AutoAcad

A major project report submitted in partial fulfilment of the requirement for the award of degree of

Bachelor of Technology

in

Computer Science & Engineering

Submitted by

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Under the guidance & supervision of

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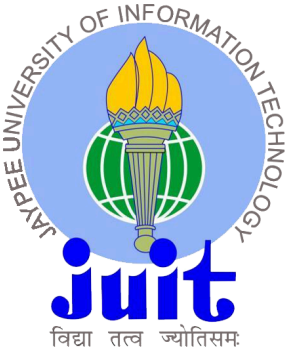

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May 2025

SUPERVISOR'S CERTIFICATE

This is to certify that the major project report entitled **'AutoAcad'**, submitted in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology** in **Computer Science & Engineering**, in the Department of Computer Science & Engineering and Information Technology, Jaypee University of Information Technology, Waknaghat, is a bona fide project work carried out under my supervision during the period from July 2024 to May 2025.

I have personally supervised the research work and confirm that it meets the standards required for submission. The project work has been conducted in accordance with ethical guidelines, and the matter embodied in the report has not been submitted elsewhere for the award of any other degree or diploma.

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CANDIDATE'S DECLARATION

We hereby declare that the work presented in this major project report entitled **'AutoAcad'**, submitted in partial fulfilment of the requirements for the award of the degree of **Bachelor of Technology** in **Computer Science & Engineering**, in the Department of Computer Science & Engineering and Information Technology, Jaypee University of Information Technology, Waknaghat, is an authentic record of our own work carried out during the period from July 2024 to May 2025 under the supervision of **Prof. (Dr.) Vivek Sehgal , Prof. (Dr.) Shruti Jain**.

We further declare that the matter embodied in this report has not been submitted for the award of any other degree or diploma at any other university or institution.

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LIST OF ABBREVIATIONS

JWT: JSON Web Token

ASTM: Add Student to Mentor

DB: Database

API: Application Programming Interface

CORS: Cross-Origin Resource Sharing

JS: Java Script

UI: User Interface

CGPA: Cumulative Grade Point Average

GDPR: General Data Protection Regulation

LMS: Learning Management System

RMSE: Root Mean Squared Error

DOM: Document Object Model

SIS: Student Information System

SAP: Systems, Applications & Products in Data Processing

ABSTRACT

Efficient management of academic information is a critical issue for schools, especially when it involves guiding students and timely interventions. Conventional manual procedures for monitoring student performance, recognizing at-risk students, and alerting guardians are usually labor-intensive, error-prone, and unscalable.

The Auto Acad project solves these problems by offering an automated system of academic management that aims to simplify the process of monitoring student performance and increasing mentoring effectiveness. Developed with advanced web technologies such as React, Node.js, and Oracle databases, the platform combines sophisticated machine learning models to forecast future CGPA and flag students that require extra assistance.

Some of the platform's core features are automated alerts to guardians of poorly performing students, interactive data visualization tools for tracking performance, and predictive analysis for decision-making in anticipation. Through the automation of menial tasks, Auto Acad lowers administrative burden, allows for timely communication, and gives mentors to concentrate on individualized support for their students.

The outcomes of this project attest to dramatic enhancements in the efficiency and correctness of academic management processes. With its scalable architecture and integration directories, Auto Acad can significantly change the way mentoring is done, making it more data-driven and effective. The project creates a solid base for further refinements, such as mobile integration and real-time analysis.

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

Academic data management is at the forefront of promoting student success and institutional efficacy. Yet, today's faculty mentors confront a twofold challenge: navigating the rising tide and increasing difficulty of academic data while tending to the imperative of assisting struggling students. Conventional means of monitoring academic performance—hand-recorded keeping, spreadsheet analysis, and boilerplate communication with caregivers—are both time-intensive and subject to human error [1]. For example, research indicates that mentors devote around 30% of their time spent on administrative work such as preparing attendance reports or composing emails, with little bandwidth for one-on-one student support [2]. These inefficiencies hinder timely interventions, e.g., alerting guardians to deteriorating grades or attendance, which can have lasting impacts on student outcomes.

To counter these issues, we created Auto Acad, a revolutionary academic management solution that is aimed at streamlining mentorship processes by automating, data-informed insights, and predictive analytics. Unlike traditional fragments of tools-based systems, Auto Acad incorporates cutting-edge technologies–like React.js for dynamic frontend, Node.js for scalable backend, and MongoDB for adaptable data storage–to consolidate academic tracking. The system also uses machine learning tools like scikit-learn to forecast student performance in the future, allowing mentors to anticipate students at risk.

At its core, Auto Acad tackles three critical pain points:

1.1.1 Data Fragmentation:

Academic metrics (marks, attendance) are often scattered across spreadsheets, LMS platforms, or physical registers. Auto Acad consolidates this data into a **unified dashboard,** offering real-time visualizations (e.g., trend graphs, attendance heatmaps) to simplify analysis.

1.1.2 Inefficient Communication:

Crafting personalized emails to guardians by hand can be quite a chore. That's where our system comes in! It streamlines the whole process with customizable email templates, making it super easy for mentors to send personalized messages to guardians with just a click after getting the green light. For instance, a mentor can quickly filter students whose attendance is below 70%, check out the pre-written emails, and send them off in no time!

1.1.3 Reactive Interventions:

Existing systems often miss the opportunity to use historical data to predict academic challenges. Auto Acad's machine learning model dives into past performance patterns—like semester grades and attendance trends—to project a student's future CGPA. This way, it can alert mentors to step in before any problems arise. [3].

The impact of this system extends beyond administrative efficiency. By automating repetitive tasks, mentors can redirect their efforts toward meaningful interactions, such as counseling students or designing improvement plans. Guardians, too, benefit from timely, transparent updates about their child's progress, fostering a collaborative approach to academic support. For institutions, Auto Acad offers a scalable solution to reduce dropout rates and improve academic outcomes—a priority highlighted in recent studies on educational technology [4].

1.2 MOTIVATION

The very reason to develop such an application as Auto Acad stems from the issues that bother the educational institutions in managing the academic data along with mentoring the students. Faculty mentor spends a long time doing an administrative task; hence, it leaves them with minimum bandwidth for personal-in-student support. Late insights, or if not real-time data processing, result in delays in the addressing of academic issues, thus contributing to poorer student performances and outcomes.

1.2.1 INSPIRATION:

The increasing complexity of academic data, driven by growing student populations and diverse metrics, has surpassed the capabilities of traditional data management systems. Mentors often rely on time-consuming manual processes to identify students needing assistance, inform guardians, and generate performance reports, leaving these tasks prone to human error. This inefficiency delays timely intervention, as the lack of predictive tools prevents early identification of at-risk students and academic trends. The AutoAcad project is all about using the latest in web development and machine learning to tackle some real challenges. Its goal? To create a smart, automated system that makes academic mentoring easier and more efficient, ultimately benefiting both students and educational institutions.

1.3 PROBLEM STATEMENT

It's important to keep an eye on how faculty mentors enhance the performance of studies—they truly have a vital role to play here. That said, the traditional approaches to academic mentoring do come with their own set of challenges.

1.3.1 PROBLEM DEFINITION: [5] Large volumes of academic information are cumbersome and prone to errors to deal with manually, and it is challenging for mentors to efficiently manage students' information. Such inefficiency makes it challenging to monitor students requiring immediate intervention, and interventions are delayed.

Apart from this, the lack of a standardized system of communication poses difficulties in informing guardians about the performance of their child in an effective and coordinated way. Without a standardized mechanism, mentors are unable to ensure that parents are given information that is essential.

[6] The absence of forecasting tools also contributes to the issue, where mentors lack advanced analytics to predict future academic trends or identify students who require intervention at the earliest. Because of this, proactive intervention and early help to poor-performing students becomes impossible.

[7] In addition, lack of good visualization of results hinders mentors from making good conclusions from the data. The existing practices are not good at presenting academic data in an easy-to-understand, actionable manner, and the mentors are left to grapple with interpreting and responding to the data shown. These issues cumulatively hamper the capacity of the mentors to offer timely and effective support, with adverse effects on the academic performance and well-being of the students.

1.4 OBJECTIVES

To counter these challenges, Auto Acad offers the automated academic management system web based, comprising new web technologies and machine learning to improve mentoring interventions. The system offers:

1.4.1 Guardians of low-performing students get real-time updates on how their child performs in academics, which enables timely interventions. [8]

1.4.2 The performance indicators are depicted through dynamic, interactive graphs and dashboards in very easy-to-interpret formats.

1.4.3 Machine learning models are based on historical information to predict future CGPA, which would enable the mentor to anticipate academic trends and act proactively. [9]

1.4.4 A singular system to manage academic data on a seamless basis across different functionalities.

Thereby enabling the faculty mentors to focus on personalized student responses and strategic decisions by automating routine tasks as well as providing actionable insights.

1.5 SCOPE

Auto Acad aims to fulfill the varied needs of Faculty Mentors, Guardians and Academic Administrators. The system is meant to:

1.5.1 By automating the administrative work, the mentors can devote more time to impart personalized guidance to the students.

1.5.2 Automatic alerts will ensure the guardians have access to their child's academic progress and also where improvement is needed.

1.5.3 Predictive analytic and visualizations of performance help derive data-induced decision-making processes hence enable to have proactive academic support.

1.5.4 The system has been designed and developed keeping in mind the features of scalability and integration with other academic frameworks or the capabilities to become mobile-enabled to enhance the accessibility.

1.6 REPORT ORGANIZATION

This report is subdivided into six chapters, each discussing various components of the project.

1.6.1 Chapter 1: Introduction

Gives an overview of the project; motivation; problem statement; the proposed solution, and scope.

1.6.2 Chapter 2: Literature Review

Contains a discussion of the existing academic management systems, modern technologies used in applications similar to the proposed project, and the research gaps filled by Auto Acad.

1.6.3 Chapter 3: System Design and Methodology

Details system architecture, module specifications, development methodology, including diagrams and flowcharts.

1.6.4 Chapter 4: Implementation

It deals with the technical implementation of the project, like frontend, backend, database design, machine learning integrated into the project.

1.6.5 Chapter 5: Results and Discussions

It elaborates on the various outcomes of the project as to performance evaluation, features of the system, and comparisons with already existing methods.

