



DEVELOPMENT OF AN ONLINE CLASS AND MODULE WEB APPLICATION UTILIZING THE MERN STACK: A COMPREHENSIVE APPROACH

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Abstract: The rise of online education has brought about a new era of learning, bringing with it various opportunities and challenges for both educators and learners. One particular challenge is the lack of comprehensive, user-friendly platforms that cater to the changing needs of modern education. To address this issue, the focus of this study is on developing an online class and module web application using the MERN (MongoDB, Express.js, React.js, Node.js) stack.

Acknowledging the necessity for an all-encompassing solution, we explore the intricacies of educational technology, pinpointing the main drawbacks of current platforms. Our strategy revolves around creating a well-rounded application that is carefully designed to tackle these shortcomings and provide a compelling option for educators and learners. By following a thorough process that includes conceptualization, design, implementation, and evaluation, we navigate the complex world of web application development, guided by the principles of usability, scalability, and adaptability.

Leveraging the flexibility of the MERN stack, our platform aims to deliver a smooth user experience that encourages collaboration, engagement, and knowledge retention. Features such as real-time communication, user-friendly interfaces, and robust module management capabilities come together to establish a dynamic learning environment that caters to a variety of educational settings.

Index Terms - Online Class, Web Application, MERN, AlphaEase

Introduction

THE RISE OF DIGITAL TECHNOLOGY HAS TRANSFORMED THE FIELD OF EDUCATION, MARKING THE BEGINNING OF AN ERA CHARACTERIZED BY UNPARALLELED ACCESS AND CREATIVITY. ONLINE LEARNING HAS REVOLUTIONIZED THE WORLD OF EDUCATIONAL COMMUNITY IN THE RECENT PAST AS BEING MORE COST EFFECTIVE AND CONVENIENT FOR LEARNERS IN COMPARISON TO TRADITIONAL EDUCATIONAL SYSTEM [3]. IN LIGHT OF THIS SHIFT, EDUCATORS AND DEVELOPERS ARE CONTINUOUSLY STRIVING TO LEVERAGE TECHNOLOGY TO BUILD DYNAMIC, INTERACTIVE, AND EFFICIENT LEARNING ENVIRONMENTS.

NEVERTHELESS, DESPITE THE ABUNDANCE OF ONLINE EDUCATION PLATFORMS, SIGNIFICANT OBSTACLES REMAIN. CONVENTIONAL LEARNING MANAGEMENT SYSTEMS OFTEN STRUGGLE TO MEET THE DIVERSE NEEDS OF EDUCATORS AND LEARNERS, DISPLAYING DEFICIENCIES IN USABILITY, INTERACTIVITY, AND ADAPTABILITY.

RECOGNIZING THESE LIMITATIONS, THERE IS A GROWING DEMAND FOR COMPREHENSIVE, FEATURE-RICH SOLUTIONS CAPABLE OF ADDRESSING THE INTRICATE DEMANDS OF CONTEMPORARY EDUCATION.

IN THIS CONTEXT, THE CREATION OF AN ONLINE CLASS AND MODULE WEB APPLICATION USING THE MERN (MONGODB, EXPRESS.JS, REACT.JS, NODE.JS) STACK EMERGES AS A PROMISING INITIATIVE. THE MERN STACK, KNOWN FOR ITS FLEXIBILITY, SCALABILITY, AND DEVELOPER-FRIENDLY ENVIRONMENT, PROVIDES A SOLID FOUNDATION FOR DEVELOPING ADVANCED WEB APPLICATIONS TAILORED TO THE SPECIFIC REQUIREMENTS OF ONLINE EDUCATION.

THIS RESEARCH PAPER EMBARKS ON A THOROUGH EXAMINATION OF THE DEVELOPMENT PROCESS, FROM CONCEPTION TO EXECUTION, OF A MERN-BASED WEB APPLICATION INTENDED TO STREAMLINE ONLINE CLASSES AND MODULE MANAGEMENT. BY HARNESSING THE STRENGTHS OF EACH MERN COMPONENT, OUR OBJECTIVE IS TO ESTABLISH A COHERENT, USER-FRIENDLY, AND EXPANDABLE PLATFORM CAPABLE OF ENRICHING THE TEACHING AND LEARNING EXPERIENCE ACROSS VARIOUS EDUCATIONAL SETTINGS.

Through meticulous scrutiny, iterative enhancement, and empirical assessment, we aspire not only to offer a solution to the identified challenges but also to contribute valuable insights to the broader conversation on educational technology.

I. RELATED WORKS:

E-learning, or online learning, has experienced significant growth in recent years due to technological advancements, with nearly every individual possessing their own digital device [2]. An examination of existing online class and module web applications reveals several key objectives that contribute to their effective usage, including their functionalities, user-friendliness, and ease of access.

Zoom emerges as a preferred tool for many individuals seeking to conduct video conferences due to its well-balanced features [1]. However, it is not without its drawbacks, as it often suffers from varying degrees of lag and stutter, particularly in audio transmission [1]. Additionally, while Zoom offers rudimentary tools for modules or assignments, it lacks comprehensive capabilities in this regard.

