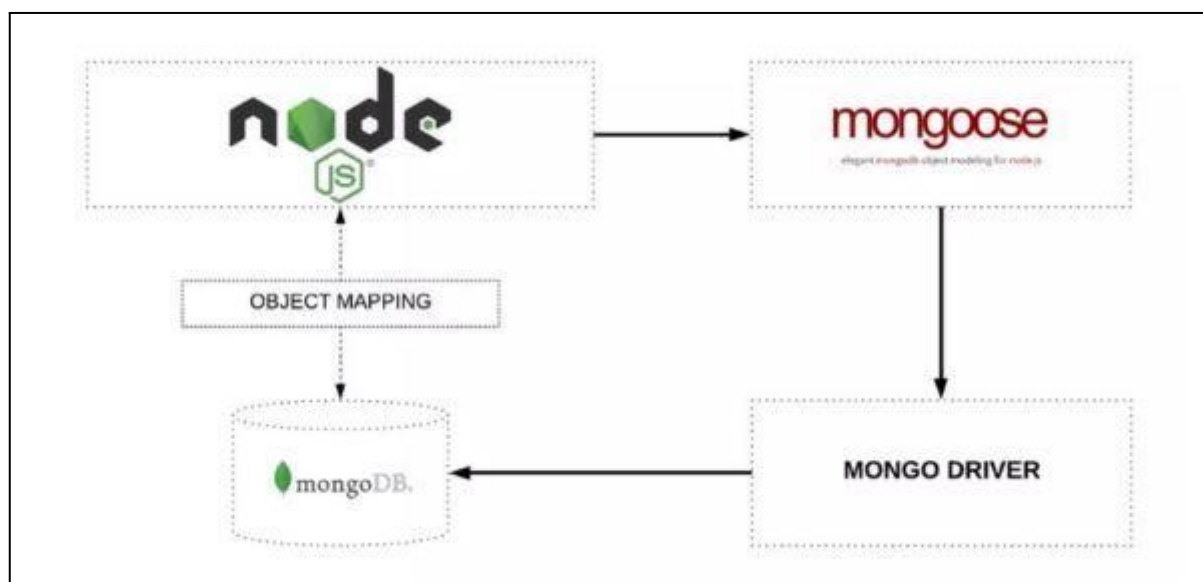

Figure 6. The relationship between Mongoose, NodeJS and MongoDB

1.4 HARDWARE & SOFTWARE REQUIREMENTS :-

1.4.1 Hardware Specification :- (Minimum requirement)

Processor : Any processor above 500 MHz

RAM   : 1GB

Hard Disk : 80GB

System   : Pentium IV 2.4 GHz

Internet Connection : Active

1.4.2 Software Specification :-

Operating System : Any operating system

Web Browser   : Any web browser

Any system with above or higher configuration is compatible for this project.

[CHAPTER – 2 : - LITERATURE SURVEY]

LITERATURE SURVEY

MERN stack is a commonly used combination of technologies for building modern web applications, comprising MongoDB, Express.js, React, and Node.js. E-commerce websites are increasingly important due to the rise of online shopping. This literature review discusses the use of the MERN stack for e-commerce website development, covering its advantages, technical aspects, security considerations, case studies, best practices, and future developments.

Scalability is a key advantage of using the MERN stack for e-commerce website development. The modular architecture allows easy scaling of the application, while the use of MongoDB as a NoSQL database enables flexible data modelling for complex and dynamic data structures. Another advantage is the stack's performance, which is boosted by its ability to handle both client-side and server-side components. Furthermore, React allows for the efficient rendering of components, thus reducing load times.

Developing an e-commerce website using the MERN stack involves creating an API with Express.js for server-side communication. MongoDB stores and retrieves data while React builds dynamic and responsive user interfaces. Node.js is used for server-side scripting to enable real-time communication between client-side and server-side components.

Security is a critical aspect of e-commerce website development, and the MERN stack provides several features to ensure the security of the application. MongoDB provides authentication and access control, and SSL/TLS encryption for secure communication. Express.js handles authentication and authorization and can be used to prevent common security vulnerabilities. React and Node.js support SSL/TLS encryption and XSS protection.

Several successful e-commerce websites have been built using the MERN stack, such as Grofers in India and Ubuy in the Middle East.

Best practices for e-commerce website development using the MERN stack include optimizing performance, testing thoroughly for reliability and security, deploying to a reliable and scalable infrastructure, and maintaining the application through regular updates and bug fixes. Additionally, it is important to adhere to industry standards and regulations such as PCI DSS compliance for payment processing.

One of the potential drawbacks of using the MERN stack for e-commerce website development is its learning curve. The technology stack requires expertise in multiple technologies, which can be challenging for novice developers. Additionally, the modularity of the MERN stack can result in a large number of dependencies, which can increase the complexity of the application and make maintenance more difficult. Finally, the MERN stack may not be the most appropriate choice for all e-commerce websites, particularly those with simpler requirements.

The future of e-commerce website development using the MERN stack will see the

integration of emerging technologies like machine learning, blockchain, and augmented reality. Machine learning can provide personalized product recommendations, blockchain can facilitate secure payment processing, and augmented reality can provide a more immersive shopping experience.

MERN stack offers a flexible and powerful solution for e-commerce website development, with advantages in scalability and performance. Its security features and successful case studies make it a reliable and popular choice for e-commerce developers. Best practices and future developments provide guidance and opportunities for continued innovation

2.1 EXISTING SYSTEM:-

The present scenario for shopping is to visit the shops and market manually and then from the available product list one needs to choose the item he or she wants and then pay for the same item mainly in cash mode is done, as not every society is well educated and aware to use net banking or card modes or wallets etc.

This system is not much user-friendly as one needs to go to the market physically and then select items only from the available list. So mostly it is difficult to get the product as per our desire. Description About the products is less available and are mostly verbal only. For this type of shopping, one needs to have an ample amount of free time.

Also, not really good markets exist everywhere, so many times good markets become out of reach for certain people. In the proposed system customers need not go to the shops for purchasing the products. He/she can order the product he/she wishes to buy through the use of this system. The shop owner can be the admin of the system.

The shop owner can appoint officials particularly to handle this, who will help the owner in managing the customers and product orders. The system also endorses a home delivery system for delivering the purchased products.

The current system for shopping is to visit the shop manually and from the available product choose the item customer wants and buy the item by payment of the price of the item.

- It is less user-friendly.
- User must go to the shop and select products.
- It is difficult to identify the required product.
- Description of the product limited.
- It is a time-consuming process.
- Not in reach of distant users.

2.2 PROPOSED SYSTEM:-

The proposed system for an e-commerce website using the MERN stack will leverage the latest technologies to provide a user-friendly, secure, and scalable e-commerce platform. The MERN stack, comprising MongoDB, Express.js, React, and Node.js, will be used to develop a robust and dynamic e-commerce website that will enable businesses to sell products online.

The proposed system will have a client-server architecture, with the server-side component built using the MERN stack. MongoDB will be used as the database to store and retrieve data, and Express.js will handle the server-side communication and routing. Node.js will be used for server-side scripting, allowing real-time communication between the client-side and server-side components.

The client-side component will be developed using React, which will enable the creation of dynamic and responsive user interfaces. React will also provide an efficient rendering of components, resulting in reduced load times and enhanced user experience. Additionally, the proposed system will be developed using a modular approach, allowing for easy scaling of the application.

The proposed system will have a range of features to provide a seamless e-commerce experience for users. These features will include

- Product Catalog: The product catalogue will allow users to browse through a wide range of products and filter them based on their preferences.

- Shopping Cart: The shopping cart will enable users to add products to their cart, review their orders, and checkout.

- Payment Gateway Integration: The payment gateway integration will allow users to make secure payments using a variety of payment methods, such as credit cards, debit cards, and digital wallets.

- Order Management: The order management system will enable businesses to manage orders, track shipments, and generate invoices.

- User Management: The user management system will enable businesses to manage user accounts, including registration, login, and authentication.

- Search Engine Optimization: The proposed system will be optimized for search engines to improve the visibility of the e-commerce website and increase traffic.

The proposed system will incorporate several security features to ensure the safety and security of user data and transactions. These features will include

- SSL/TLS Encryption: The system will use SSL/TLS encryption to secure all

communication between the client-side and server-side components.

- Access Control: Access control will be implemented using role-based authentication to ensure that only authorized users have access to sensitive data.

- PCI DSS Compliance: The system will be compliant with the Payment Card Industry Data Security Standard (PCI DSS) to ensure the secure processing of credit card payments.

- Regular Security Audits: The proposed system will undergo regular security audits to identify and address any vulnerabilities or security issues.

The proposed system for e-commerce websites using the MERN stack will provide businesses with a powerful and flexible platform for selling products online. The system will be developed using the latest technologies and security features to ensure a seamless and secure e-commerce experience for users. The modular architecture of the MERN stack will enable easy scaling of the application, allowing businesses to expand their e-commerce operations as they grow.

2.3 FEASIBILITY STUDY:-

The feasibility study for an e-commerce website using the MERN stack is essential to evaluate the practicality and viability of the proposed system. This study will assess the technical, operational, economic, and legal aspects of the project and provide insights into the feasibility of developing an e-commerce website using the MERN stack.

Economic Feasibility:

The economic feasibility of the proposed system is determined by assessing the cost of development, deployment, and maintenance of the e-commerce website. The MERN stack is an open-source technology, and the initial cost of development is relatively low. However, ongoing maintenance and updates will require a dedicated team, which may result in recurring expenses. The project's profitability will depend on the volume of sales generated, and the e-commerce website's scalability and flexibility will enable businesses to expand their operations and generate more significant profits.

Technical Feasibility:

The technical feasibility of the proposed system is determined by evaluating the availability of resources and the compatibility of the MERN stack components with the project requirements. The MERN stack has a vast developer community, and there are numerous resources available for learning and development. Moreover, MongoDB, Express.js, React, and Node.js are compatible with each other and can be integrated seamlessly to create a robust e-commerce website.

Operational Feasibility:

The operational feasibility of the proposed system is evaluated based on the availability of resources, skills, and expertise required for development, deployment, and maintenance. The development team must possess the necessary skills and expertise in the MERN stack to ensure the successful development and deployment of the e-commerce website. Additionally, the team must have experience in managing e-commerce websites, including order management, user management, and inventory management.