1.6.6 Chapter 6: Conclusion and Future Scope

This chapter will summarize the contributions of the project and highlight the areas where future enhancements can take place.

The initial chapter lays the groundwork for comprehending the objectives and significance of Auto Acad, thereby illuminating the way leading to more detailed discussions in the coming chapters.

CHAPTER 2: LITERATURE SURVEY

2.1 OVERVIEW OF RELEVANT LITERATURE

Table 2.1: Literature Review

S.No.	Author & Paper Title	Year Of Publication	Publishing Details	Summary
1.	The Role of Modern JavaScript Frameworks in Frontend Development, Smith J., Patel K. [10]	2021	Springer Link	This research paper dealing with the Evolution of the JavaScript frameworks i.e., React, Angular, and Vue.js' is going to discuss their effects based on the creation of dynamic and responsive user interfaces and the comparison in large-scale applications.
2.	Responsive Web Design and User Experience: Best Practices, Doe A., Kumar R..[11]	2020	ACM Digital Library	Discusses the principles of responsive web design, including media queries, grid systems, and flexbox, to ensure optimal user experience across devices.
3.	RESTful API Design and Implementation for Web Applications, Wang Z., Li S.[12]	2021	Research Gate	Explores best practices for designing RESTful APIs for web applications, including authentication mechanisms, performance optimization, and error handling.
4.	A Comparative Study of Node.js and Django for	2022	IEEE Xplore	This study compares Node.js (JavaScript runtime) and Django (Python framework) for backend

	Backend Development, Gupta M., Taylor H. [13]			development. It evaluates their scalability, performance, and ease of integration with databases.
5.	Seamless Integration of Frontend and Backend in Web Applications, Johnson R., Rivera P. [14]	2021	Elsevier	This paper highlights the challenges and solutions for integrating frontend and backend systems. Topics include API communication, session management, and state synchronization.
6.	Web Application Architecture: Patterns and Practices, Brown D., Zhang Y. [15]	2020	Springer Link	Discusses architectural patterns for integrating frontend and backend, including MVC (Model-View-Controller), MVVM (Model-View-ViewModel), and microservices. **Source:** Springer Link
7.	Challenges in Full-Stack Web Development: A Case Study, Sharma V., Lee J. [16]	2022	IEEE Xplore	Explores the challenges of managing frontend and backend development in a single project, including tool selection, performance optimization, and developer collaboration
8.	Building Scalable Web Applications Using MERN Stack, Kumar S., Allen B.[17]	2021	Research Gate	Discusses the integration of MongoDB, Express.js, React.js, and Node.js for building scalable and efficient web applications.

9.	Automated Testing for Web Applications: Tools and Techniques, Smith L., Zhao H. [18]	2021	ACM Digital Library	This paper evaluates tools like Selenium, Jest, and Postman for testing frontend, backend, and API integrations.
10.	Error Handling and Debugging in Web Development, Gupta P., Sanders T. [19]	2022	IEEE Access	Highlights best practices for debugging frontend and backend code using tools like Chrome DevTools and backend log analyzers.

2.2 EXISTING SYSTEMS

Academic management systems have evolved significantly over the years, yet many institutions still rely on manual processes or outdated tools for managing student performance. Below is an analysis of traditional systems and modern approaches:

2.2.1 TRADITIONAL ACADEMIC MANAGEMENT SYSTEMS

Conventional systems, generally paper-based or utilizing straightforward software packages such as spreadsheets, are severely constrained in efficiently handling scholarly information.

One of the most basic issues is manual input of data, which is time-consuming, error-prone, and hard to maintain, especially for large volumes of data. This inefficiency is a hindrance to mentors' workload and is prone to errors.

The second of these disadvantages is the lack of scalability. When more students get enrolled, the traditional systems fall short and get cumbersome, and it is difficult to manage growing amounts of information. This is followed by the

slowing down of processes and lack of efficiency when dealing with student information.

The delay in interventions is another major limitation. Without real-time processing of information, mentors are unable to identify struggling students in a timely manner, typically learning too late to effectively implement remedial measures. The delayed response can negatively affect students' academic and personal performance.

Lastly, conventional systems do not have data visualization support. Using tabular formats, it is not easy for mentors to easily spot trends or patterns, and thereby offer timely and efficient assistance. All these shortcomings cumulatively point towards the necessity of more sophisticated and efficient systems in academic mentoring.

2.2.2 MODERN ACADEMIC MANAGEMENT TOOLS

[21] Recent advances in technology in the form of Learning Management Systems (LMS) have also included features of tracking student records, performance monitoring, and communication. A perfect example of such a system is Moodle, which is open-source, free, and utilized by most schools. Moodle is for the delivery of materials and grading students and therefore finds application among teachers. Moodle is still not ideal, however, since it does not have the inclusion of machine learning to enable predictive analysis or automated notification, and therefore its ability to enable proactive intervention is lessened.

Another is PowerSchool SIS, a business-grade Student Information System (SIS) with decent performance monitoring and communication capabilities. Although it excels in handling academic information, it is too costly for small groups. It is also not designed with predictive analytics, so it is not possible for it to catch struggling students early.

SAP Student Lifecycle Management is a higher-level system that is aimed at specifically addressing detailed lifecycle information of the student. While best suited for large institutions, its emphasis on scalability comes at the expense of being unable to accommodate real-time notification capability. This might hinder timely communication and intervention activities in the case of students with high priority for their needs.

2.3 MODERN TECHNOLOGIES IN ACADEMIC SYSTEMS

AutoAcad is all about using the latest technology to fix the gaps in both traditional and modern systems. With its innovative tools, it's designed to scale up, operate efficiently, and really improve the experience for students and users alike.

2.3.1 Frontend Technologies: Built with React, a popular JavaScript library known for creating dynamic and interactive user interfaces, AutoAcad takes advantage of React's component-based structure, quick updates through the virtual DOM, and a strong community backing. Its widespread use on platforms like Coursera and EdX showcases its knack for providing a smooth user experience. [22] [23] [24]

2.3.2 Backend Technologies: Node.js and Express.js, the latter being an opinionated JavaScript framework, drives AutoAcad's backend. Enterprise-grade by nature, Node.js streamlines configuration and deployment and provides an opinionated way of building applications with the system being fast, flexible, and maintainable. The system is a standard one widely used in institutional environments to handle student data and academic performance information, providing reliability as well as scalability.

2.3.3 Databases: On the backend, AutoAcad relies on MongoDB Database, which stores everything from student records to attendance logs and email templates in a flexible, JSON-like format. This database is perfect for managing large amounts of data, making it ideal for tracking detailed student records and

performance metrics thanks to its scalability, high availability, and robust analytics capabilities. [20]

2.3.4 Data Visualization Tools: To effectively communicate student performance metrics, the site employs D3.js and Chart.js. These libraries help create interactive and dynamic charts and graphs, making it easy for mentors to understand and analyze the data through effective visualization. [25]

2.3.5 Machine Learning Frameworks: AutoAcad utilizes TensorFlow.js and scikit-learn to enable machine learning. TensorFlow.js enables machine learning in the browser such that frontend applications can be incorporated with ease. Scikit-learn provides more advanced algorithms in predictive analytics such as regression and classification models and assists the platform in identifying academic trends and students in danger early.

2.4 PREDICTIVE ANALYTICS IN EDUCATION

Predictive analytics has also been a powerful tool in school districts, where schools have been able to predict student outcomes and act before they even happen.

2.4.1 IMPORTANCE OF PREDICTIVE ANALYTICS

[26] Predictive analytics is a core function in advising because it enables proactive intervention through the identification of students at risk early enough and timely intervention that can preclude their problems. Predictive analytics enables administrators and mentors to make data-informed, well-reasoned decisions, promoting evidence-based student success strategies. Predictive analytics maximizes resource allocation by sending mentoring interventions where they will be most effective with maximum aggregate benefit to student outcomes and institutional effectiveness.

2.4.2 APPLICATIONS IN ACADEMIC SYSTEMS

[27] Predictive analytics has numerous applications in academic systems, enhancing both student outcomes and institutional efficiency. CGPA prediction

utilizes linear regression models to forecast future academic performance based on historical data, enabling timely interventions. Dropout prevention leverages classification models to identify students at risk of leaving, allowing for targeted support to retain them. Additionally, personalized learning through recommender systems offers tailored study plans, addressing individual student needs and promoting more effective learning experiences.

2.4.3 CHALLENGES IN PREDICTIVE ANALYTICS

Working with predictive analytics in system institutions can be a tremendous help but also comes with an equal share of challenges. One great challenge has to be data quality, for should the data be missing, incomplete, or inconsistent, the system's prediction may prove inaccurate or unreliable. This especially sets a barrier in trusting the insight yielded by the model. On the other hand, there are serious ethical concerns. Students' privacy must be safeguarded, and provisions must be put in place to ensure algorithms are not discriminating against a category of students. Should these concerns be left unaddressed, people will lose trust in the system and more importantly, implementation of the system will become impossible.

2.5 RESEARCH GAPS ADDRESSED BY AUTO ACAD

2.5.1 LACK OF INTEGRATION

Performance tracking or predictive analytics--these are the terra firma for which existing systems travel; the two are rarely combined. Auto Acad fills this vacuum, while integrating data visualization, automated notification, and machine learning.

2.5.2 INADEQUATE COMMUNICATION TOOLS

Most platforms have no automation for communication, thus creating lags in informing guardians. Auto Acad offers real-time notification so interventions can be made in time. [28]

2.5.3 ABSENCE OF SCALABLE PREDICTIVE MODELS

Auto Acad, thus, incorporates scalable machine learning models that can handle large datasets and can hence be deployed in institutions of all sizes.

2.6 CASE STUDIES OF RELATED APPLICATIONS

2.6.1 A LEARNING ANALYTICS DASHBOARD

Learning Analytics Dashboard seeks to provide student performance insights through effective data visualization techniques and thereby help the mentors make informed decisions. Even though the system has certainly accentuated decision-making, the lack of automation and absence of predictive analytics within it renders the system somewhat reactive in nature, constraining its ability to timely constitute and address certain auspicious circumstances for students.