Udemy stands out as one of the most popular and successful online learning platforms, boasting a vast array of courses (over 65,000) and a large user base (over 20 million learners) [2]. Nevertheless, it lacks affiliation with top universities or established foundations, a feature that distinguishes it from other platforms [2]. Furthermore, Udemy falls short in providing a real-time online class platform, offering only pre-recorded modules.

Similarly, Coursera offers online courses akin to Udemy, but with partnerships with some of the world's leading universities and organizations [3]. Despite this advantage, like Udemy, Coursera does not offer a real-time online lecture platform and instead relies on a module-based design.

Google Classroom serves as a straightforward collaborative tool for teachers and students, equipped with features such as class creation, file and media sharing, and student invitation via links [1]. However, its integration with Google applications and accounts presents limitations, requiring a separate account (apart from Gmail) for classroom access [1]. Moreover, some students have voiced concerns regarding the quality and grading system of Google Classroom [4].

In summary, while various online learning platforms offer diverse features and functionalities, there remain challenges and limitations that impact their effectiveness and user experience.

II. CONTEXT TOOLS:

MERN is a term utilized to describe a distinct collection of JavaScript-based technologies employed in the development of web applications [5]. The MERN stack comprises four distinct frameworks and libraries: MongoDB, Express JS, React JS, and Node JS [6]. Together, they facilitate the implementation of the MVC architecture, ensuring a seamless development process and achieve full stack capabilities [6].

(i) MongoDB:

MongoDB is the alternate database option to traditional SQL databases. Unlike SQL, MongoDB stores data in flexible documents, such as JSON, offering versatility in data storage [5].

MongoDB employs dynamic schemas, allowing for the creation of records without the need to define their structure upfront, including attributes or data types [7]. This model facilitates the representation of hierarchical relationships, storage of arrays, and handling of other complex structures with ease [7].

(ii) Express JS:

Express is a Node.js web application framework renowned for enhancing the capabilities of web and mobile API applications [6]. Express JS offers extensive additional functionality beyond the HTTP module, eliminating the need to reinvent the wheel for common tasks such as request handling, route definition, or static asset rendering [8].

(iii) React JS:

ReactJS is a JavaScript library utilized for crafting reusable user interface (UI) components [9]. React essentially empowers the creation of expansive and intricate web applications capable of updating their data without requiring page reloads. It serves as the View (V) component in the Model-View-Controller (MVC) architecture [9].

(iv) Node JS:

Node.js stands as the prevailing open-source web server environment, enabling the execution of JavaScript code beyond the confines of web browsers [6].

Node.js is a platform constructed upon Chrome's JavaScript runtime, designed for the straightforward development of rapid, scalable network applications. Employing an event-driven, non-blocking I/O model, Node.js achieves lightweight and efficient operation, ideally suited for data-intensive real-time applications spanning distributed devices [10].

III. PROPOSED METHODOLOGY:

This section outlines the design and implementation of the online education platform, "AlphaEase," developed using the MERN stack. AlphaEase is a comprehensive digital solution aimed at providing live and recorded classes to students on college campuses, fostering an efficient learning environment. The platform caters to administrators, instructors, and students, facilitating seamless interaction and learning experiences.

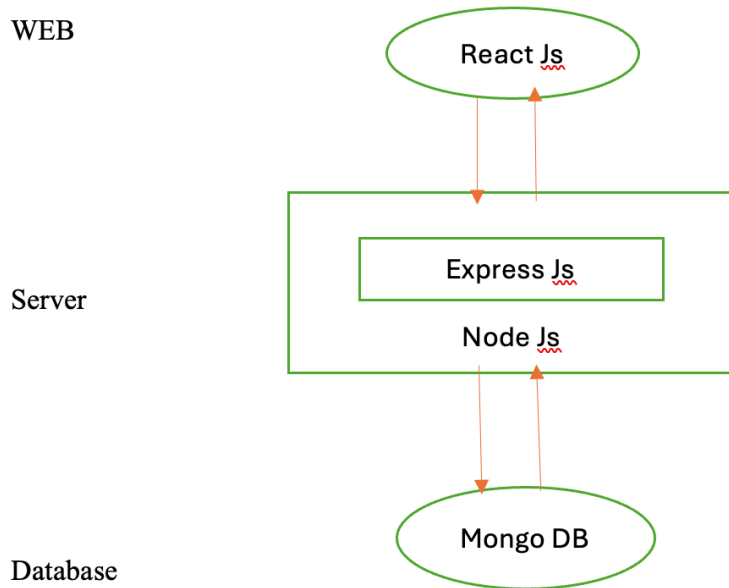
To initiate the development process, requirements were gathered from stakeholders including college administrators, instructors, and students, ensuring alignment with their needs and preferences. This user-centric approach guided the development process to meet the specific demands of the college community.