Legal Feasibility:

The legal feasibility of the proposed system is evaluated by assessing compliance with data protection laws, intellectual property laws, and other relevant regulations. The e-commerce website must comply with the General Data Protection Regulation (GDPR) and other data protection laws to ensure the security and confidentiality of user data. Additionally, the website must comply with intellectual property laws, such as trademark and copyright laws, to avoid legal disputes.

The feasibility study demonstrates that developing an e-commerce website using the MERN stack is technically and operationally feasible. However, the project's profitability will depend on the volume of sales generated, and businesses must be prepared for recurring expenses associated with maintenance and updates. The legal feasibility of the project will depend on compliance with data protection and intellectual property laws, and businesses must ensure compliance to avoid legal disputes. Overall, the proposed system for an e-commerce website using the MERN stack is a viable and practical solution for businesses looking to sell products online.

[CHAPTER – 3 : - SYSTEM ANALYSIS DESIGN]

SYSTEM ANALYSIS DESIGN

3.1 PROJECT SPECIFICATION:-

The project specification for an e-commerce website using the MERN stack is a comprehensive document that outlines the requirements, functionality, and features of the proposed system. This specification will provide a detailed description of the e-commerce website, including its design, user interface, functionality, security, and performance.

General Requirements:

The e-commerce website must be developed using the MERN stack, which includes MongoDB, Express.js, React, and Node.js. The website should be responsive, intuitive, and easy to navigate. It should be designed with a clean and modern interface, consistent with the branding and image of the business. The website must support multiple languages and currencies to facilitate global sales.

Functional Requirements:

The e-commerce website must have the following features and functionalities:

- User Account Management: The website should allow users to create and manage their accounts, including personal information, shipping addresses, and payment options.

- Product Catalog: The website should provide a comprehensive catalogue of products, including product descriptions, images, prices, and reviews. Users should be able to search and filter products based on different criteria, such as price, category, and brand.

- Shopping Cart: The website should allow users to add products to their shopping cart, view the contents of their cart, and proceed to checkout.

- Payment Gateway Integration: The website should integrate with a secure and reliable payment gateway to facilitate secure online transactions.

- Order Management: The website should allow businesses to manage orders, including order tracking, order processing, and order fulfillment.

- Customer Service: The website should provide customer service options, such as live chat, email support, and FAQ section.

Security Requirements:

- The e-commerce website must have the following security features:

- SSL Encryption: The website should use SSL encryption to secure user data and prevent unauthorized access.

- User Authentication: The website should require users to create and use strong passwords to protect their accounts.

- Payment Security: The website should use a secure payment gateway to ensure secure and safe online transactions.

Performance Requirements:

The e-commerce website must have the following performance features:

- Fast Load Time: The website should load quickly to provide a seamless user experience.

- Scalability: The website should be scalable to accommodate growing user traffic and transactions.

- Reliability: The website should be reliable and available 24/7 to facilitate sales and transactions.

The project specification for an e-commerce website using the MERN stack provides a detailed overview of the proposed system's requirements, functionalities, and features. The specification highlights the importance of a responsive design, intuitive user interface, secure payment gateway, and fast load time to provide a seamless and satisfactory user experience. By following this specification, businesses can develop a robust e-commerce website using the MERN stack and expand their operations to reach a global audience.

3.2 System Architecture :-
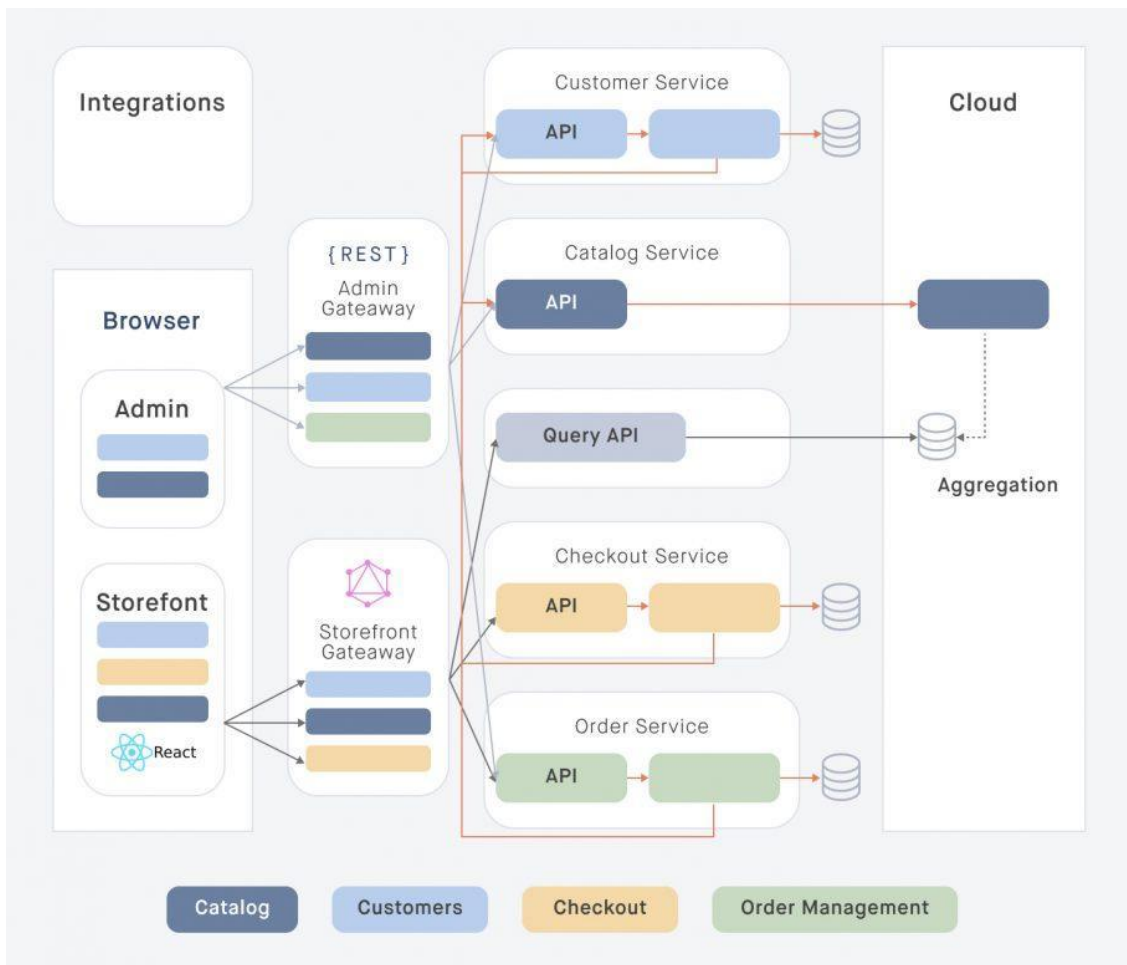
Figure 7. Architecture design
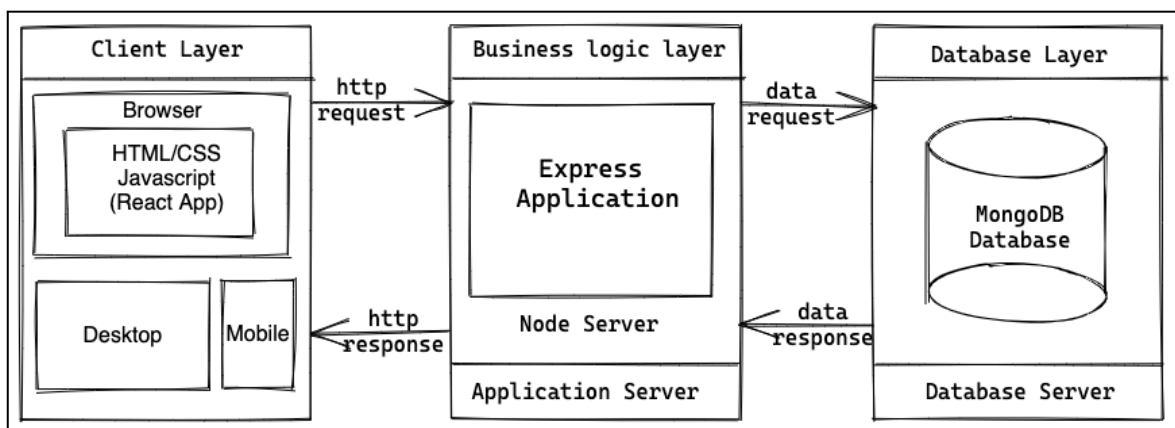
Figure 8. 3-Layer Architectural Pattern

3.3   Design/Diagrams and FlowCharts :-

USE CASE DIAGRAM:
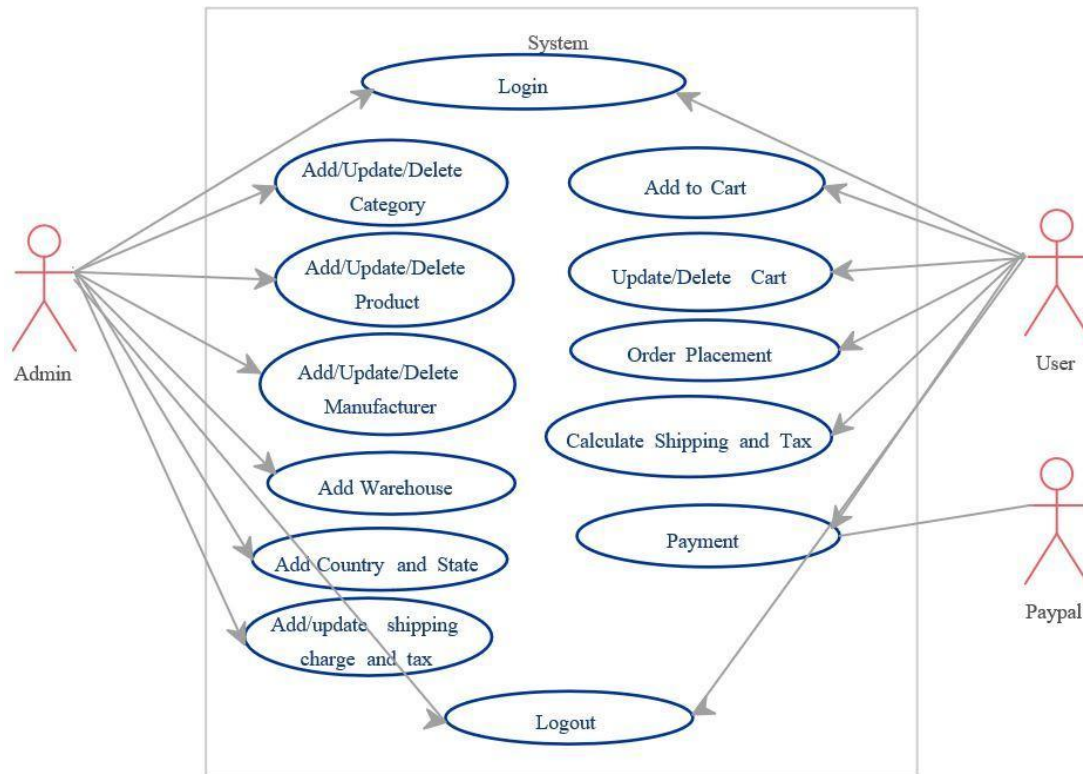
Figure 8. Use Case Diagram