2.6.2 AUTOMATED PARENT NOTIFICATION SYSTEM

The Automated Parent Notification System was created to send SMS notifications to parents of students who were performing below average as a means to improve communication between the mentors and the spirit of guardianship. However, even though it improved the flow of notifications, it only had basic notification logic and none of the more advanced features such as performance analyses that would have given it greater utility by contributing to deep insights and able interventions. [28]

2.6.3 ML-BASED STUDENT PERFORMANCE PREDICTION

The ML-Based Student Performance Prediction system aims to predict student performance in terms of grades using machine learning algorithms and is almost accurate; but it could hardly be considered useful because of the design limitation of lacking integration with an academic management system that comprehensively supports academic mentoring and intervention. [29]

2.7 SUMMARY OF LITERATURE REVIEW

Auto Acad is a system that attempted to harness the good points of the existing systems and at the same time address their weaknesses. By bringing automation and data visualization with the predictability of general analytics into one platform, the system hence equips academic mentoring with full-scale support.

Table 2.7: Existing Systems vs Auto Acad

Comparison Table: Existing Systems vs. Auto Acad

Feature	Traditional Systems	Modern Tools	Auto Acad
Data Visualization	Limited	Advanced	Advanced with actionable insights
Predictive Analytics	Absent	Basic	Integrated ML models
Automation	Minimal	Moderate	Comprehensive
Communication with Guardians	Manual	Semi-automated	Fully automated

CHAPTER 3: SYSTEM DESIGN AND METHODOLOGY

3.1 SYSTEM ARCHITECTURE

The system architecture of **AutoAcad** is designed to be robust, scalable, and efficient, comprising four major layers that work seamlessly together.

3.1.1 The **Frontend Layer**, built using ReactJS, serves as the user interface where mentors, guardians, and administrators interact with the platform. It offers several features, including performance dashboards and notification tools, ensuring an intuitive and user-friendly experience. Also used some Javascript libraries like **React Quill** for email drafting, **React Icons** for icons used in the website, **Formik** for form management of the whole website, **Bcrypt** for encoding sensitive information, **Axios** for api calling and error management, **React Toastify** for notifications on the website. Also rather than normal traditional CSS we are using **SASS** which is a preprocessor for css and css can be written and managed easily with SASS.

3.1.2 The **Backend Layer** is developed using Node JS, which handles the business logic, APIs, and communication between the frontend and the database. This layer ensures smooth data processing and mediates actions to maintain a seamless flow of information within the system. Many other libraries of JavaScript are also being used like **Bcrypt** for encoding and decoding, **JOI** for data validation for models, **Nodemon** for ease in development, **Mongoose** for MongoDB connection, **JSON Web Token** used to generate a JWT Token for session management.

3.1.3 The **Database Layer** utilizes MongoDB as its database, designed to store essential records such as student performance, guardian details, and other critical data. This layer ensures data integrity, scalability, and efficient retrieval, supporting the system's operational requirements. [30]

3.1.4 This layer for **Machine Learning** combines TensorFlow.js and scikit-learn for the purpose of predictive analytics. TensorFlow.js runs models in the browser itself, facilitating real-time prediction, while scikit-learn trains and evaluates models on the server side. The layer ingests historical academic data and gives out predictions on future performance metrics like CGPA and dropout probabilities, hence allowing the mentors to have actionable insights.

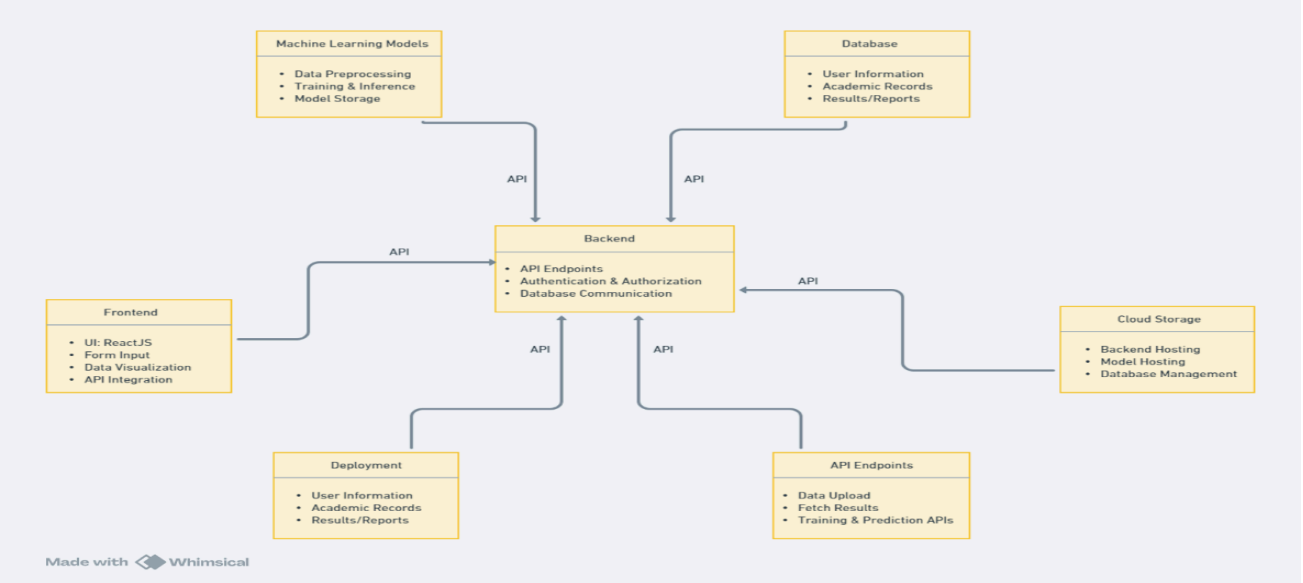


Figure 3.1: Project Design

3.2 MODULE DESCRIPTION

The AutoAcad system is divided into multiple modules, each carefully developed to support the platform's goals.

3.2.1 Frontend Module:

The Student Performance Dashboard provides a visual display of students' academic data, featuring interactive charts and graphs powered by Chart.js. The User Authentication module ensures secure login screens through React's form handling and authentication libraries. Additionally, the Interactive Notifications feature offers a user-friendly interface for mentors to send alerts and updates to guardians. [31]

3.2.2 Backend Module:

The API Development module includes RESTful APIs created using Spring Boot, facilitating smooth communication between the frontend and backend. Key endpoints, such as GET /students to retrieve student data and POST /sendMail to send notifications to guardians, enable efficient interaction within the system. The Business Logic handles requests, data manipulation, and runs algorithms for performance predictions. [33]

3.2.3 Database Module:

The Schema Design of the database incorporates tables for students, performance records, and guardian information, ensuring data normalization and efficient query performance. The Data Integrity and Security measures include constraints and encryption to maintain data integrity and safeguard sensitive information. [35]

3.2.4 Machine Learning Module:

The Model Training and Prediction module starts with Data Preprocessing, addressing missing values and normalizing data. Model Selection involved choosing linear regression for predicting CGPA, due to its simplicity and effectiveness for continuous data. Evaluation Metrics such as Root Mean Squared Error (RMSE) were used to assess model performance. Finally, the trained models are Integrated into the system through the Spring Boot server for real-time predictions and analysis [36]

3.3 DEVELOPMENT METHODOLOGY

The project followed an Agile Development Process, with the following key phases:

3.3.1 Requirement Gathering:

The team gathered input from stakeholders—mentors, students, and administrators—to define the system's requirements. Key features identified included automation, visualization, and prediction, which would streamline the mentoring process and improve decision-making.

3.3.2 System Design:

UML diagrams as well as flow charts were established to provide a clear picture of the overall process of the flows and flows together with system architecture. The API structures and schema for the database were also established. This was all important, as it was crucial to integrate the frontend, backend, and database. Therefore, this entire project would take the least amount of development time to complete.

3.3.3 Implementation:

The modules for the frontend and backend were developed at the same time to minimize integration time. While the frontend and backend were being developed, the team developed machine learning models in scikit-learn where the models were connected the backend for predictive analytics.

3.3.4 Testing and Deployment:

Unit testing, integration testing, performance tests were conducted to ensure the system performed as required, and completed satisfactory. The system was finally deployed to a local server in order to showcase, and evaluate the final product.

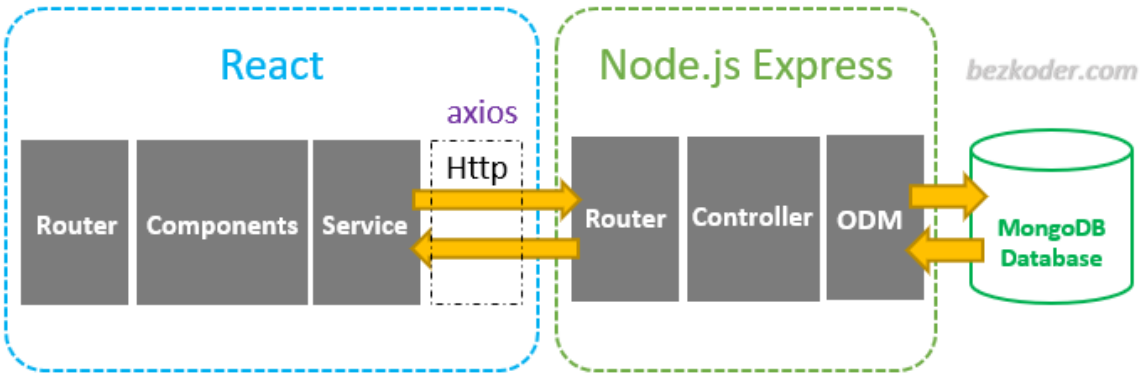


Figure 3.3: System Design

3.4 KEY CHALLENGES

Auto Acad faced several challenges during its design and development:

3.4.1 Data Integration:

Developing seamless integration of data between the frontend, backend and database without sacrificing data integrity was a huge challenge. Planning and executing all communication between the different layers of the system took a lot of work.

3.4.2 Model Accuracy:

Developing machine learning algorithms so there was decent prediction accuracy required a significant number of tests and tuning, including a lot of trial and error and testing of various models and tunable parameters, to be able to increase the reliability of prediction.