AlphaEase offers a variety of features to enhance the learning experience. Students have access to a diverse catalog of courses, both live and recorded, offered by instructors. The platform incorporates a user-friendly interface with separate login options for students and instructors, streamlining access to course materials.

Instructors can monetize their expertise by offering paid courses through the platform. They can customize course content, set pricing, and engage with students through live lectures and interactive sessions. The platform empowers instructors to expand their reach beyond physical classrooms, creating new revenue streams.

Administrators benefit from comprehensive tracking and analytics tools, allowing them to monitor student enrollment, course popularity, and revenue generation. Additionally, the platform facilitates communication between stakeholders, enabling administrators to address queries and concerns effectively.

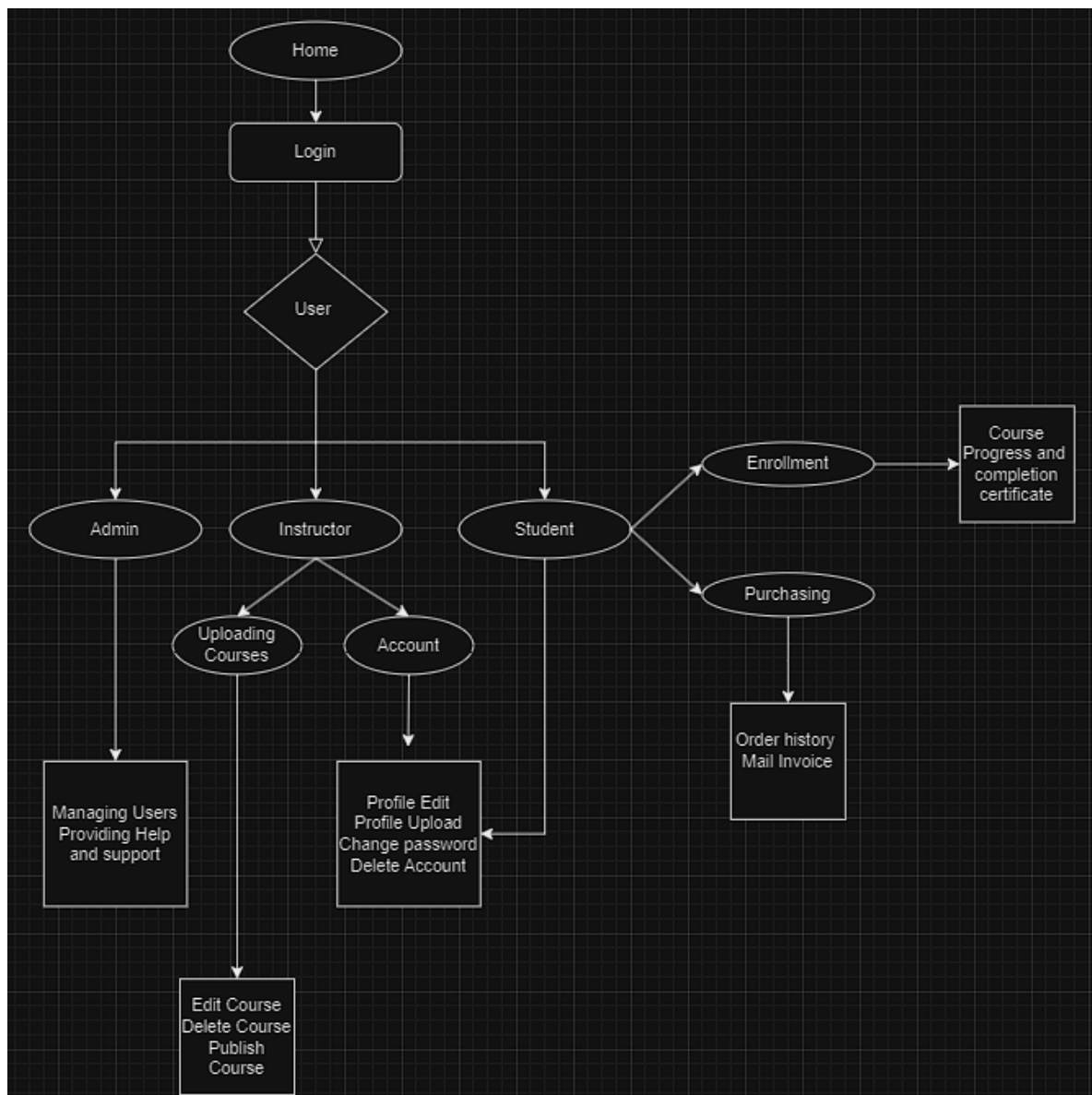
AlphaEase contributes to the sustainability of college campuses by reducing the need for students to seek external resources. By providing a centralized platform for education, it promotes collaboration and knowledge-sharing within the college community.



The AlphaEase web application aims to empower local instructors, educational institutions, and students to generate additional income without the need for significant financial investment. It provides a valuable opportunity for individuals and businesses alike. As depicted in Figure 1, the web application is built using MongoDB, ExpressJS, ReactJS, and NodeJS. MongoDB serves as the cloud storage database, while ReactJS is utilized for the front-end design of the platform.