BLOCK DIAGRAM:
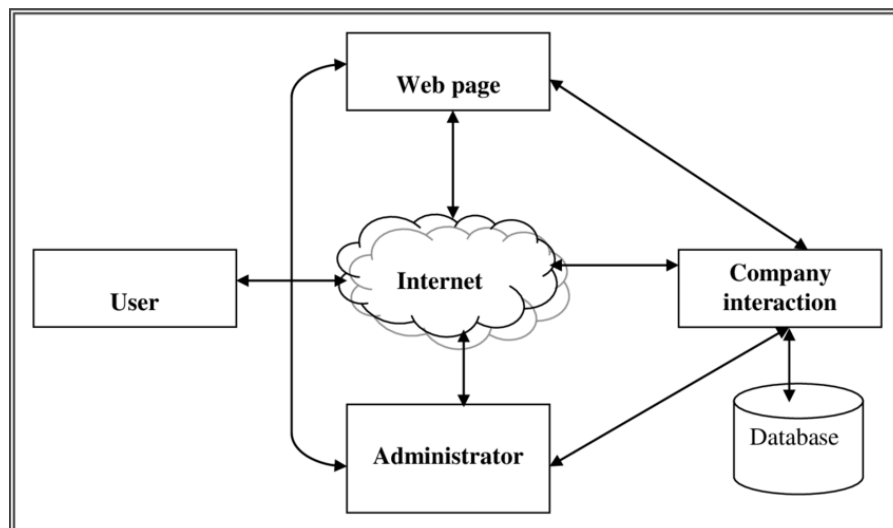
Figure 9. Block Diagram

SEQUENCE DIAGRAM:
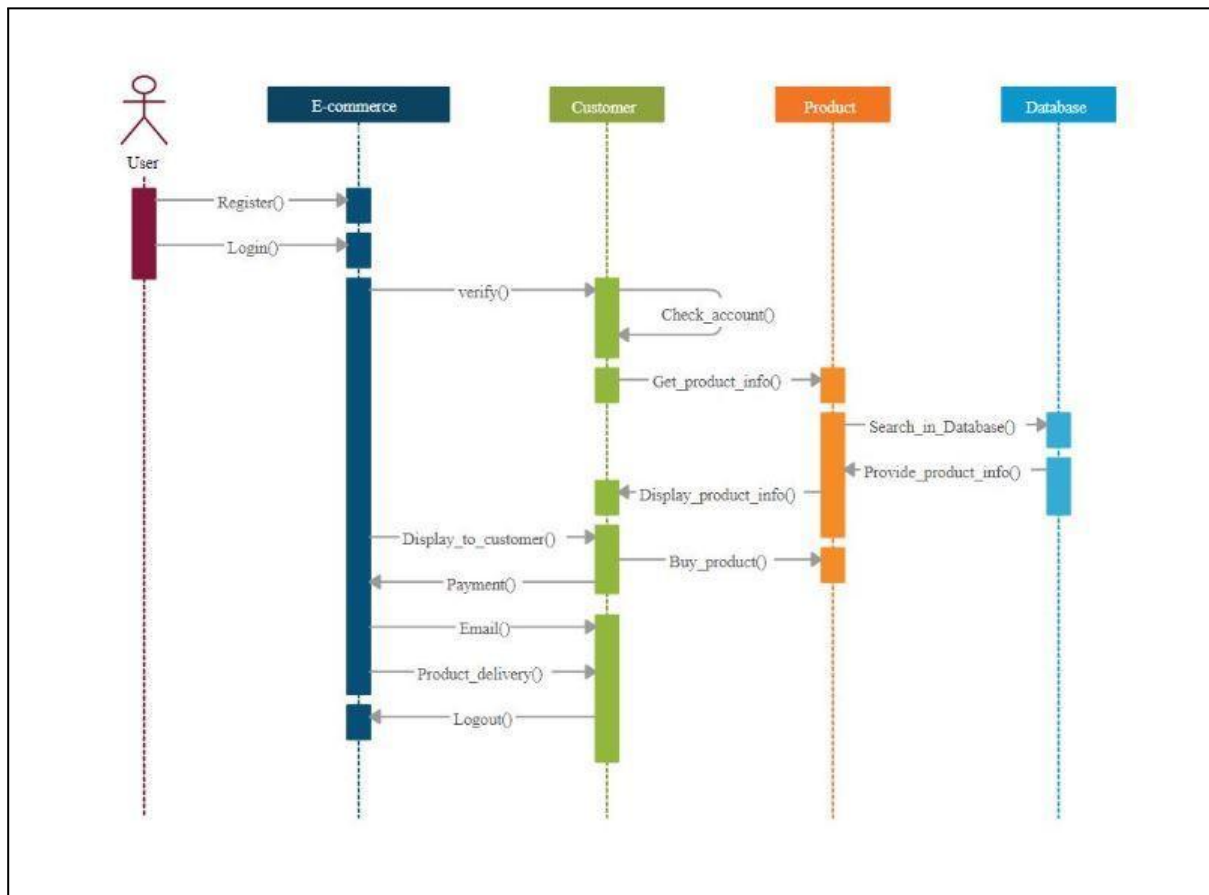
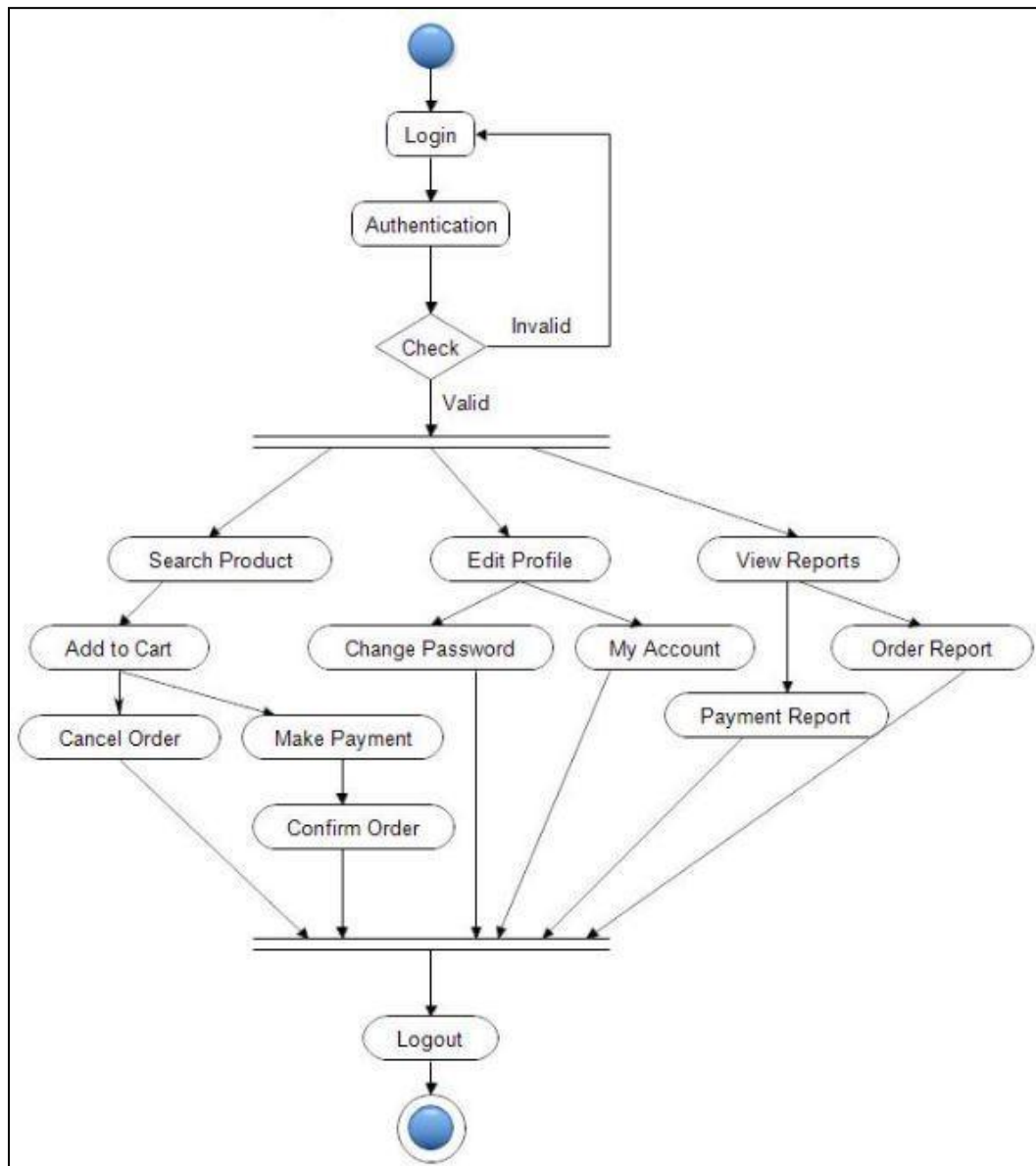Figure 10. Sequence Diagram