3.4.3 User Experience:

It was important to design an interface to be interactive and usable to ensure all features would be usable and clearly understood. The team needed to make sure there are understandable and intuitive flows from the perspective of each role, including mentor, guardian and administrator, as well as ensuring the data the user manages is clear and usable.

3.4.4 Scalability:

Building a system that will be sufficient for the growing number of users and larger datasets was a concern. Making sure the system would respond efficiently and provide a seamless experience was a concern when building under stringent loads.

3.4.5 Security Concerns:

Making sure that data could be protected in an event of a breach and that authentication mechanisms were secure was a concern. The team worked to ensure data privacy compliance and adopted measures to protect sensitive data.

These challenges were addressed through ongoing shaping and development, constant testing, and close collaboration among the project team members.

CHAPTER 4: Implementation

4.1 FRONTEND DEVELOPMENT

The UI for Auto Acad frontend is created using React, the most accepted JavaScript library for developing dynamic and responsive user interfaces. The following are core implementations:

“The last version of the Auto Acad application is available online at https://autoacad.netlify.app/. It is a complete working version that has all features together with the user interface.”

4.1.1 SIGNUP PAGE

The signup page manages user registration according to the role (Mentor or Student). Takes the minimal but important required fields for ease in signup.

Features:
1. Form validation checks on input fields (email and password).
2. API integration using Axios with the backend authentication endpoints.
3. Responsive design for all phones and computers.

4.1.1 LOGIN PAGE

The login page manages user authentication and provides a way of logging into the system according to the role of the user (i.e., mentor or administrator).

Features:
1. Form validation checks on input fields (email and password).
2. API integration using Axios with the backend authentication endpoints.
3. Responsive design for all phones and computers.

4.1.2 DASHBOARD

The dashboard acts like a one-point stop for mentoring students in observing the student's performance. [35]

Features:
1. Individual student’s details page featuring all academic records of the student.
2. Dynamic tables showcasing a list of students that can sort and filter their columns.
3. View Mail templates.
4. Edit Mail templates.
5. Batch view for sending mail.
6. Adding a new student to mentor in mentor’s dashboard.

4.1.3 NOTIFICATIONS

This module is meant to automatically alert the guardians of students through emails when predetermined academic criteria are met. [33]

Features:

1. Send out email alerts if a student falls below a required CGPA level or marks in a test.
2. A simple UI for controlling all calls.