IV. Proposed System Design:

As mentioned, the proposed system is based on MERN stack architecture, the following flowchart displayed in figure will explain the workflow and the functions implemented on the website.



The MERN stack architecture is the foundation of the proposed system. Above diagram figure displays the flowchart of our proposed system. It follows the following steps:

Step 1. User Authentication

The login credentials entered by the users are cross-checked against the stored MongoDB database and, upon successful authentication, they are redirected to the dashboard of the website.

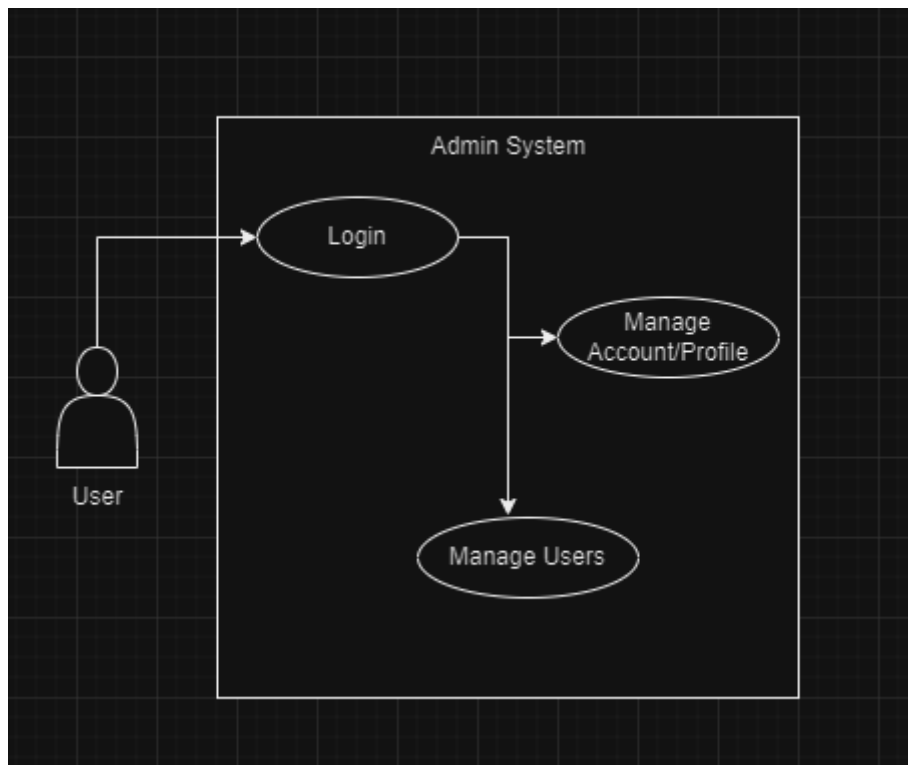
Step 2. Assigned role detection.

Different roles for different users are stored subsequently in the database and upon authentication, they are redirected to the dashboard according to their roles defined in the MongoDB database namely – i. Admin, ii. Student, iii. Instructor

- i. **Admin Role:** The admin is the overall system administrator who oversees data storage and authentication.
- ii. **Instructor Role:** The instructor is teacher at the university who have registered on our website to provide their valuable courses to the student. They sign up and redirect to the instructor dashboard so they can easily upload the relevant content.
- iii. **Student User Role:** After successfully logging in on the front-end website students can buy the courses and give some tests accordingly to pass the course.

Different Use Case diagrams for our roles are: -

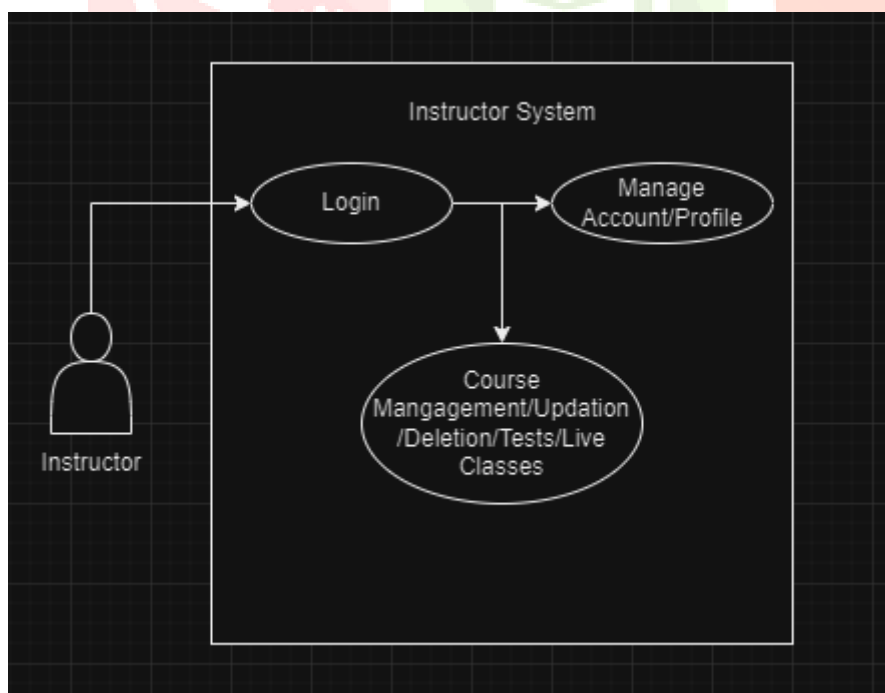
a. Admin Role



Manage Users: Allows the admin to make changes to the instructor and student provided credentials and deactivate their account, if necessary.