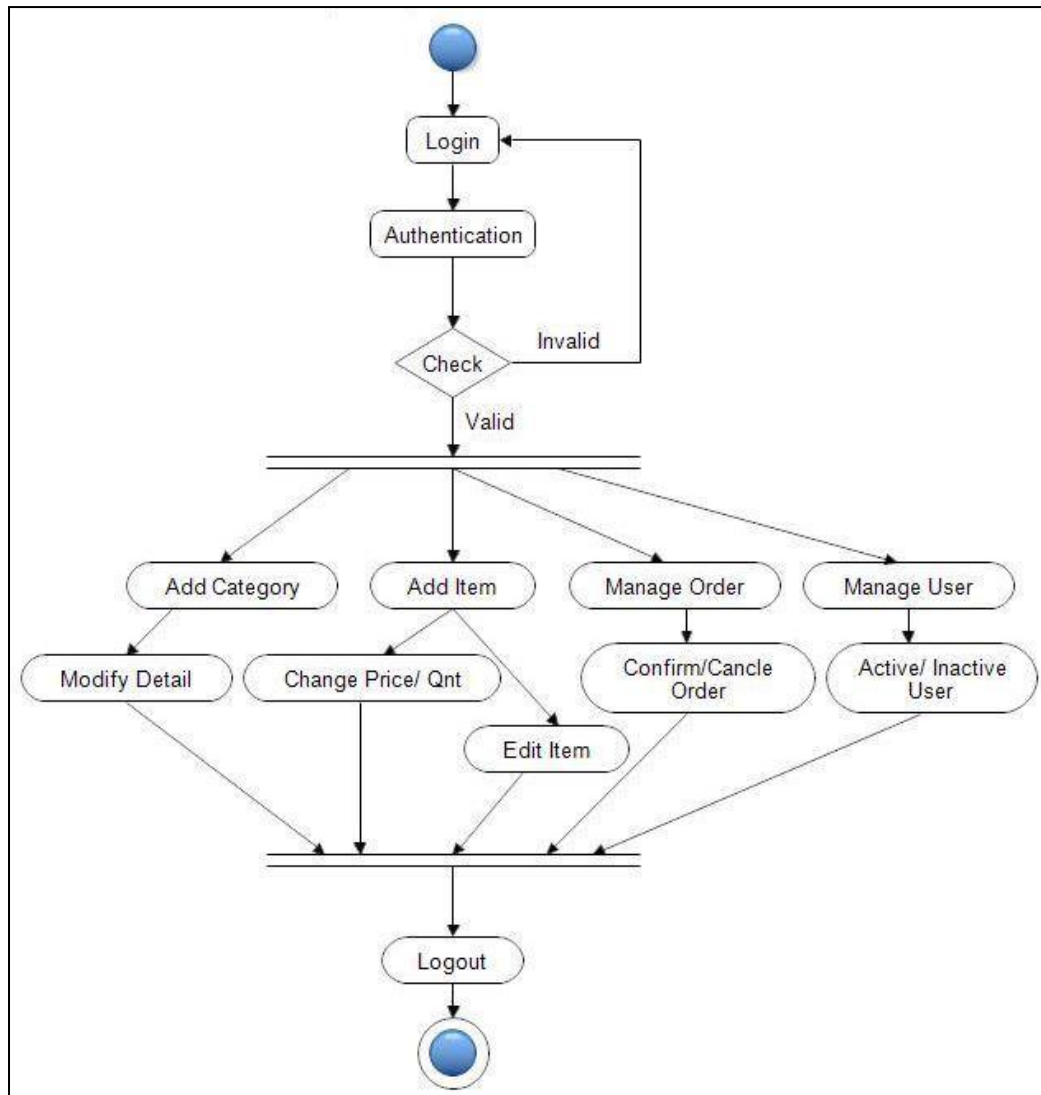## ACTIVITY DIAGRAM:

Figure 11. Client Side Activity Diagram

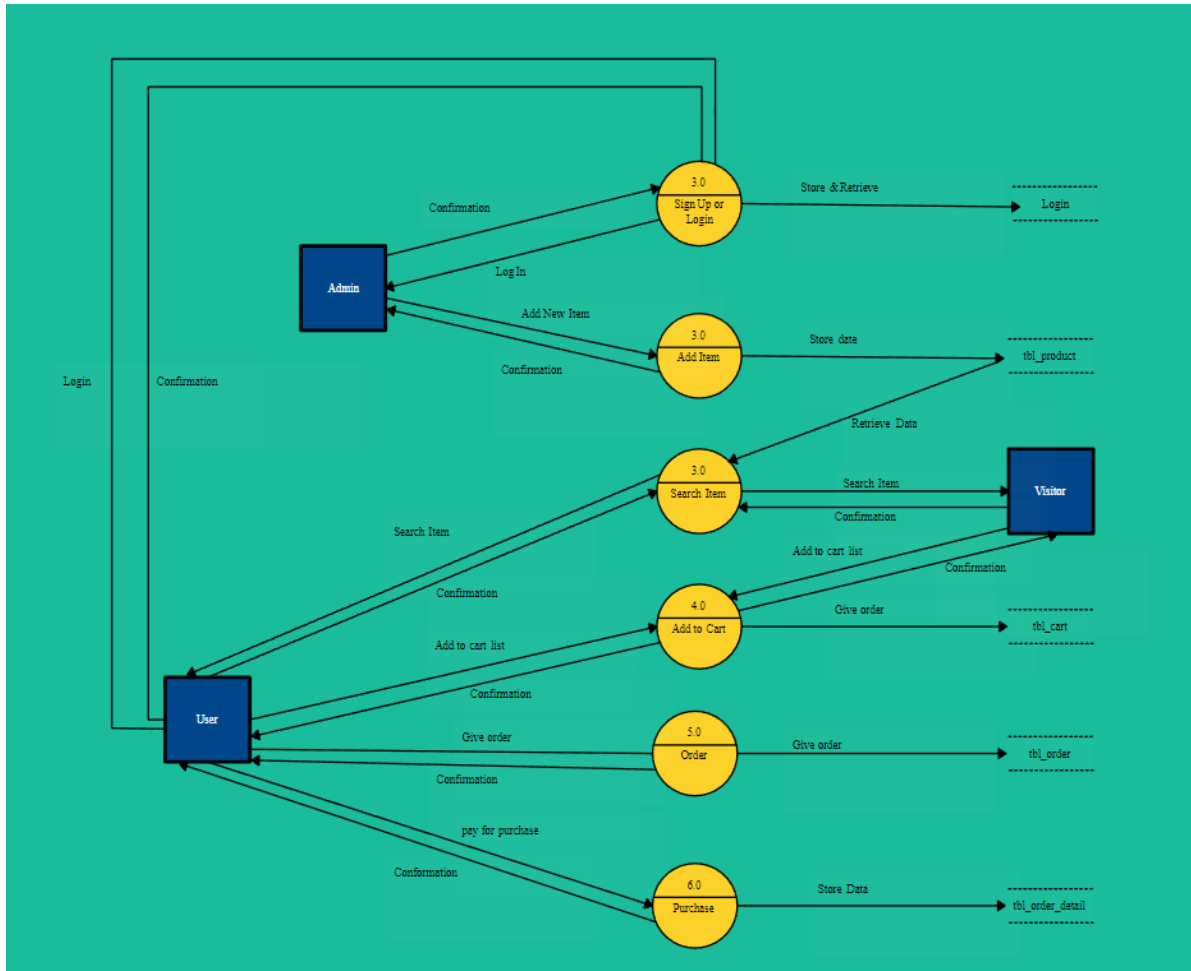Figure 11. Admin Side Activity Diagram

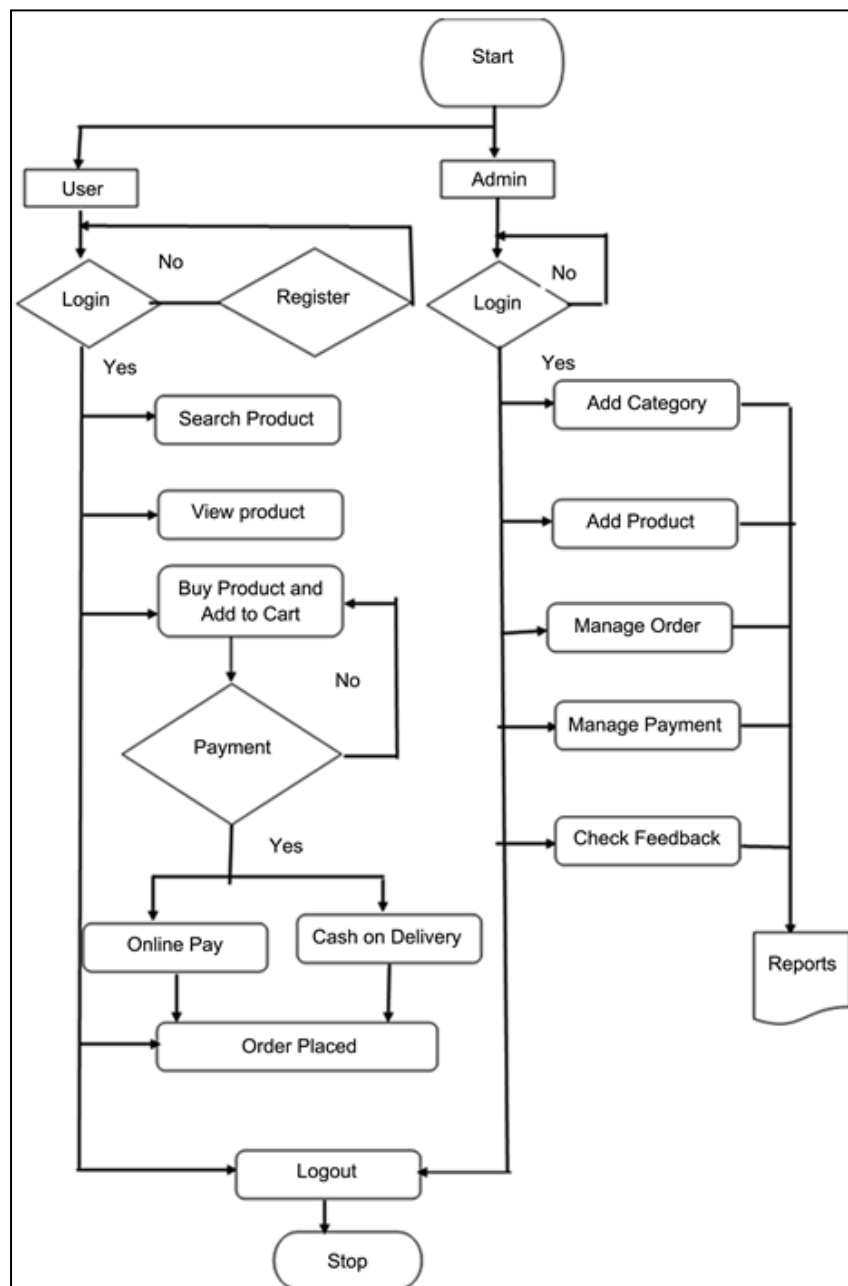# DATAFLOW DIAGRAM :

Figure 11. DataFlow Diagram

FLOWCHART :

Figure 11. FlowChart

[CHAPTER – 4 : - OUTPUTS & RESULT]

OUTPUTS & RESULT

The initial version of an electronic commerce application that reproduces an online store was successfully built by leveraging all four key technologies that comprise the MERN stack and making use of numerous Node modules. This particular programme is made to be effective, simple to use, and run smoothly.