4.2 FRONTEND CODE SNIPPETS

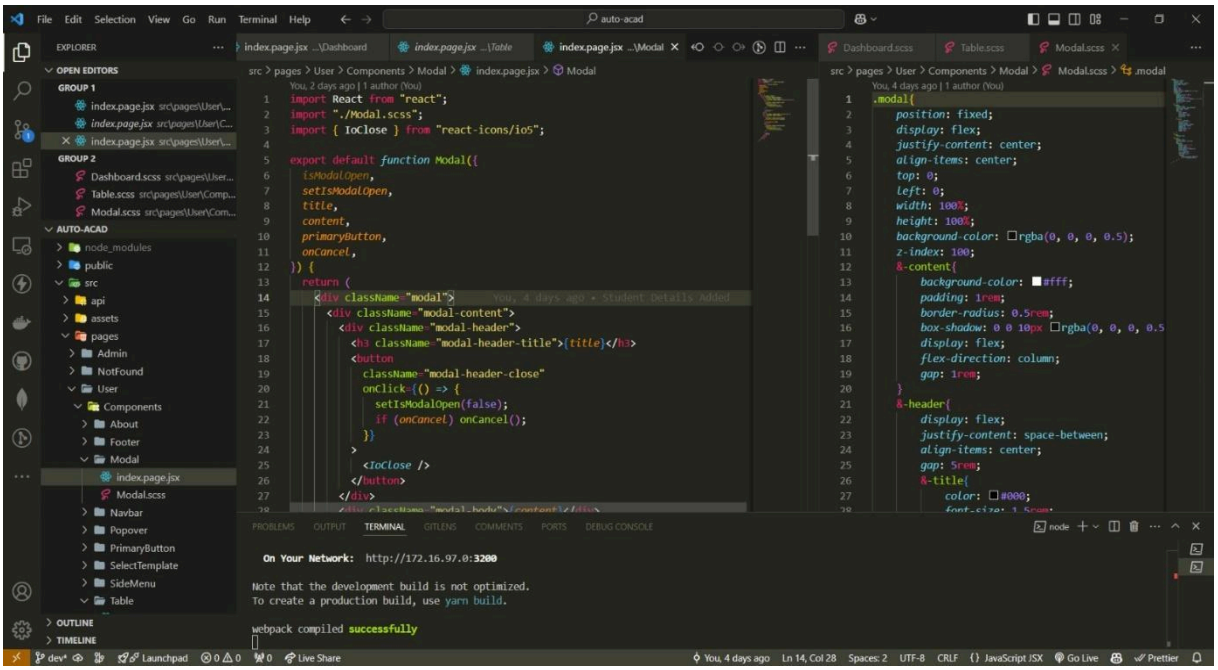


Figure 4.2.1: Modal Component Code

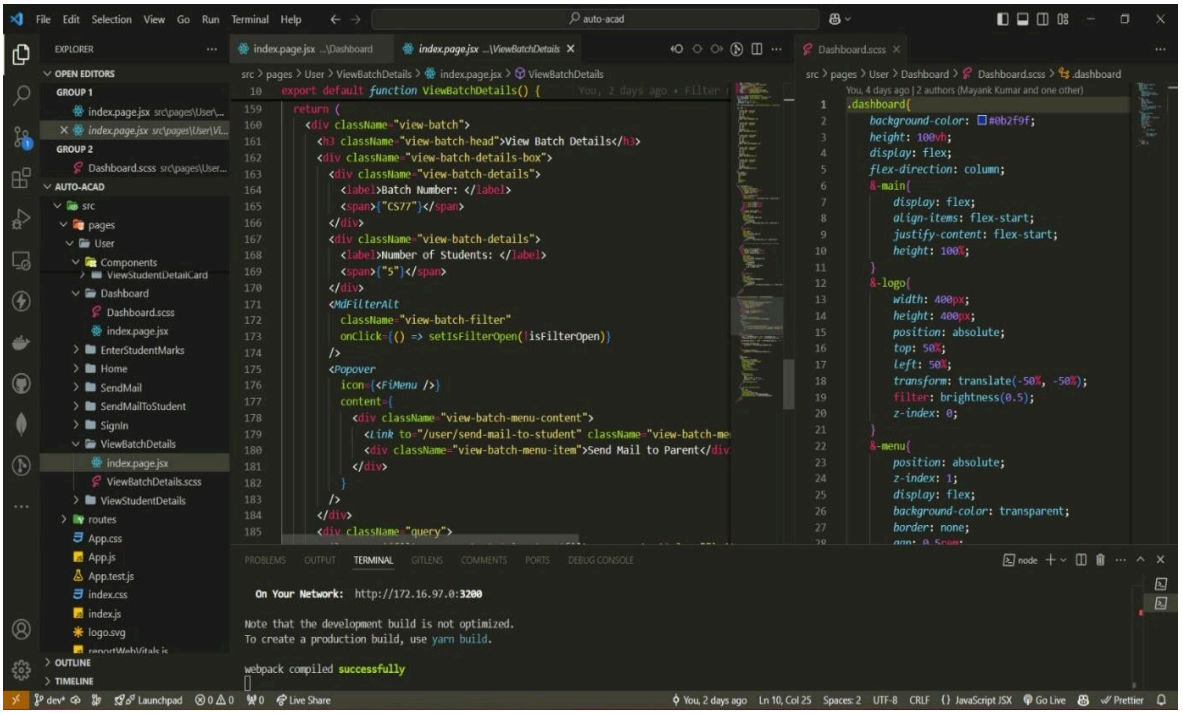


Figure 4.2.2: View Batch Details Page Code

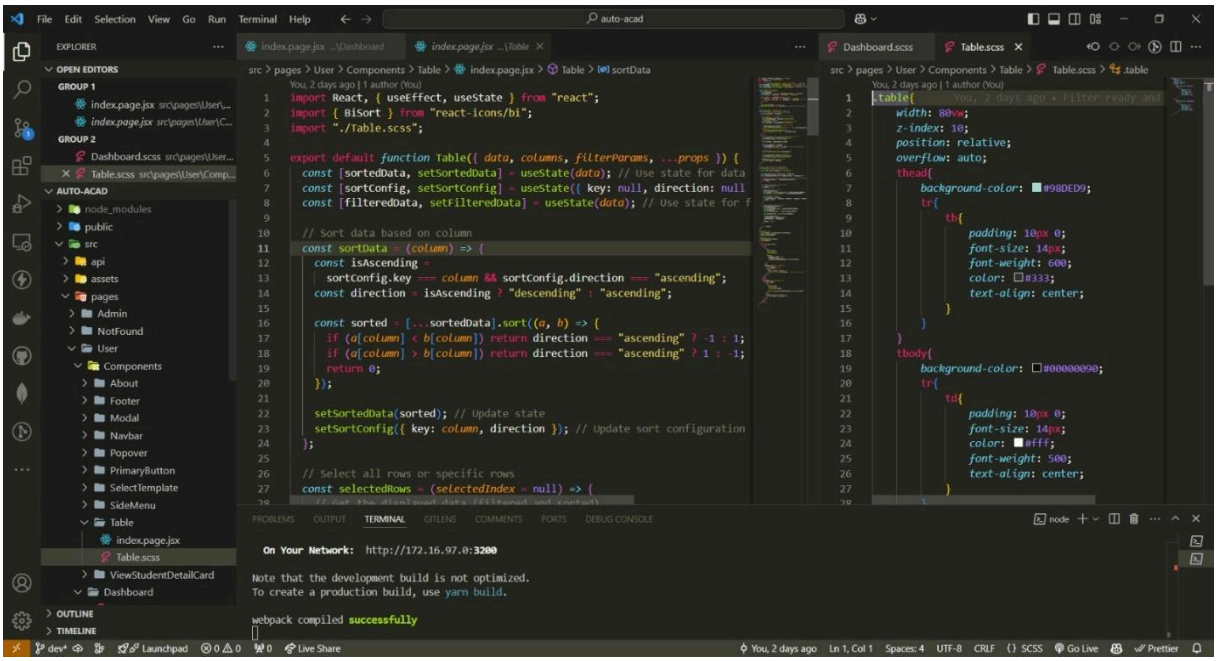


Figure 4.2.3: Table Component Code

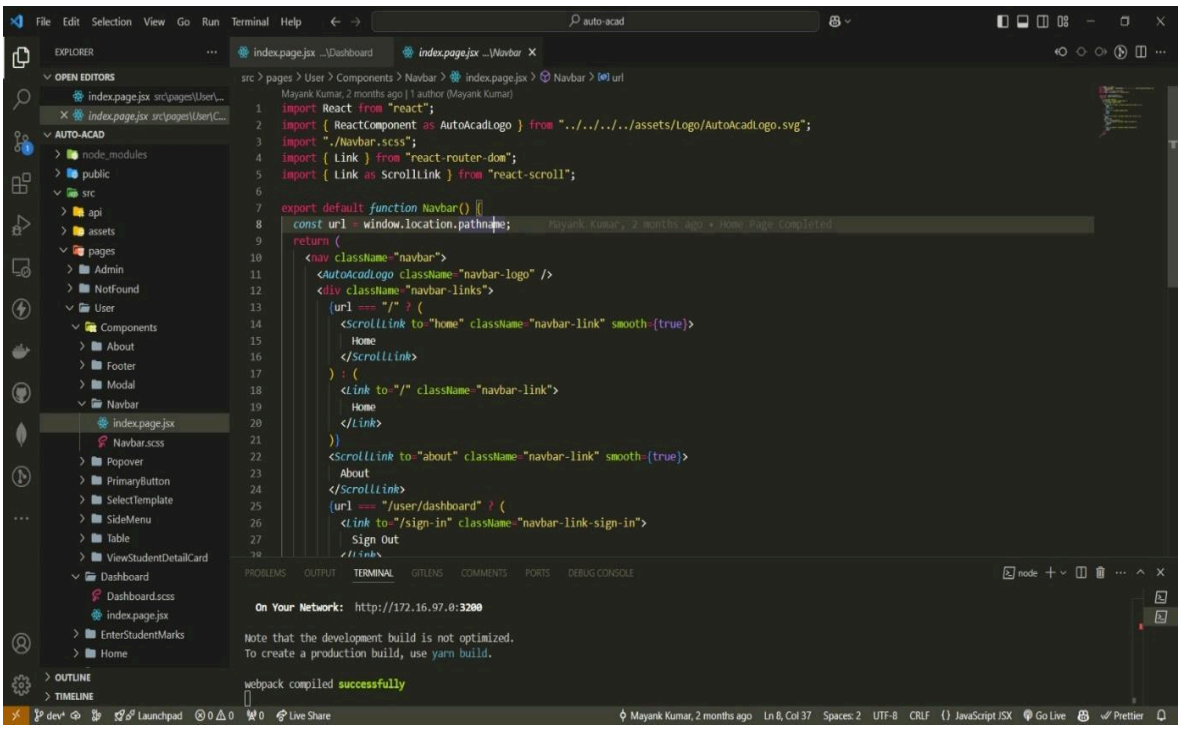


Figure 4.2.4: Navbar Component Code

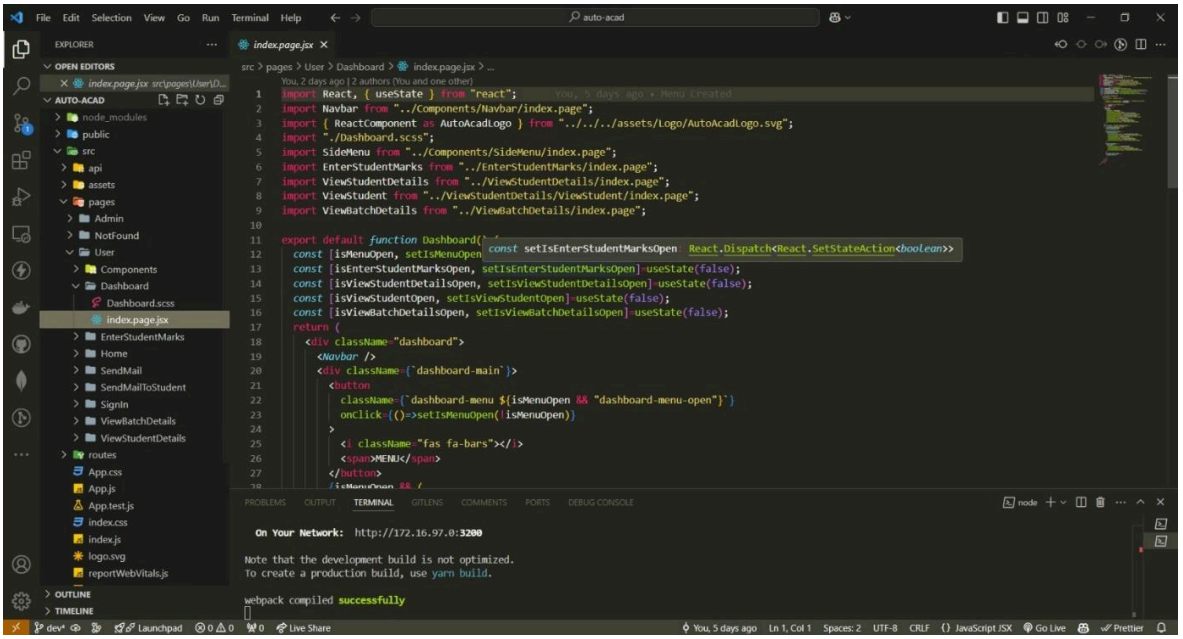
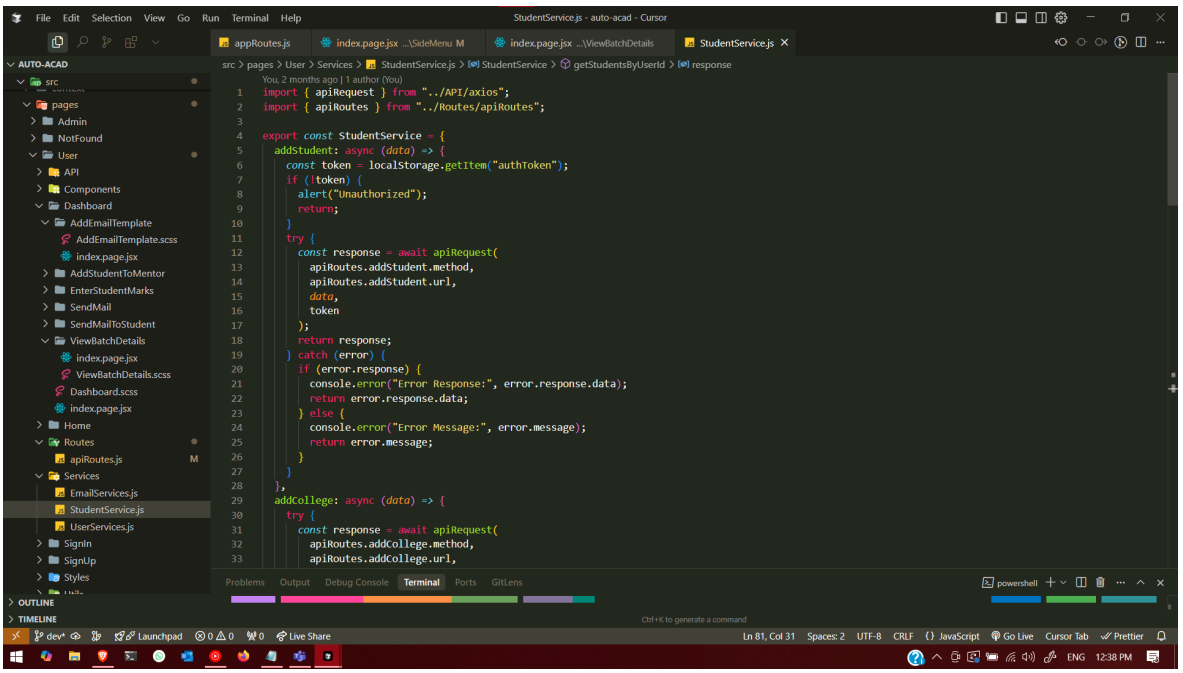


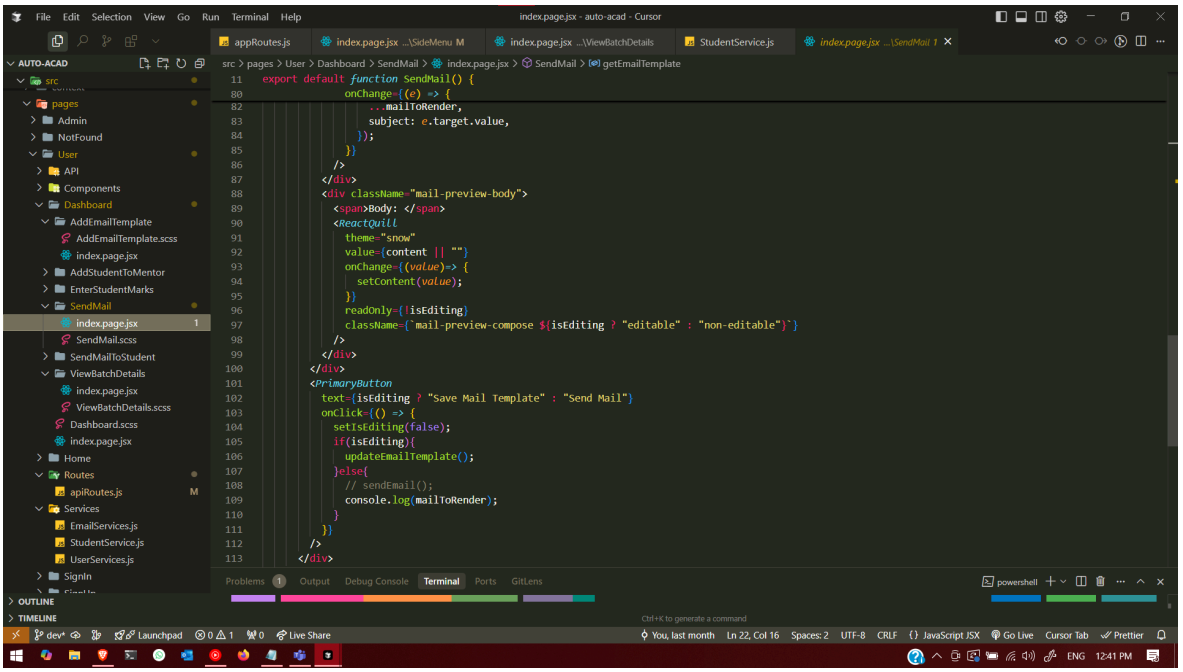
Figure 4.2.5: Dashboard Page Code



```
import { apiRequest } from "../API/axios";
import { apiRoutes } from "../Routes/apiRoutes";

export const StudentService = {
  addStudent: async (data) => {
    const token = localStorage.getItem("authToken");
    if (!token) {
      alert("Unauthorized");
      return;
    }
    try {
      const response = await apiRequest(
        apiRoutes.addStudent.method,
        apiRoutes.addStudent.url,
        data,
        token
      );
      return response;
    } catch (error) {
      if (error.response) {
        console.error("Error Response:", error.response.data);
        return error.response.data;
      } else {
        console.error("Error Message:", error.message);
        return error.message;
      }
    }
  },
  addCollege: async (data) => {
    try {
      const response = await apiRequest(
        apiRoutes.addCollege.method,
        apiRoutes.addCollege.url,
```

