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React based fullstack edtech web application

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Abstract - *This research paper provides a detailed exploration of the architectural framework employed in the educational technology (ed-tech) platform. The platform comprises three principal components: the front end, back end, and database, adhering to a client-server architecture. The front end, developed using ReactJS, ensures dynamic and responsive user interfaces crucial for an immersive learning experience. The back end, constructed with NodeJS and ExpressJS, offers scalable APIs for functionalities like user authentication and course management. MongoDB, a NoSQL database, is employed for flexible and scalable data storage, accommodating diverse types of course content and user data. The paper includes an architecture diagram to visually represent the system's structure.*

Key Words: Technology and education, Synergies, Transformative potential, MERN stack, User interface

1.INTRODUCTION

EdTech is a mix of "Education" and "Technology" and it's also called learning technology or instructional technology. Education technology means using technology to help people learn better and have easier access to education. This can include things like computers, programs, and other items that teachers and students use for learning. Education is changing. Instead of just learning online, now students are using iPads and interactive displays in the classroom to help them learn. This includes whiteboards and other new technology to help with education. We have seen technology change the education industry a lot. In the pandemic, many students had to learn from home. Technology became very important for education. This led to the creation of educational computer programs. Right now, the Edtech industry is working every day to change the way we do education and how we manage learning. An education technology platform that focuses on its MERN stack base and REST API structure. The progress being made will bring improvements in how things work and in how the interface looks, but we expect there will be some difficulties, especially in bringing different technologies together and fixing any problems that come up. We want to make a website for learning that is easy to use and works well.

2. LITERATURE SURVEY

1.Bhavyaa, Suhani Gupta, Ms. Vaishali: The complicated problem was finally solved by the team of experts. Bhavyaa and Suhani Gupta, and their teacher Ms. Vaishali said that in a study called "Comprehensive Study Of MERN Stack – Architecture, Popularity and Future Scope," the authors discussed the main things that influence their decision when choosing software. They consider how easy it is to learn, the support from the community, what their clients need, and if there are developers available for that specific software. Time to load, add, update, and delete tasks. Using client-side software like Vue.

2.Earl A. Evans, S. Murray: Earl A Evans, S Murray wrote a paper about how new technology has made online education better. In the study, we measured how satisfied the faculty were with the web-based course tools, how well they thought the tools worked, how often they used them, and how important they thought the tools were for teaching the course.

3.Preeti Manchekar , Aakash Patil, Ashutosh Patil, Shruti Pawar, Sulochana Madachane: Preeti Manchekar , Aakash Patil, Ashutosh Patil, Shruti Pawar, Sulochana Madachane: The paper titled “Design and Implementation of Ecommerce Web Application using MERN Stack and Data Science” addresses social media.The social media has been influencing e-commerce in multiple ways by being a platform of marketing for e- commerce business over the years .Performance metrics of the e-commerce platform and accuracy/effectiveness of the sales forecasting feature using the ARIMA model.

4.S.Ivanova, Georgi Georgiev: In an education application : A practical approach" addresses modern web frameworks that manage to cope with this client- side complexity by adopting a mindset oriented towards the design of robust and complex applications that can be delivered quickly with a high level of security , scaled easily, and extended simply. the study titled "Using modern web frameworks when developing.

5.Christopher Rafael, Philipus Wijaya Adikusumo, Ngurah Agus Sanjaya, M. S. Anggreainy: In the study titled "Application of Software Engineering in Intermediate and Higher Education through Web Apps Development" The paper concludes by summarizing the key contributions of the research, highlighting the successful development of a fully functional. WebApp designed to assist high school and university students in their online studies. The conclusion also reflects on the broader implications for the intersection of software engineering and education, setting the stage for further exploration and development in this dynamic field. The main or primary outcomes measured in the study is the improvement of online learning for high schoolers and university students.

6.Billie Jack Pasion: The paper titled "Development and Assessment of Web Application for Industrial Technological Education" addresses the WAITE . The WAITE was made to help teachers and students with flexible learning. Evaluation of the Web Application for industrial Technological Education (WAITE) by IT professionals , teachers and students ,focusing on its technical characteristics (functionality, efficiency, reliability, usability, maintainability and portability) and instructional use.