HOME PAGE:-

The home page of an e-commerce site is the main landing page that customers first see when they visit the website. It serves as the storefront or the main entrance to the online store. The home page provides a snapshot of the website's products, services, and overall brand identity. The home page typically includes several key elements, including a Navigation menu, Featured products, Promotional banners, Search bar, and About Us section.
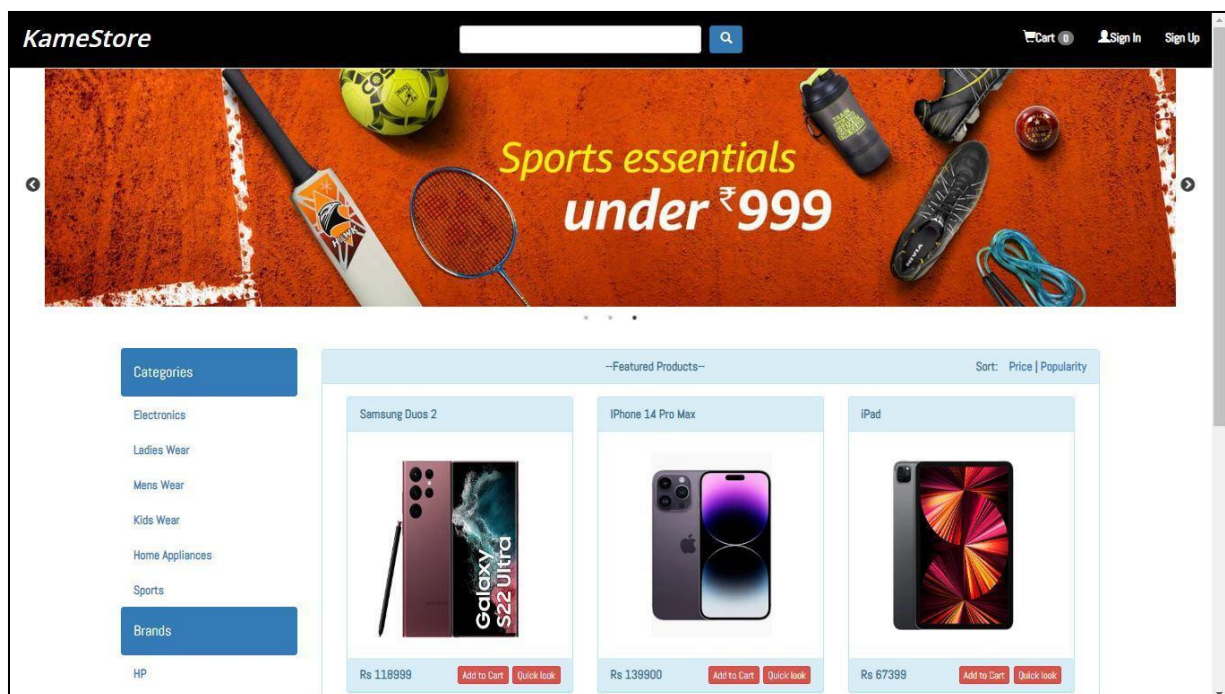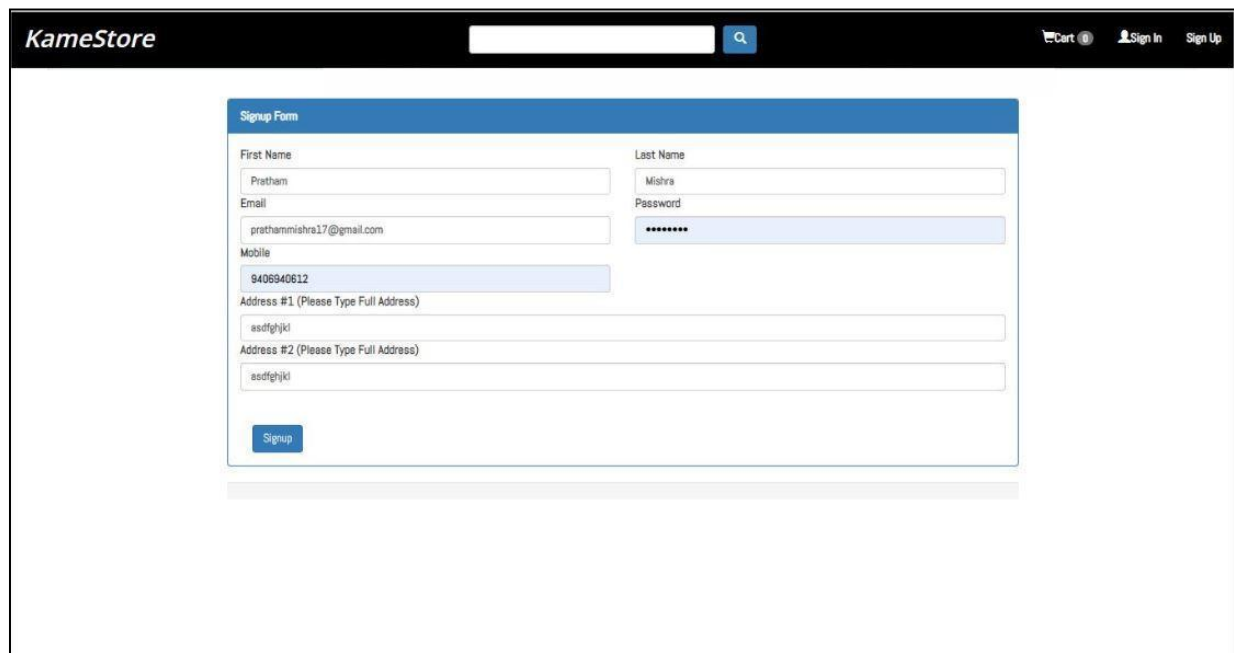

Figure 12. Home Page

SIGNUP PAGE:-

A signup page is a webpage that allows users to create an account with a website or online service. It is typically the first step in the onboarding process for new users. The signup page collects important information from the user, such as their name, email address, and password, and may also ask for additional details such as their date of birth or location.
Here are some common elements you might find on a signup page: Registration form, Fillup forms (Name, Password requirements, Mobile number, Address, etc), Terms and conditions, Social login options.

Overall, the signup page is an important part of the user onboarding process, and it's essential that it's designed to be user-friendly, easy to navigate, and secure. A well-designed signup

page can help to build trust with users and encourage them to continue using the website.
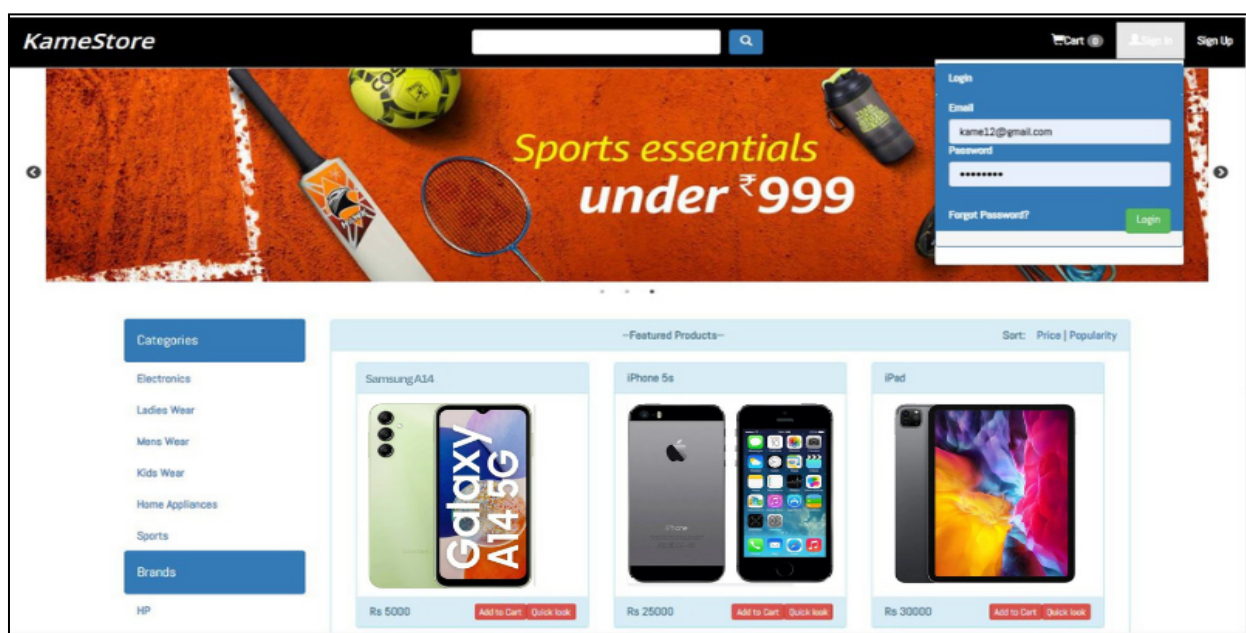

Figure 13. SignUp Page

SIGN-IN OPTION:-

The sign-in option on a website or application allows users who have already created an account to log back into their account. This allows users to access their personal information, settings, and account features. Typically, the sign-in option is located on the website or application's homepage and can be accessed by clicking on a "sign in" or "log in" button. Once clicked, the user is directed to a sign-in page, where they are prompted to enter their username or email address and password.