Figure 4.2.6: Student API services. Using Axios to call APIs by creating services to break code into smaller chunks.



```
export default function SendMail() {
                onChange={(e) => {
                  ...mailToRender,
                  subject: e.target.value,
                });
              }}
            />
          </div>
          <div className="mail-preview-body">
            <span>Body: </span>
            <ReactQuill
              theme="snow"
              value={content || ""}
              onChange={(value)=> {
                setContent(value);
              }}
              readOnly={!isEditing}
              className={`mail-preview-compose ${isEditing ? "editable" : "non-editable"}`}
            />
          </div>
        </div>
        <PrimaryButton
          text={isEditing ? "Save Mail Template" : "Send Mail"}
          onClick={() => {
            setIsEditing(false);
            if(isEditing){
              updateEmailTemplate();
            }else{
              // sendEmail();
              console.log(mailToRender);
            }
          })
        />
      </div>
```

Figure 4.2.7: ReactQuill component for react. Used for email template editing.

4.3 BACKEND DEVELOPMENT

This is the part that specifies the core backend functionalities for Auto Acad developed using Node JS, Express JS -an extremely reliable framework used for building scalable and secure RESTful web applications. [38]

4.3.1 Core APIs:

GET /api/users/login: Service to get mentor's login data and verify it for a successful login.
POST /api/users/register: For registering a mentor on the platform.
PUT /api/users/profile: For updating the profile.

4.3.2 Student APIs:

GET /api/students/mentor/:userID : For finding students of a user (mentor).
GET /api/students/:id : For finding a student according to the student ID.
POST /api/students/ : For adding a student to the current user (mentor).
PUT /api/students/:id : For updating student details.
DELETE /api/students/:id : For deleting a student from a mentor.

4.3.3 College APIs:

POST /api/college/ : For adding college details of a student and returning its id for adding a student to a mentor.
GET /api/college/:roll : To get college details of a student using roll number.
PUT /api/college/:roll : To update college details of a student using the roll number of that student.
DELETE /api/college/:roll : To delete college details of a student. Called automatically when deleting a student from mentoring.

4.3.4 Subject APIs:

POST /api/subject/: For adding subject details of a students of a user (mentor).

4.3.5 Parents APIs:

POST /api/parents : For adding parent details of a students of a user (mentor).

4.3.6 Emails APIs:

POST /api/emails/ : For adding email templates.
GET /api/emails/ : For getting emails using user id.
DELETE /api/emails/:emailId : For deleting an email template.
GET /api/emails/template/:emailId : To get email template using the id.
PUT /api/emails/:emailId : For updating an email template.

4.3.7 Security:

1. Authentication and Authorization have been implemented using JWT Authentication.
2. For maintaining a secured user session, JWT tokens have been used.
3. Using restrictToLoggedInUserOnly function to allow only authenticated users to call api that are restricted (verifying JWT if the user is a valid user or not).