2. METHODOLOGY

1.Requirement Analysis: We need to carefully study what users need for education and what the platform should do. This will help us understand what the platform needs to do and what it shouldn't do.

2. Technology Stack Selection: Choosing the right technology: Decide on the best technology for the front end, back end, and database based on what the platform needs and the benefits of using ReactJS, NodeJS, ExpressJS, and MongoDB.

3.Front-end Development: The front-end of the website will be built using ReactJS to create the design shown in Figma. Create and put together pages like Homepage, Course List, Wishlist, Cart Checkout, Course Content, User Details, and User Edit Details for students, and Dashboard, Insights, Course Management Pages, and View/Edit Profile Details for instructors.

4.Styling and UI Frameworks: Using CSS and Tailwind frameworks to make the user interface look good and work well on different devices. Use the Figma design as a guide to make sure everything looks the same and follows the style rules.

5.State Management: Use Redux to manage the state of the application on the front end. It helps to organize and share the state across different parts of the application. This makes sure that the user's experience is smooth and things happen all at the same time.

6.Back-end Development: Building a strong and flexible server is what we do by using Node. js and Expressjs in a monolithic way. Use technology to make sure that only authorized users can access the system. Also, use technology to manage courses and handle payments. We will use JWT for security and Razor pay for handling payments.

7.Database Design and Implementation: Designing and making a plan for storing information about students, teachers, and courses using MongoDB. Create a system to save and find user information, course content, and other important details in a database.

8.API Design and Implementation: Design and make API endpoints using Node. js and Expressjs following RESTful principles. Create ways for users to log in, manage courses, and use other important features that are described in the API section.

9.Security Measures: Use tools like JWT to make sure only authorized users can access the system, Bcrypt to keep passwords secure, and use secure methods to send and receive user data to protect their privacy and keep it accurate.

10.Deployment: Utilize Vercel for deploying the front end, and Render or Railway for deploying the back end. Host media files on Cloudinary and the database on MongoDB Atlas. Ensure seamless integration between all components in the production environment.

11 Testing: Do a lot of testing to find and fix any problems in the system. This includes testing small parts, testing how everything works together, and letting users try it out to make sure it works well.

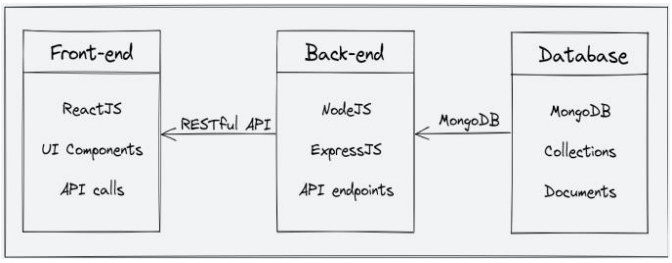
12.Documentation: Create comprehensive documentation covering the architecture, API design, and deployment process for future reference and maintenance.

13.Future Enhancements: In the future, we plan to make improvements to our program. We will consider adding fun features, personalized learning options, social learning features, a mobile app, and virtual reality/augmented reality. Set a schedule and decide what things are most important for each improvement.

14.Challenges and Debugging: Address challenges faced during development, especially in integrating different technologies. Implement effective debugging strategies to ensure the stability and reliability of the platform.

15.User Feedback and Iterative Development: Gather user feedback through beta testing and user reviews. Iterate on the platform based on user suggestions and identified areas for improvement.

3. SYSTEM DESIGN



The introduction contextualizes the significance of architectural considerations in ed-tech platforms, emphasizing the role of technology in shaping modern educational experiences. It introduces the ed-tech platform as a case study for architectural analysis.

1.Front-end Architecture: The front-end component, developed with ReactJS, is elucidated. ReactJS's utility in creating dynamic and responsive user interfaces is discussed, emphasizing its pivotal role in enhancing the interactive learning experience for students. The section details the front end's communication with the back end through RESTful API calls.

2.Back-end Architecture: The back-end architecture, constructed with NodeJS and ExpressJS, is examined. We chose these frameworks because they are strong and can handle big projects for building server applications. The section delves into the APIs provided by the back end, encompassing functionalities such as user authentication, course creation, and consumption. The logic for processing and storing course content and user data is explicated.