Figure 14. Sign-In Option

PRODUCT PAGE:-

The product page is a webpage on an e-commerce site that provides information about a specific product. It typically includes the product name, image, price, and a brief description of its features and benefits. The goal of the product page is to provide customers with enough information to make an informed purchasing decision. Other common elements on a product page may include customer reviews and ratings, related products, and an option to add the product to a shopping cart or wishlist. Overall, a well-designed product page is crucial for driving conversions and boosting sales on an e-commerce site.
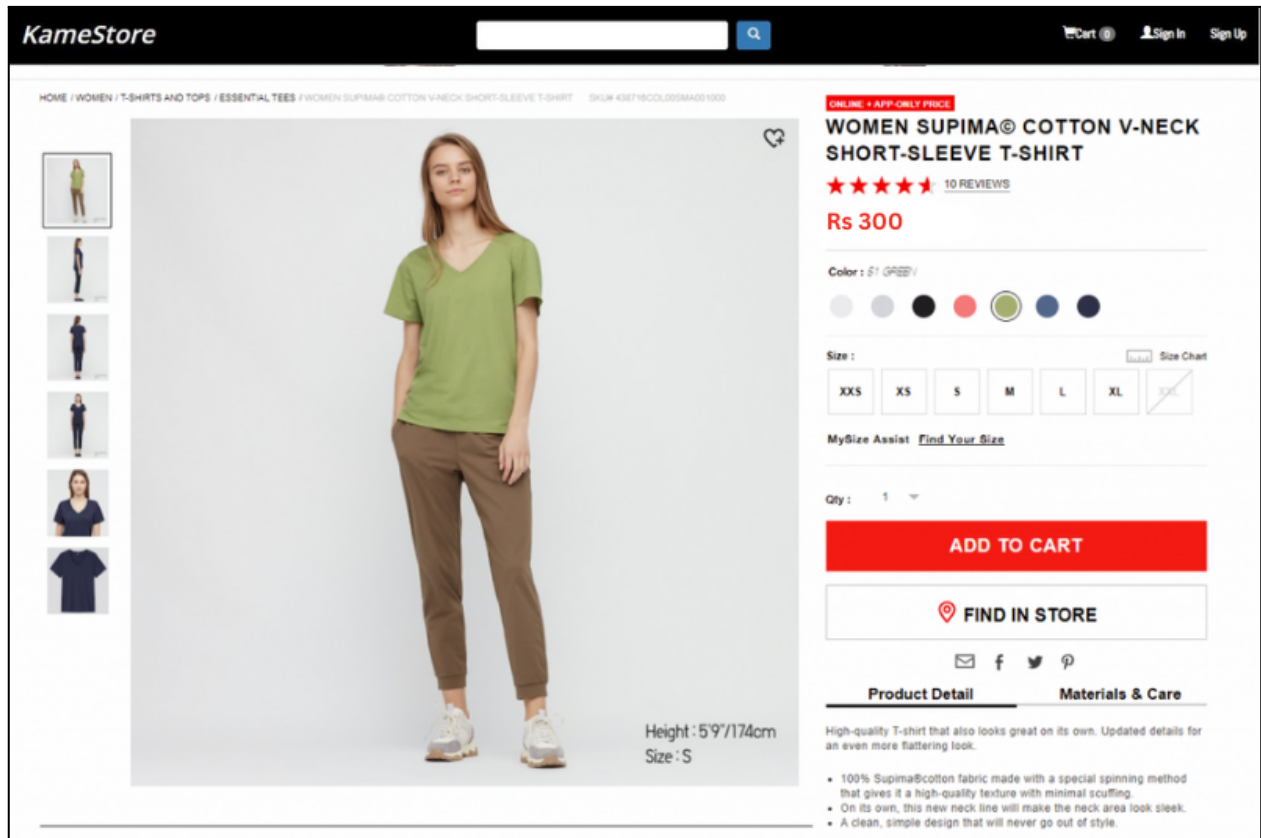

Figure 15. Product Page

CART PAGE:-

The cart page (also known as a shopping cart or basket) is a webpage on our e-commerce site that displays a customer's current order. The cart page typically shows a list of the products the customer has added to their cart, along with the quantities and prices. Customers can typically edit the quantities of each item or remove items from their cart altogether. The cart page may also display the subtotal, taxes, shipping costs, and total order costs. From the cart page, customers can proceed to checkout to complete their orders or continue shopping to add more items to their cart. A well-designed cart page is important for providing customers with a clear overview of their order, and for encouraging them to complete their purchase.
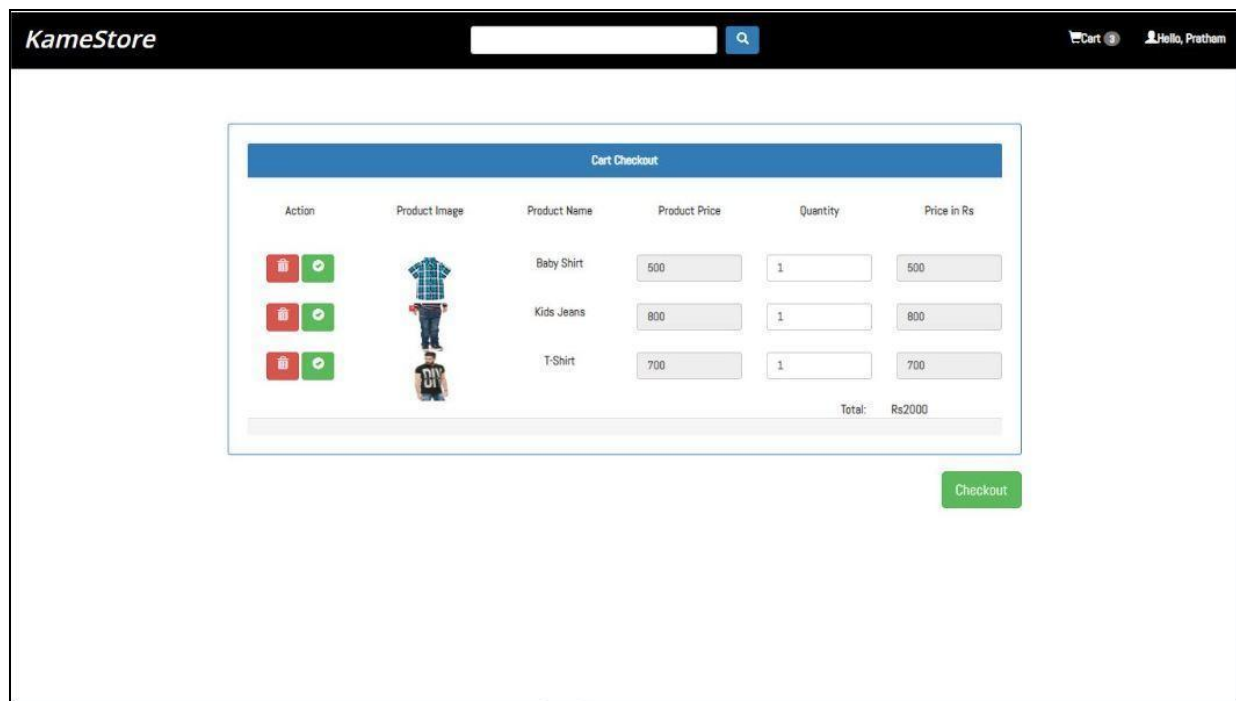
Figure 16. Cart Page

[CHAPTER – 6 : - CONCLUSION]

CONCLUSION

E-Commerce is a flexible answer for consumers and businesses. In this competitive and convenience prominent period, only some people have the time and patience to spend time in markets to buy their products and services. An online store is open all hours a day, every day, which means all your consumers can visit your store whenever they want, regardless of their schedule. E-Commerce is the requirement of the current period, which is being well-served. This project is based on a technology known as MERN stack, which makes it possible to buy and sell products on this online store. This project has features for searching and sorting products based on price and popularity. And it also can store and save user data like profile information, orders, and past searches. The online store is simple to use for sellers, they can easily add products and establish new categories. Consumers will find it quite attractive to look at the products while sitting at home or at the office.

An e-commerce website built using the MERN stack (MongoDB, Express.js, React, and Node.js) is a powerful solution for businesses looking to sell products online. The MERN stack provides a robust and scalable architecture, making it an excellent choice for building complex web applications like e-commerce websites. With MongoDB as the database, Express.js as the web application framework, React for building the user interface, and Node.js for server-side scripting, the MERN stack offers a comprehensive and cohesive development environment. This full-stack JavaScript approach allows developers to build efficient and responsive e-commerce websites that can handle high volumes of traffic and provide a seamless user experience. An e-commerce website built using the MERN stack can offer a range of features and functionalities, such as product listings, search and filtering options, shopping carts, payment gateways, and order tracking. These features can be tailored to the specific needs of the business, ensuring that the website meets the unique requirements of the e-commerce industry. Overall, an e-commerce website built using the MERN stack is a powerful tool for businesses looking to expand their online presence and sell products to a wider audience. By leveraging the capabilities of the MERN stack, developers can create robust and reliable e-commerce websites that provide a seamless and enjoyable shopping experience for customers.

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PROJECT GROUP MEMBERS' PHOTOGRAPHS
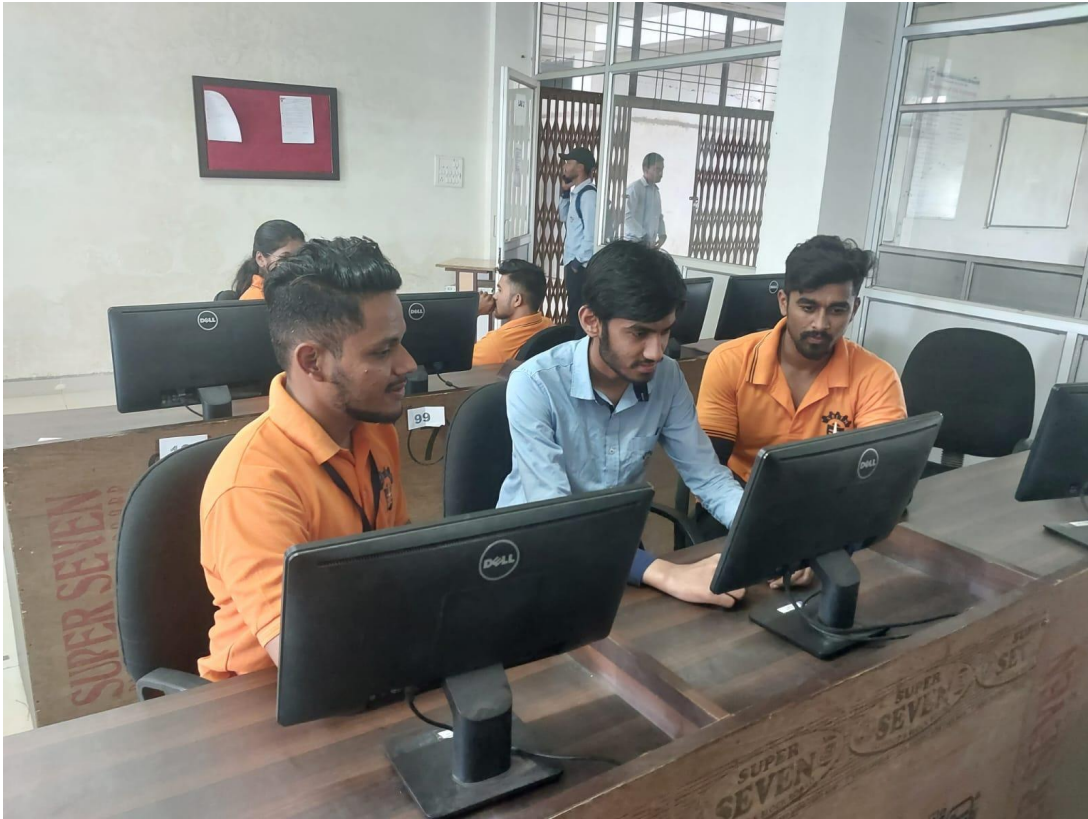
APPENDICES :-