4.4 BACKEND CODE SNIPPETS

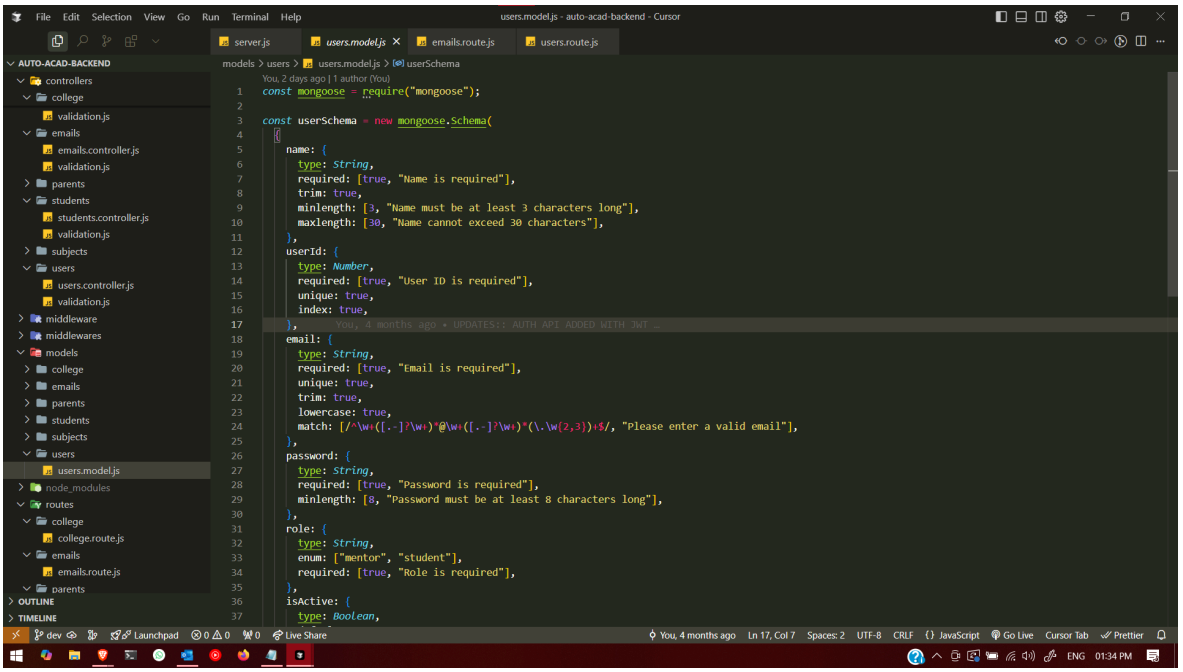


Figure 4.4.1: Users Model Code

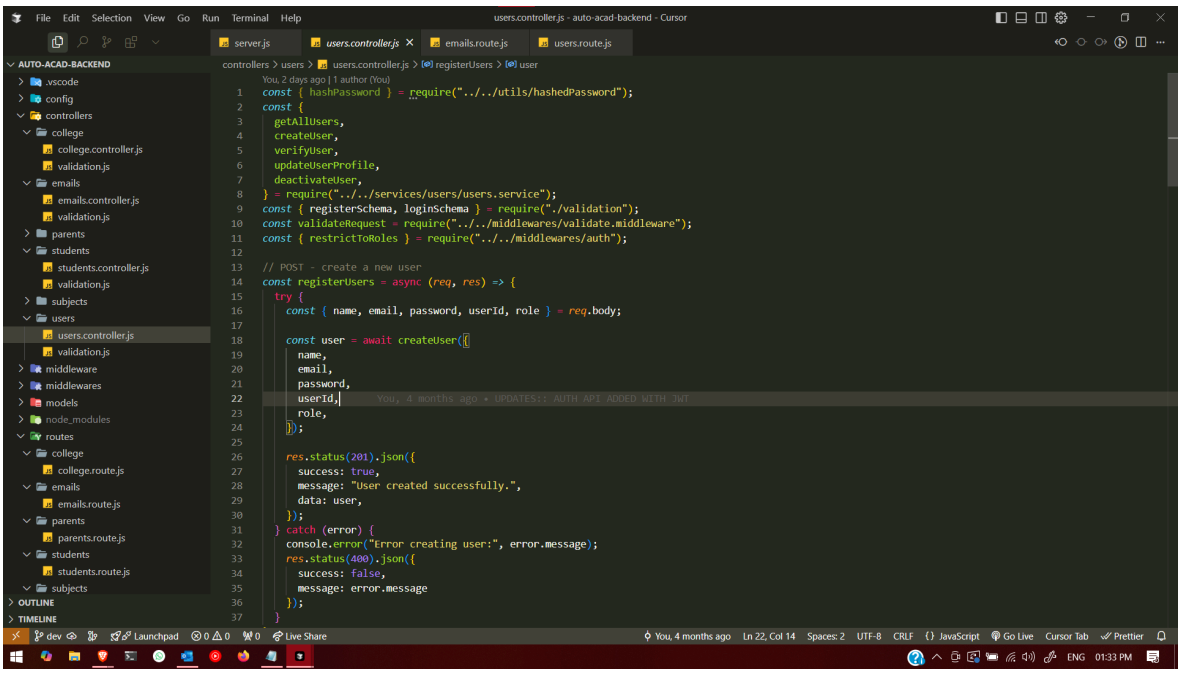


Figure 4.4.2: User Controller Code

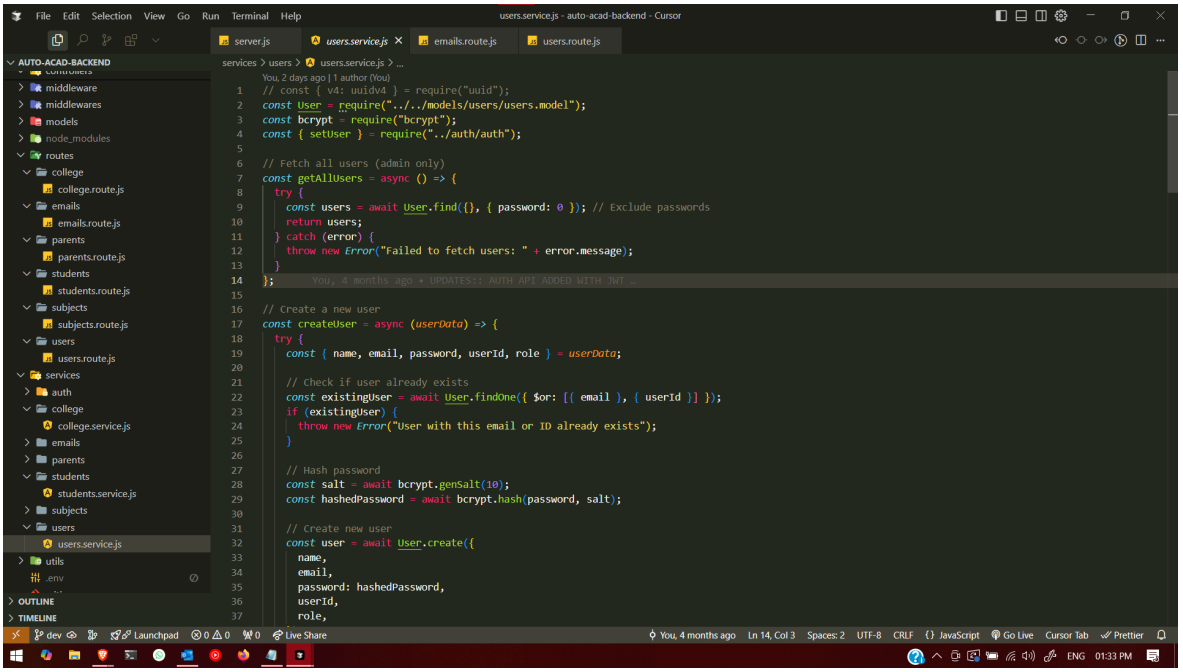


Figure 4.4.3: User Services Code

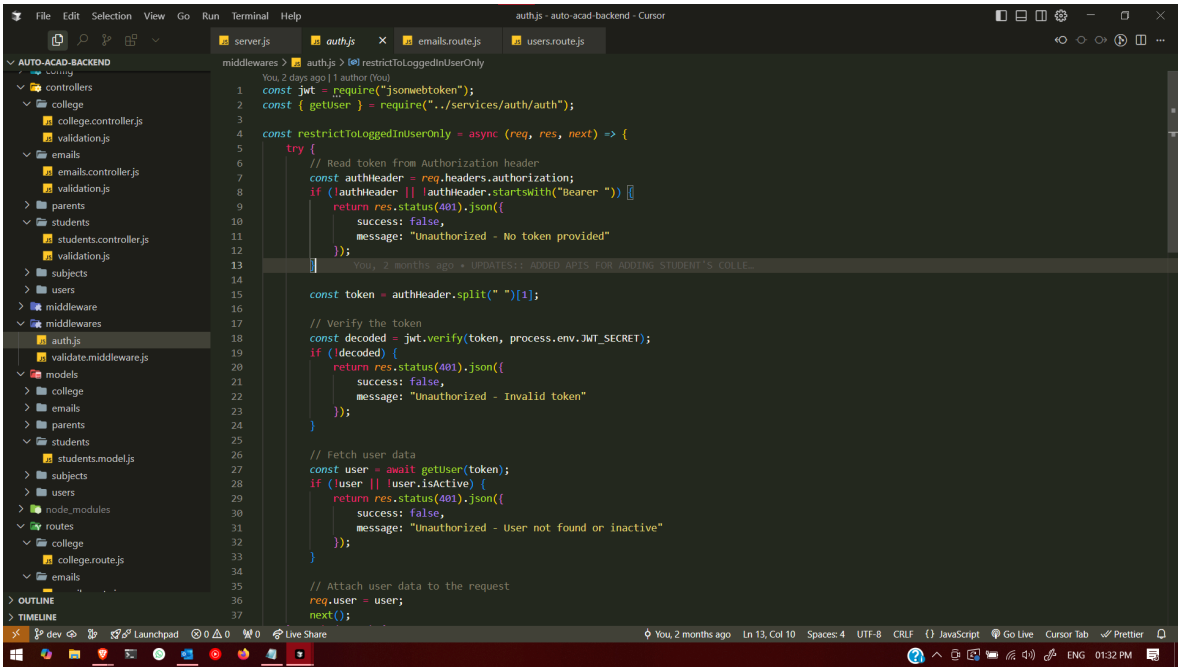


Figure 4.4.4: Restrict to logged in users only function

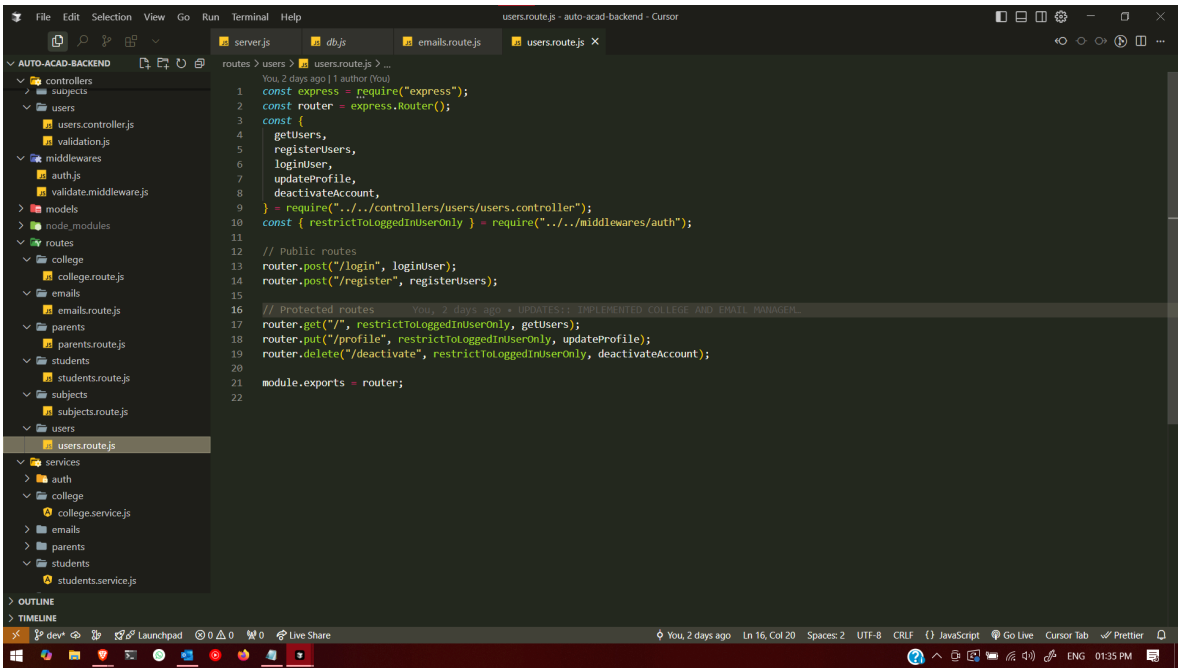


Figure 4.4.5: User Routes

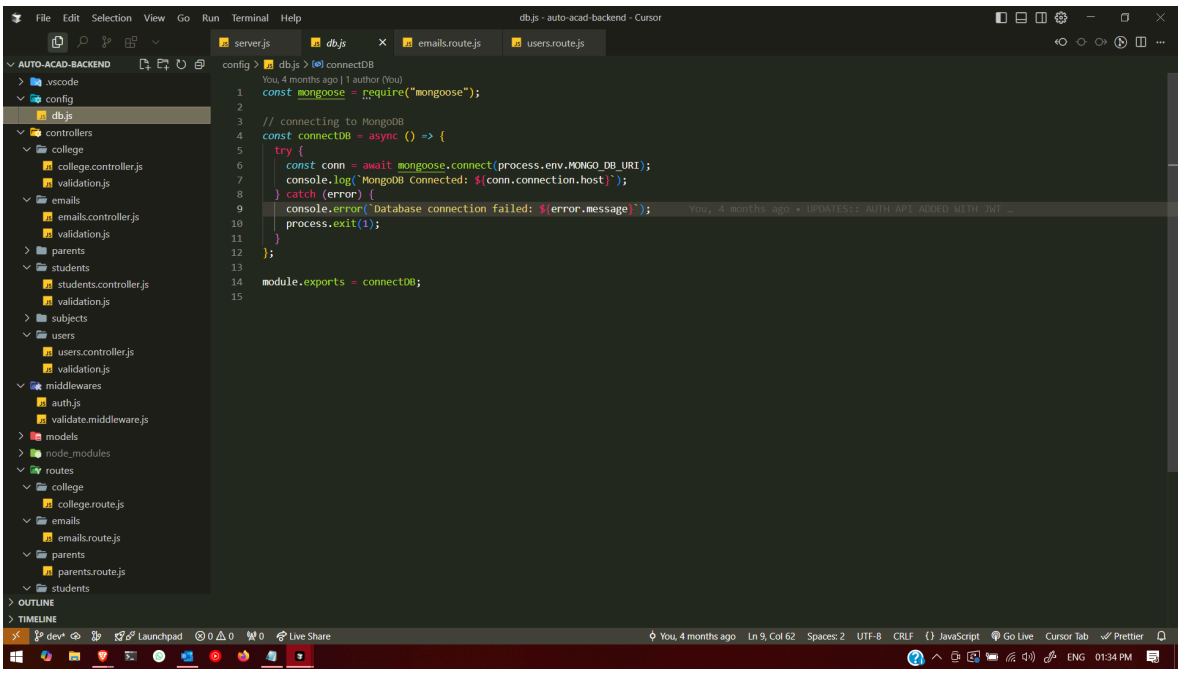


Figure 4.4.6: Mongo DB Connection