Manage Account/Profile: This allows the admin to reset the admin password, change the login credentials for themselves and manipulate data stored in the database.

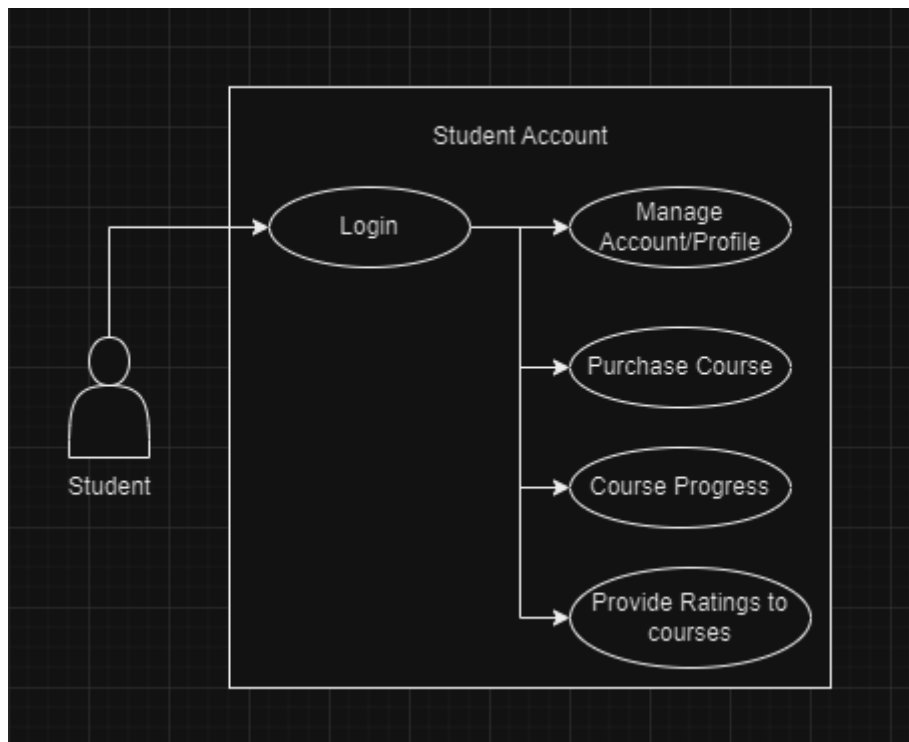
a. Instructor Role:



Course Management: The instructor can create its course after successful signup on the main page. He can delete and update the course from dashboard accordingly.

Manage Account/Profile: This allows the instructor to reset the password and add some personal details including profile picture. Also, He can delete his account.

a. Student Role:



Manage Account/Profile: This allows the student to reset the password and add their personal details including profile picture. Also, He can delete his account.

Purchase Course: The student can purchase their interest of courses provided by the instructor.

Course Progress: Students can check their progress from the dashboard to see how much courses/lectures they have completed.

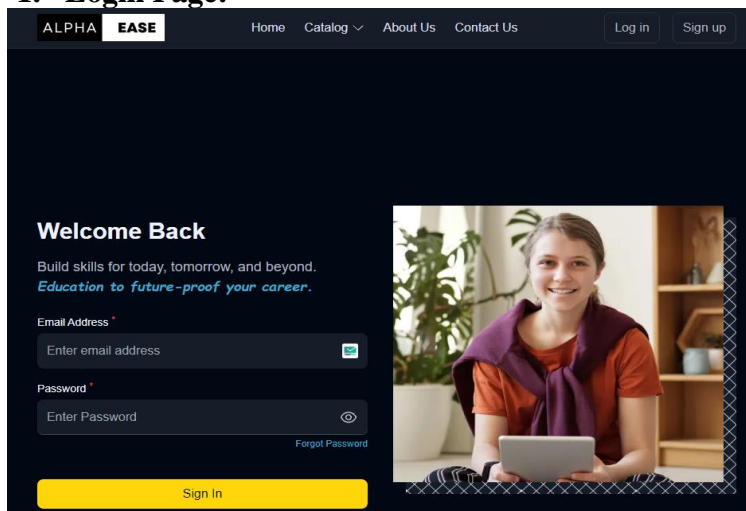
Provide Rating: Students can provide ratings so the other students can see the course is worth it or not.