Following abbreviations have been used in this document:

ASP   :   Active Server Pages

JSON   :   JavaScript Object Notation

BSON :   Binary JavaScript Object Notation

PHP   :   Hypertext Preprocessor

MERN :   MongoDB, Express, React.js, Node.js

JSX   :   JavaScript Syntax Extension

HTTP   :   Hypertext Transfer Protocol

HTML :   Hypertext Markup Language

CSS   :   Cascading Style Sheets

REST   :   Representational State Transfer

API   :   Application programming interface

URL   :   Uniform Resource Locator

NPM   :   Node Package Manager

NoSQL :   Non-Structured Query Language

MVC   :   Model View Controller

UI   :   User Interface

ODM   :   Object Data Modeling DOM Document Object Model

JWT   :   JSON Web Token

B2C   :   Business to Customer

[RESEARCH PAPER & CERTIFICATE]

E-Commerce Website Using MERN Stack

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Shri Balaji Institute of Technology and
Management

Abstract: **In our present generation, e-commerce has taken over and become a new normal in our lives. These days most people choose to buy products online instead of paying a visit to the market. As nearly everyone in the world now has access to the internet, the number of people making purchases online is increasing exponentially. Online shopping is far more convenient as customers don't have to leave their homes and they can make any purchases at any time of day from anywhere. The market for digitalized shopping will grow in this decade of digitization. This project is created using the MERN Stack, which includes MongoDB, the Express.js framework, the ReactJS library, and the NodeJS environment. MERN is one of the most powerful stacks for developing full-stack web applications. This application is fully functional and has many different features. We can easily purchase many different types of products by using this web application with some clicks.**

Index Terms: E-commerce, Mern Stack, Framework, Library, React.js, Node.js, Express.js, MongoDB.

I. INTRODUCTION

E-commerce, or simply electronic commerce, is the term used to describe the buying and selling of products and services via the Internet. E-commerce is a massive industry that has grown dramatically in recent years, providing more benefits and conveniences than offline businesses. The fashion of interaction between businesses and customers has also changed drastically because of the internet boom and rapid innovations and development of the logistics industry, and E-commerce has even made it possible for small businesses to commerce with customers globally. Recognizing this need, we made the decision to create an E- commerce web application as our project. This project is implemented using the MERN Stack. MERN Stack is an open-source JavaScript-based stack that is used for building dynamic web applications more quickly and easily. It is a combination of modern technologies for building high-end online apps. MERN Stack is a package of MongoDB, Express, React, and Node.

II. LITERATURE SURVEY

E-commerce is the buying and selling of products, raw materials, and services via the Internet. It is a rapidly growing industry expected to continue expanding in the coming years. To create an e-commerce website, various technologies can be used. The MERN stack is one such technology that we put to use. This research explores the use of the MERN stack in developing e-commerce websites.

The MERN stack is a package of four technologies: MongoDB, Express, React, and Node.js. MongoDB is a NoSQL database that allows for scalable and flexible data storage. Express is a framework for Node.js that facilitates the development of web-based applications. React is a JavaScript library that makes it possible to create interactive user interfaces. Node.js is a JavaScript runtime environment that enables server-side programming.

MERN stack provides various advantages for building e-commerce websites such as the potential to build dynamic single-page applications utilizing React, the scalability and adaptability of MongoDB for storing massive amounts of data, and the server-side programming ability of Node.js. However, there are some potential drawbacks to employing the MERN stack such as the complicated learning curve for developers

unfamiliar with JavaScript, possible inconsistencies in data management with NoSQL databases such as MongoDB, and limited scalability of Node.js.,

Nevertheless, the MERN stack is widely regarded as a useful technology for building e-commerce websites. The use of React allows for the development of dynamic and responsive user interfaces, while MongoDB provides scalability and flexibility for storing significant amounts of data. Despite some limitations, the benefits of the MERN stack make it a suitable option for developing e-commerce websites.

II. E-COMMERCE

E-commerce, also known as E-comm, EC for short, is a concept concerning transactions, buying and selling of goods and services via the internet. E-commerce first surfaced in the 1960s. E-commerce gained popularity after the introduction of devices like laptops and mobile phones, and social media progressively ensured the strength and expansion of web-based apps. Launchers encourage the quick growth of commerce (especially online commerce). The internet is what drives e-commerce. Customers use their own devices to access a website or mobile app to browse the products and place orders for products or services.

Types of E-commerce:

1) B2B (Business to Business): Business-to-business electronic commerce, or B2B, refers to the online buying and selling of   goods and services between corporations. B2B commerce is different from B2C commerce, which is business-to-consumer online sales of products or services to consumers.

2) B2C (Business to Consumer): Business-to-consumer (B2C) e-commerce also known as retail e-commerce, refers to the business model that involves the act of selling products and services directly to the consumers. Most of the enterprises that conduct business directly with consumers are referred to as B2C companies.

3) C2C (Consumer-to-Consumer): This is a reference to an interpersonal commercial transaction. Without any use of middlemen, individuals can sell goods, supplies, and services through the marketplaces that are specifically built for that purpose.

4) C2B (Consumer-to-Business): An exact polar opposite of a C2B model is a B2C model. In contrast to the B2C model, which is handled by a business on behalf of the customer, the C2B model allows end users to offer their products and services to businesses. The approach is regularly employed in crowdsourcing-based projects, the kinds of which frequently entail the production of logos, the sale of royalty-free photos, media, design elements, etc.

5) B2A (Business-to-Administration): This model facilitates online transactions between companies and public administration, i.e., sharing of information through central websites, empowering both governments and businesses to transact online. Using these platforms, businesses can submit bids for government opportunities such as auctions, tenders, application submissions, etc. The scope of this system has grown as a result of the resources dedicated to e-governance.

6) C2A (Consumer-to-Administration): The C2A model describes the online transactions between individual citizens and governmental authorities. With the help of the C2A e-commerce model, consumers can communicate and interact with the local governmental authorities to ask questions and exchange information on the public sector.

III. METHODOLOGY USED

A. MERN STACK:

The MERN stack is a collection of four different technologies that work together to create dynamic web applications and websites. We have used MERN Stack as our main full-stack technology in the development of the project application.
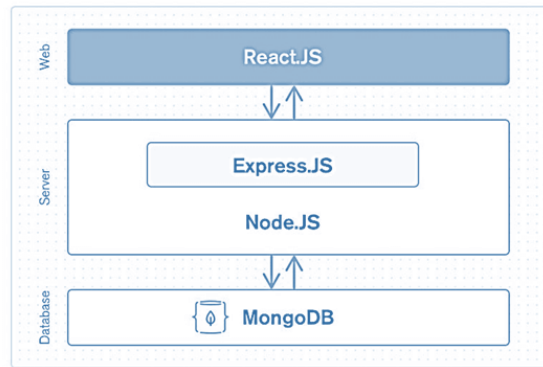
Fig. 1. Three layers of the MERN stack

The following are the components of the MERN stack:

1) MONGOBD: The MERN stack utilizes the database known as MongoDB. It is a NoSQL document-oriented database with a flexible schema and a query language based on JSON.

There is no prescribed schema that must be complied with when storing an object in a MongoDB database. It's not necessary for every document in a collection to have the same set of fields. As a result, you don't need to add or rename columns in the schema, particularly for the early phases of development.

MongoDB is a document-oriented database. A document or object is a unit of storage (which is comparable to a row), while many documents are stored in collections (which is comparable to a table). Each document in a collection has a special identification that can be used to access it. The identifier is automatically indexed. In addition to the fact that many contemporary businesses—including Facebook and Google—use MongoDB in their operations.
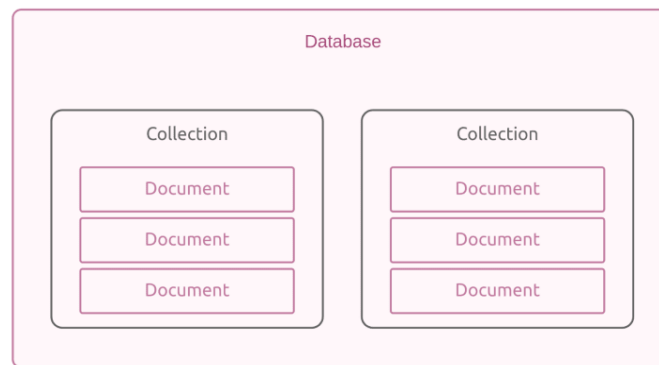

Fig. 2. The architecture design of MongoDB

2) EXPRESS.JS: Express.js is a framework that's built in conjunction with Nodejs. Express is an open-source server format that is created altogether in JavaScript. It has great features for building web-based applications and mobile applications. Additionally, Express.js supports HTTP and middleware methods, giving the API an incredible amount of power and making it simple to use.

A framework based on Node.js is Express.js. Instead of slowing down NodeJS, Express implements extra features that developers can use and have a better development environment. Importantly, the well-known frameworks of NodeJS like Sails.js and MEAN include Express.js as a core component.

It is used to create web-based applications that are single-page, multipage, and hybrid. Express.js is a quick, assertive, essential, and moderate web framework of Node.js. You can think about express as a layer built on top of the Node.js that aids in managing a server and routes. It offers an extensive set of features to create online and mobile applications. Because of its simple architecture and standard adjustments, Express is the foundation for several JavaScript components, including feathers, KeystoneJS, Kraken, and Sails.