3.Database Architecture: The database architecture, leveraging MongoDB as a NoSQL solution, is scrutinized. MongoDB's flexibility and scalability for storing unstructured and semi-structured data are discussed, particularly in the context of accommodating diverse course content like videos, images, and PDFs. The database's role in storing course content, user data, and other pertinent information is outlined.

4.Architecture Diagram: A high-level architecture diagram is presented, offering a visual representation of the ed-tech platform. The picture shows how the front end, back end, and database are connected and how data moves between them in the system.

5.Comparative Analysis: This section compares the chosen architectural components with alternative technologies, highlighting the rationale behind selecting ReactJS, NodeJS, ExpressJS, and MongoDB. The analysis aims to provide a comprehensive understanding of why these technologies were deemed suitable for web application's platform.

6. Scalability and Performance Considerations: The paper discusses scalability and performance considerations inherent in the architectural choices, outlining strategies employed to ensure the platform's ability to handle increasing user loads and deliver optimal performance. 8. Security Measures: Security measures integrated into the architecture are detailed, addressing aspects such as data encryption, user authentication protocols, and safeguarding against potential vulnerabilities.

1.For Students:

1. Homepage: Offers a platform introduction with links to the course list and user details.

2. Course List: Displays available courses with descriptions and ratings.

3. Wishlist: Presents courses added to a student's wishlist.

4. Cart Checkout: Facilitates course purchases.

5. Course Content: Provides detailed course materials including videos.

6. User Details: Displays information about the student's account.

7. User Edit Details: Allows students to modify their account information.

2.For Instructors:

1. Dashboard: Offers an overview of the instructor's courses, along with ratings and feedback.

2. Insights: Provides detailed metrics for the instructor's courses.

3. Course Management Pages: Enables instructors to create, update, and delete courses.

4. View and Edit Profile Details: Allows instructors to manage their account information.

3.For Admin (future scope):

1. Dashboard: Offers an overview of the platform's courses, instructors, and students.

2. Insights: Provides detailed metrics, including registered users, courses, and revenue.

3. Instructor Management: Allows the admin to manage instructor accounts, courses, and ratings.

4.Development Tools: The front end is built using ReactJS, a popular JavaScript library for UI development. CSS and Tailwind, styling frameworks, enhance the aesthetic appeal

and responsiveness of the user interface. To add functionality, npm packages are employed, while Redux, a renowned state management library for React, ensures effective state handling. The development environment of choice is VSCode, a widely used code editor.

4. CONCLUSIONS

In conclusion, the ed-tech platform emerges as a robust and scalable solution poised to revolutionize online learning. The adoption of the MERN stack, coupled with meticulous RESTful API design, sets the foundation for a seamless client-server architecture. Notably, ReactJS orchestrates an engaging front end, while the back end leverages the prowess of Node.js and Express.js, with MongoDB ensuring flexible data storage. The timing aligns perfectly with the advancements in technology, enabling and enhancing learning across diverse backgrounds and settings. The modernization of E-rate and the widespread adoption of openly licensed educational resources create a fertile environment for realizing the full potential of technology in education. The deployment strategy, whether through Vercel, Render.com, or Railway.app, and MongoDB Atlas, underscores a commitment to reliability. This strategic approach ensures that the ed-tech platform is well-equipped to meet the demands of users seeking a responsive and dependable online learning experience. Looking forward, the vision for the platform extends beyond its current capabilities. Future enhancements, such as the integration of gamification features, personalized learning paths, and the development of a mobile application, demonstrate an ongoing commitment to improvement. These envisioned additions aim to elevate the platform's functionality and user experience, aligning with the evolving landscape of educational technology. It is important to acknowledge the inevitable challenges associated with integrating diverse technologies and debugging processes. However, as the project progresses, milestones will be achieved, showcasing the successful realization of planned functionalities.

The dedication to delivering a user-friendly interface underscores the platform's commitment to enhancing the educational journey for its users. In essence, the ed-tech platform represents more than just a technological solution—it symbolizes a transformative force in the educational landscape. By using new technology and thinking ahead, the platform shows how online learning is getting better and always changing.

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