IV. Result and Discussion:

The Course Management System will manage all the courses/lecture effectively by using the latest and relevant technologies available to us.

Some of the snapshot of our website.

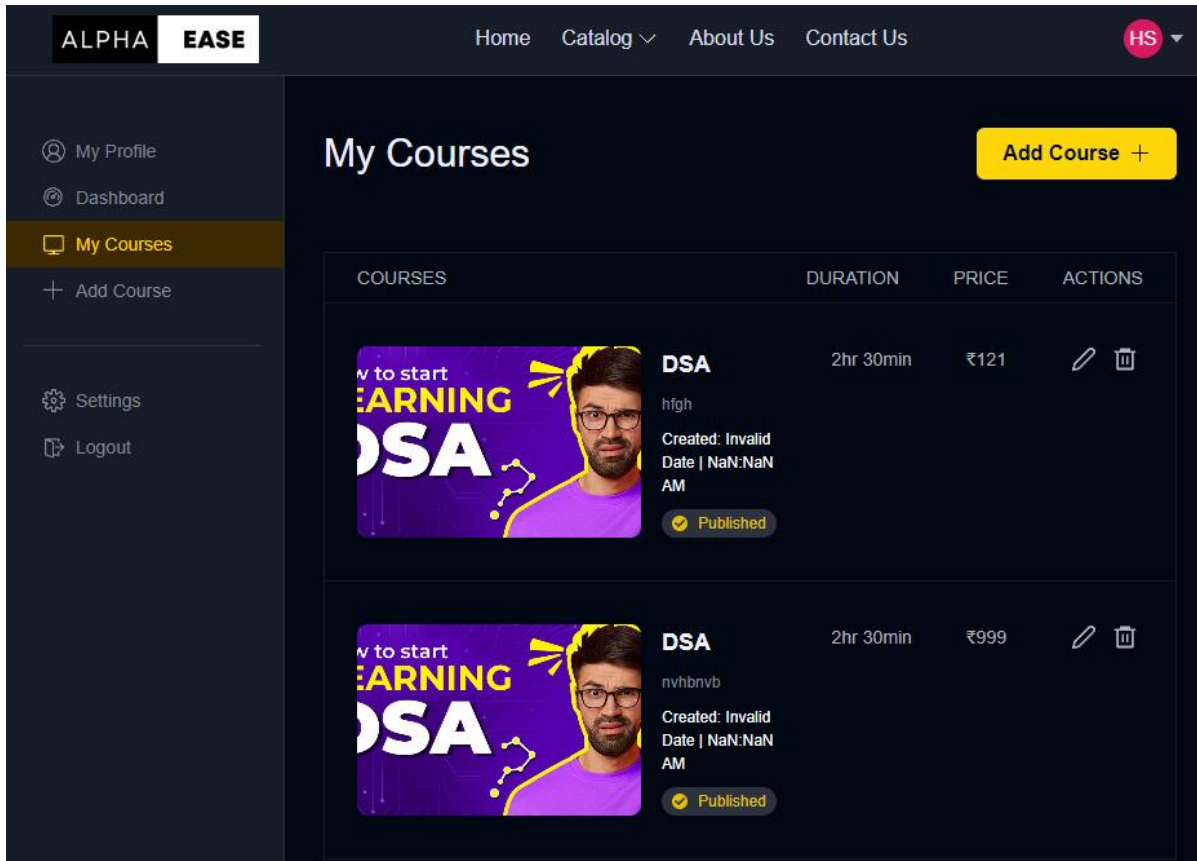
1. Login Page:









a. The figure displayed above is the page used to login to see the dashboard.

b. The page redirects us to various dashboard depending upon the credentials provided i.e. It verifies whether the credentials entered are of the Admin, Instructor or Student against a 'MongoDB' database.

