Full Stack Development with MERN

Introduction:

* Project Title: Online Learning Platform
* Team Members:
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  + Praveen P (2021503035): Frontend developer.
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Project Overview:

* Purpose:

To provide a flexible, accessible, and user-friendly platform for online learning, enabling learners and instructors to connect, share knowledge, and achieve educational goals through interactive and self-paced courses.

* Features:
  + User-Friendly Interface: Simplified navigation for learners and instructors.
  + Course Management: Upload, organize, and track course materials and progress.
  + Interactivity: Discussion forums, live webinars, and real-time chat support.
  + Certification: Digital certificates upon course completion.
  + Accessibility: Multi-device compatibility for learning anytime, anywhere.
  + Self-Paced Learning: Freedom to progress through content based on individual schedules.
  + Payment Options: Free and premium courses with secure payment systems.

Architecture:

* Frontend:

The frontend is built using React.js, employing a component-based architecture to ensure modularity and reusability. Key elements include:

* + Routing: React Router for navigating between pages such as course browsing, user profile, and course details.
  + UI Libraries: Bootstrap and Material-UI for responsive and user-friendly design.
  + State Management: Context API or Redux (optional for scalability) to manage application-wide states like user authentication and course enrollment.
  + API Integration: Axios is used for communication with backend RESTful APIs to fetch and send data in real-time.
* Backend:

The backend is developed using Node.js and Express.js, designed with a layered architecture:

* + Route Layer: Handles API endpoints for user actions (e.g., registration, course enrollment).
  + Controller Layer: Manages the business logic for processing requests and responses.
  + Service Layer: Handles data manipulation and interaction with the database.
  + Middleware: Implements features like authentication (JWT) and error handling.
  + Real-Time Features: WebSocket or libraries like Socket.IO (optional) for live chat and webinar functionality.
* Database:

The database uses MongoDB to store and retrieve structured data. The schema includes:

* + User Collection: Stores user details (e.g., name, email, password, role [student/instructor], enrolled courses).
  + Course Collection: Contains course information (e.g., title, description, instructor, modules, pricing).
  + Progress Collection: Tracks individual learner progress (e.g., completed modules, scores).
  + Payments Collection: Manages payment records and subscriptions for premium courses.
  + Database interactions use Mongoose, providing a clear schema definition and efficient query handling. The relationships are designed to ensure flexibility and scalability, allowing seamless addition of new features.

Setup Instructions:

* Prerequisites:
  + Node.js (v16.x or later) - For running the backend and managing dependencies.
  + MongoDB (v5.x or later) - For database storage.
  + Git - For cloning the project repository.
  + Web Browsers - Two installed browsers for testing (e.g., Chrome and Firefox).
  + Code Editor - Recommended: Visual Studio Code (VS Code).
  + Internet - Minimum bandwidth of 30 Mbps.
* Installation:
  + Clone the Repository:

git clone <repository-url>

cd <project-directory>

* + Install Dependencies:
    - For Frontend:

cd frontend

npm install

* + - For Backend:

cd backend

npm install

* + Set Up Environment Variables:
    - Create a .env file in the root of the backend directory with the following values:

PORT=8000

MONGO\_URI=<your-mongodb-connection-string>

* + Start the Application:
    - Run Backend:

cd backend

npm start

* + - Run Frontend:

cd client

npm start

* + Access the Application:
    - Open a browser and navigate to http://localhost:5173.
  + Testing and Usage:
    - Register as a user or instructor to explore features.
    - Upload courses, enroll, and simulate interactions.

Folder Structure:

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Running the Application:

* To run the application locally, use the following commands:
  + Frontend:
    - Navigate to the client directory and start the frontend server:

cd frontend

npm start

* + - This will launch the React application at http://localhost:5173.
  + Backend:
    - Navigate to the server directory and start the backend server:

cd backend

npm start

* + - The backend server will run on http://localhost:8000 (or the port specified in the .env file).
  + Ensure both servers are running simultaneously for full functionality.

API Documentation:

Authentication:

User Interface:

Testing:

* The project follows a comprehensive testing strategy to ensure the application's functionality, performance, and reliability. Testing is divided into the following stages:
* Unit Testing:
  + Focuses on testing individual components or modules in isolation.
  + Examples: Testing backend APIs (e.g., user registration, course creation).
* Integration Testing:
  + Verifies that different modules work together as expected.
  + Examples: Ensuring the frontend properly integrates with backend APIs.
* Manual Testing:
  + Performed for exploratory and UI/UX testing to ensure the user interface meets expectations.

Screenshots or Demo:

Known Issues:

* File Upload Limitations:
  + Large files may take longer to upload or could fail due to server limitations.
  + Potential Fix: Optimize file upload configurations and enable cloud-based storage like AWS S3 or Google Cloud Storage.
* Error Handling:
  + Some API responses might not provide detailed error messages, making debugging difficult.
  + Potential Fix: Improve error handling middleware for descriptive error responses.
* Token Expiration:
  + Users need to log in again when their JWT token expires, which might disrupt the learning experience.
  + Potential Fix: Implement token refresh functionality.

Future Enhancements:

* AI-Powered Recommendations: Use machine learning to recommend courses based on user interests, progress, and feedback.
* Localization: Add multi-language support to cater to a global audience.
* Live Class Integration: Allow instructors to schedule and conduct live classes or webinars directly on the platform using tools like Zoom or WebRTC.
* Course Reviews and Ratings: Enable students to leave feedback and ratings for courses, helping others make informed choices.
* Third-Party Integration: Integrate with platforms like LinkedIn for certification sharing and professional networking.