3) REACT.JS: ReactJS is an open-source client-side JavaScript library that is declarative and flexible in nature and is used for creating reusable UI components. It is a component-based front-end library that

mainly handles the application's view layer. Facebook created it and now maintains it with a group of developers and companies. Each React web application is made up of reusable components that make up various user interface elements. For example, we can have discrete components for our navigation bar, the footer, the main content, and so on. Development became easier because of the elimination of the need to repeat repetitive code, all thanks to these reusable components. The only task left is to develop its logic and import the component into the proper section of the code.

4)   NODE.JS: Node.js open-source cross-platform server environment. It is a JavaScript runtime environment that is used for carrying out and implementing scalable JavaScript applications that are being used for building networking and server-side JavaScript applications. It is one of the most powerful cross-platform runtime environment that helps developers to build scalable web servers and web clients.

NodeJS is a runtime environment developed on Google Chrome's V8 engine for creating fast and scalable network web-based applications, and because of it, its execution time is very quick, and it runs very swiftly. It is employed for developing I/O-intensive web apps such as video streaming websites, single-page web applications, and other web applications. Node.js is lightweight and efficient, making it perfect for highly data-intensive real-time web applications that run across numerous distributed devices. It uses an event-based, non-blocking I/O architecture.

NodeJS does not require standing by and waiting for an API to return the data, so for building high data-intensive and real-time web applications, it is very helpful. Nodejs is asynchronous in nature which implies it is non-blocking. Because of better code synchronization between the client and server due to having the exact same code base, NodeJS speeds up the loading time for audio and video files.
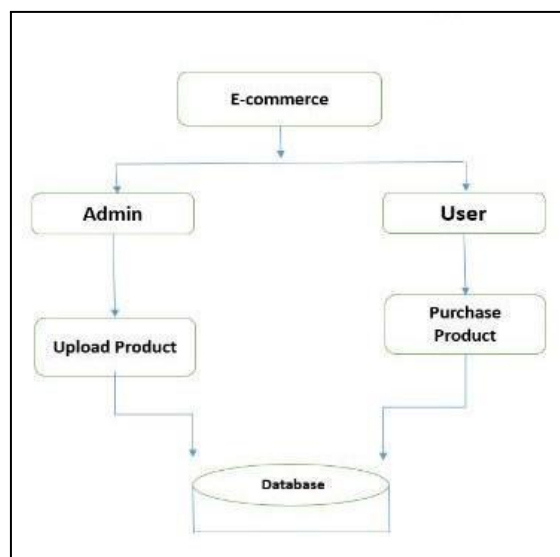
B. ARCHITECTURE DESIGN:

Fig. 3. Architecture Design of E-commerce Website.

IV. ADVANTAGES

1) Market at the global scale with a huge customer base.

2) Saves customer time.

3) Easy to maintain and scale up.

4) A wide variety of products.

5) Accessible anywhere at any time.

6) Precise and targeted marketing.

VI. RESULTS

The initial version of an electronic commerce application that reproduces an online store was successfully

built by leveraging all four key technologies that comprise the MERN stack and making use of numerous Node modules. This particular programme is made to be effective, simple to use, and run smoothly.

A. HOME PAGE:

The project's home page mostly includes a list of the products that have been saved in the database. And there is a search bar and some options that are displayed on the navigation bar, such as "Sign in" and "Sign up" options. Sign-In and Sign-Up Option: Sign-in and Sign up are two-option on the navigation bar of the page where the user clicks on the sign-in option then the user can fill out a form to sign in with an account. And on clicking the sign-up option user will redirect to the sign-up page.
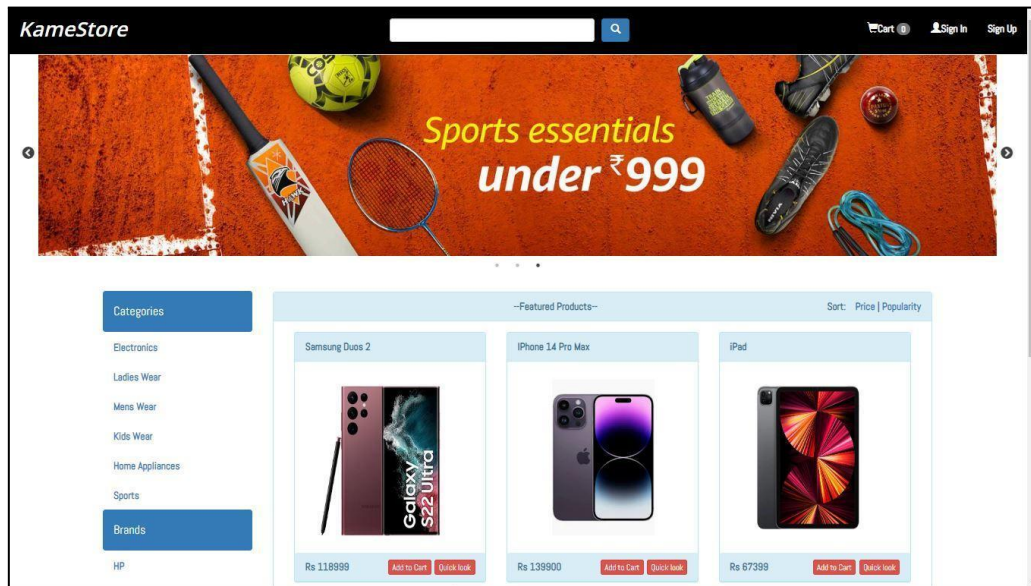

Fig. 4. Home Page

B. SIGNUP PAGE:

The project's Sign Up page is a page where users can sign up and acquire access to your system on their own using the signup page.
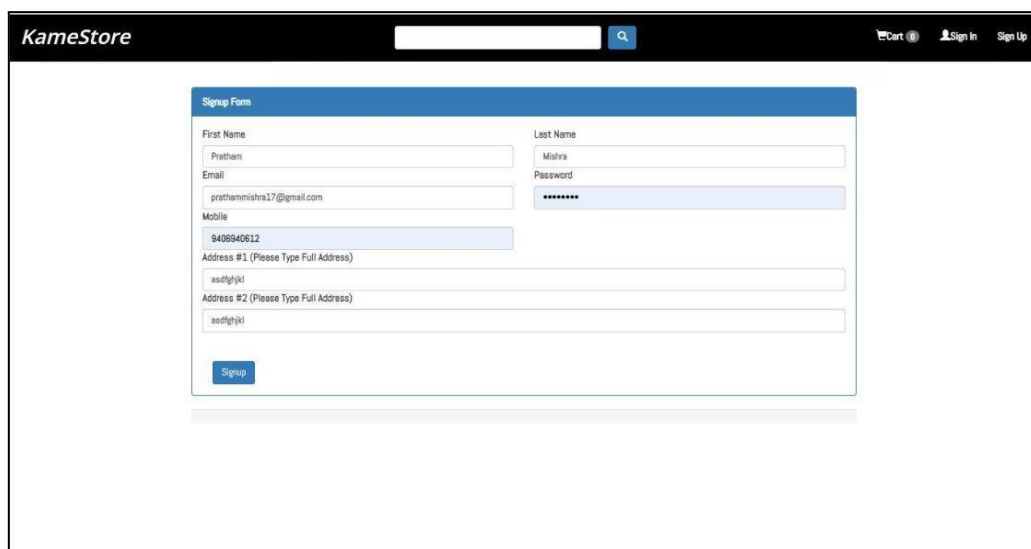

Fig. 5. Sign-up Page

C. CART PAGE:

On the project's cart page, users can simply add everything to their cart and check out by making an online payment on this page. After adding any product to the cart user gets their product on this page and can pay for the product and then carry out the shipment details procedure to place the order. Payment can be done
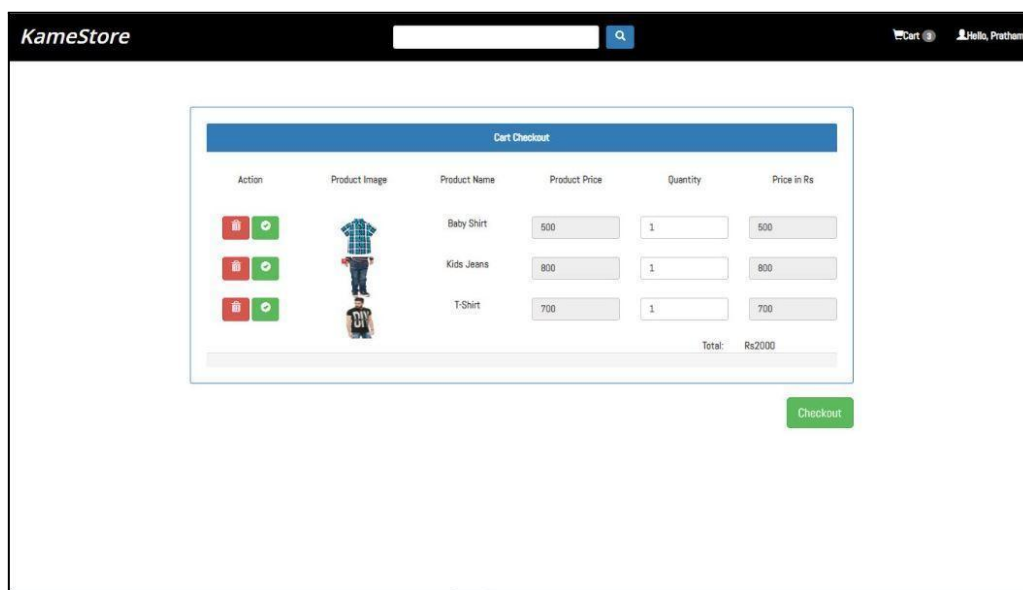
with the help of credit/debit card and UPI.

Fig. 6. Cart Page

VII. Conclusion

E-Commerce is a flexible answer for consumers and businesses. In this competitive and convenience-prominent period, only some people have the time and patience to spend time in markets to buy their products and services. An online store is open all hours a day, every day, which means all your consumers can visit your store whenever they want, regardless of their schedule. E-Commerce is the requirement of the current period, which is being well-served. This project is based on a technology known as MERN stack, which makes it possible to buy and sell products on this online store. This project has features for searching and sorting products based on price and popularity. And it also can store and save user data like profile information, orders, and past searches. The online store is simple to use for sellers, they can easily add products and establish new categories. Consumers will find it quite attractive to look at the products while sitting at home or at the office..

VIII. Acknowledgment

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