2. Instructor Dashboard:

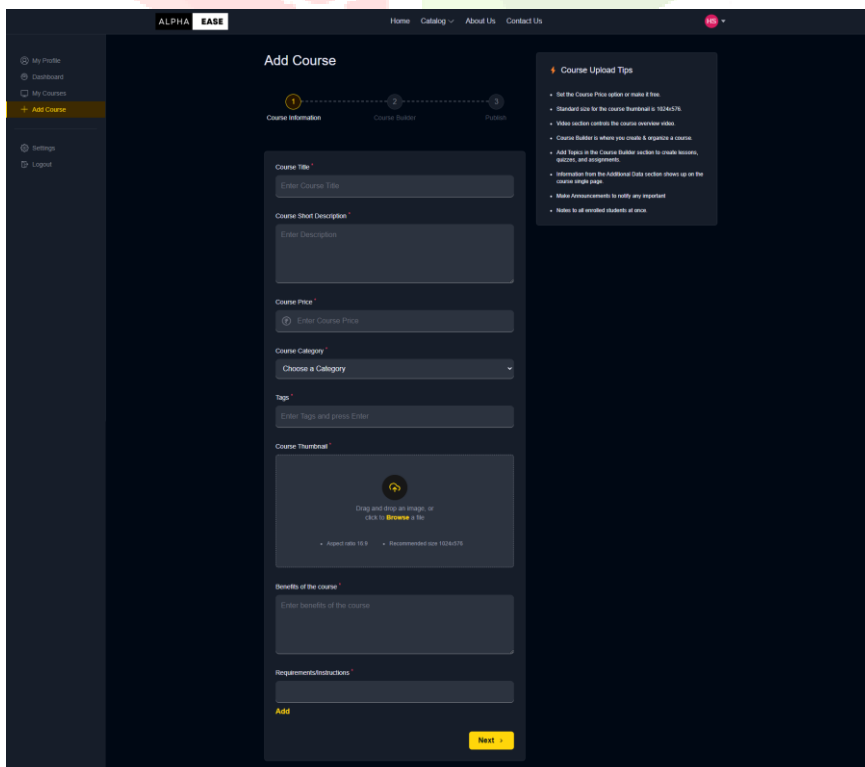


The screenshot shows the 'My Courses' dashboard. On the left is a sidebar with navigation options: My Profile, Dashboard, My Courses (selected), Add Course, Settings, and Logout. The main content area is titled 'My Courses' and features a table with columns: COURSES, DURATION, PRICE, and ACTIONS. There are two course entries, both titled 'DSA' with a duration of 2hr 30min and a 'Published' status. The first course has a price of ₹121 and the second has a price of ₹999. Both courses show 'Created: Invalid Date | NaN:NaN AM' and have edit and delete icons in the actions column.

COURSES	DURATION	PRICE	ACTIONS
 DSA high Created: Invalid Date NaN:NaN AM Published	2hr 30min	₹121	 
 DSA nvhbnvb Created: Invalid Date NaN:NaN AM Published	2hr 30min	₹999	 

Dashboard displays the side-nav bar with options with various feature. From this dashboard instructor can modify their course according to them.

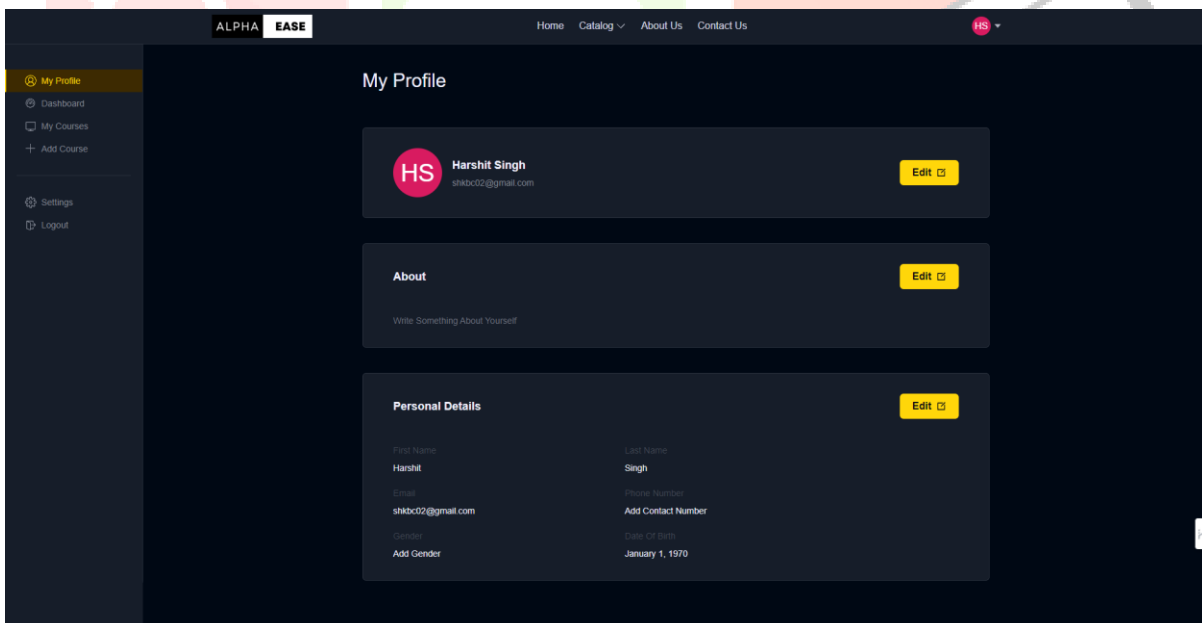
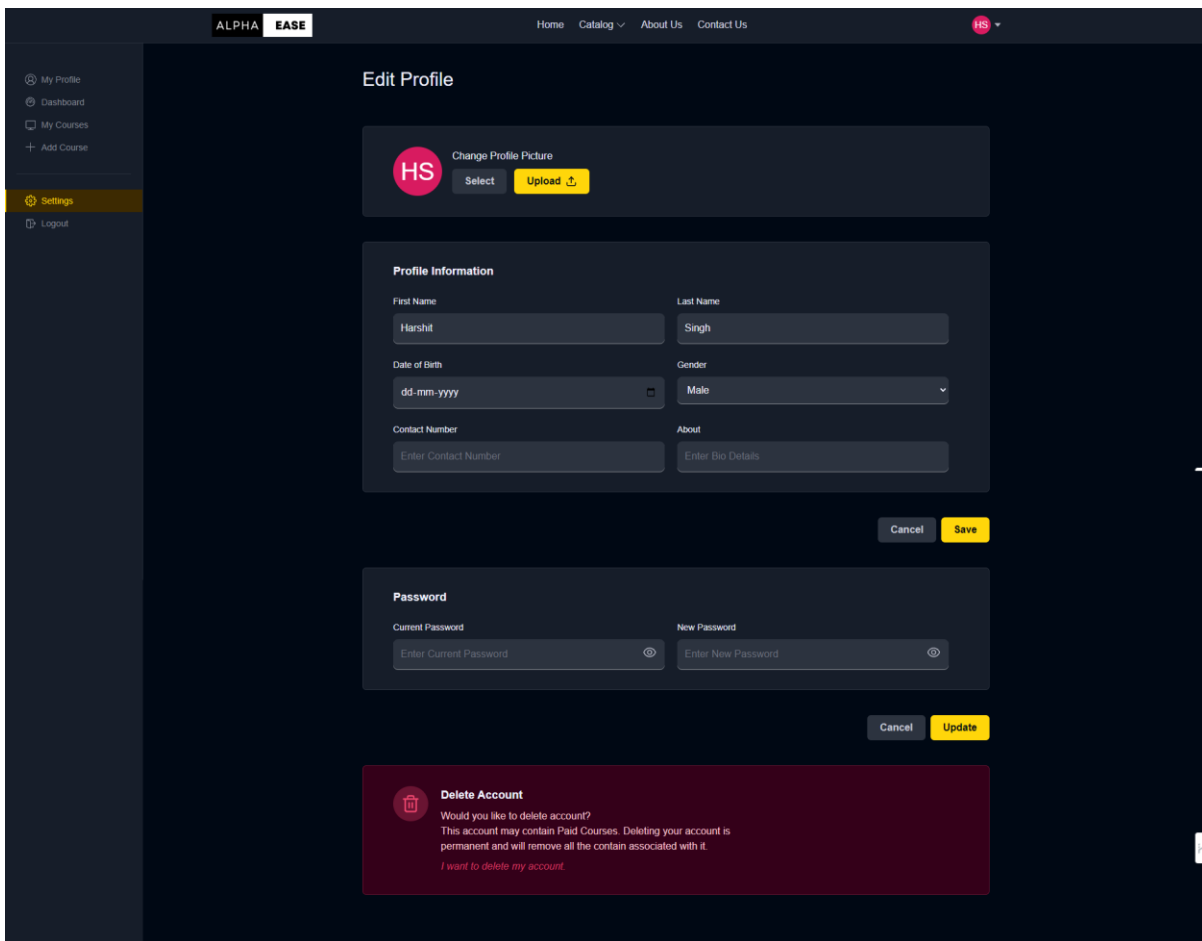
3. Course Addition:



The screenshot shows the 'Add Course' form. The sidebar on the left is the same as in the previous screenshot. The main content area is titled 'Add Course' and has three steps: Course Information (selected), Course Builder, and Publish. The 'Course Information' step contains several input fields: Course Title, Course Short Description, Course Price, Course Category (a dropdown menu), Tags, Course Thumbnail (with a file upload area), Benefits of the course, and Requirements/Restrictions. A 'Next' button is at the bottom right. On the right side, there is a 'Course Upload Tips' box with several bullet points providing instructions for course creation.

In course adding there are three stages first is to add the basic details of the course in second section the instructor can upload the video and the content after that they can publish it for the students.

4. Profile Update:



The student and admin can upload or edit their personal data if they wanted.

VI. Conclusion:

The development and implementation of the online education platform, "AlphaEase," exemplify a strategic fusion of technological innovation and user-centric design. By leveraging the MERN stack, AlphaEase delivers a dynamic learning environment tailored to the needs of college administrators, instructors, and students.

Through a meticulous process of requirement gathering from stakeholders, AlphaEase ensures alignment with the diverse needs and preferences of the college community. The platform's array of features enriches the learning experience, offering students access to a broad spectrum of courses while empowering instructors to monetize their expertise through customizable offerings.

Administrators benefit from robust tracking and analytics tools, enabling informed decision-making and effective communication among stakeholders. By centralizing educational resources, AlphaEase promotes sustainability and fosters collaboration within college campuses.

Moreover, AlphaEase represents a transformative opportunity for local instructors and educational institutions to harness the power of online education, generating additional income and expanding their reach without significant financial investment. As depicted in Figure 1, the utilization of MongoDB, ExpressJS, ReactJS, and NodeJS underscores the platform's commitment to technological excellence and user-centricity, paving the way for a more accessible and inclusive educational landscape.

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