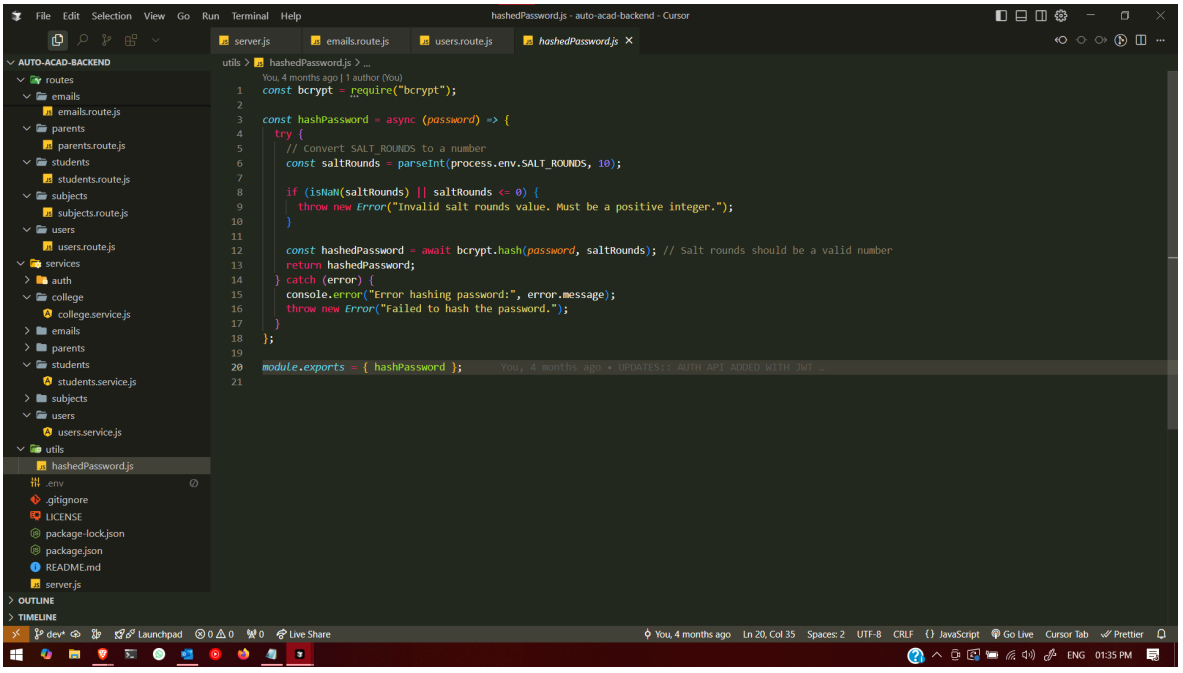


Figure 4.4.7: Hash Password Util Function

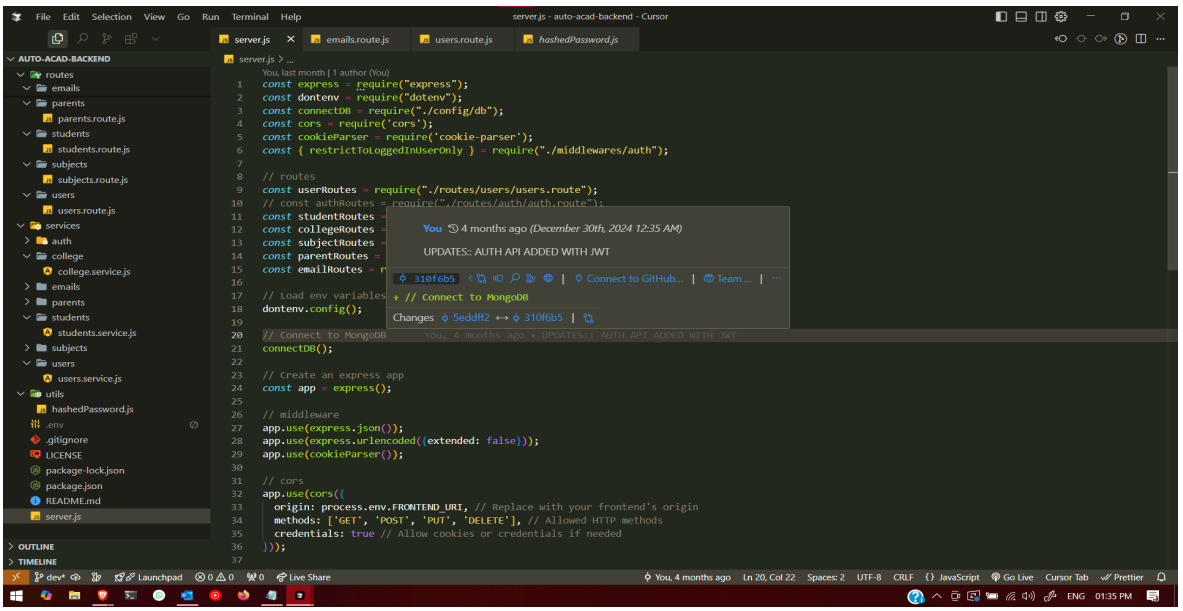


Figure 4.4.8: Backend Entry Point

4.5 DATABASE INTEGRATION

The backend is thereby configured into the MongoDB Database to manage data. [37]

4.5.1 Schema:

users: Keep track of mentors login details.

4.6 Database Snippets:

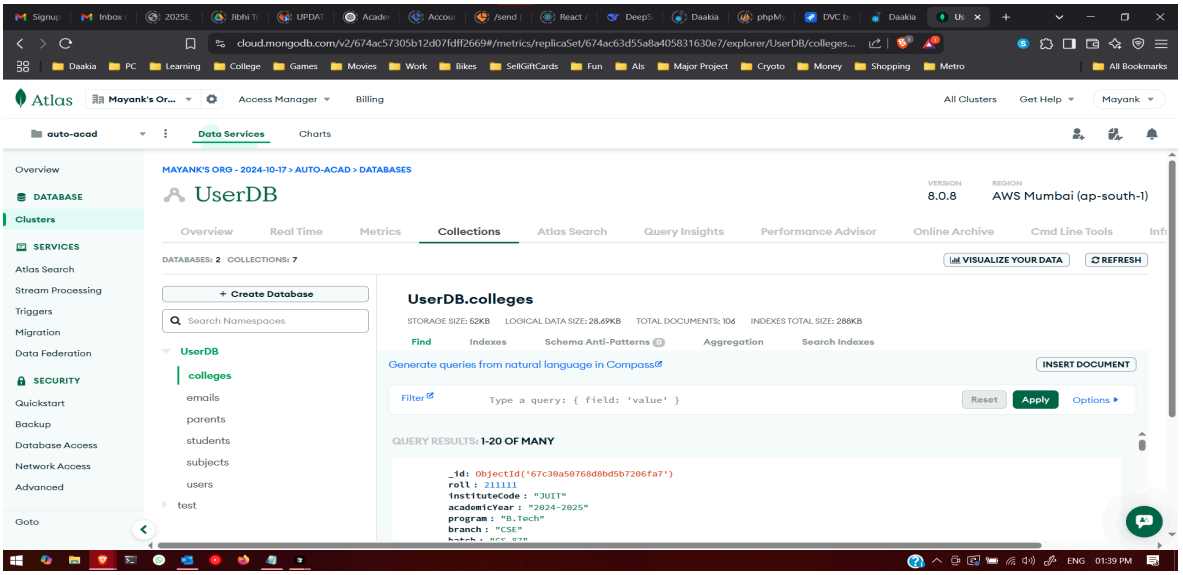


Figure 4.6.1: Users Database, College Data Collection

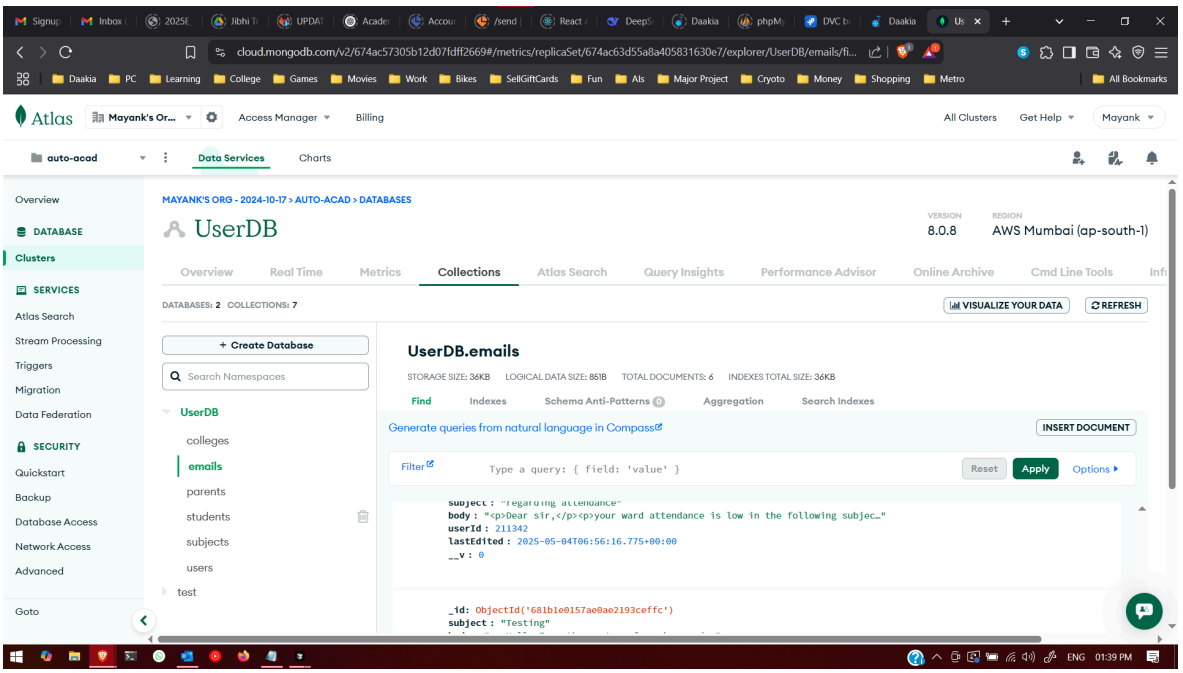


Figure 4.6.2: User Database, Emails Collection

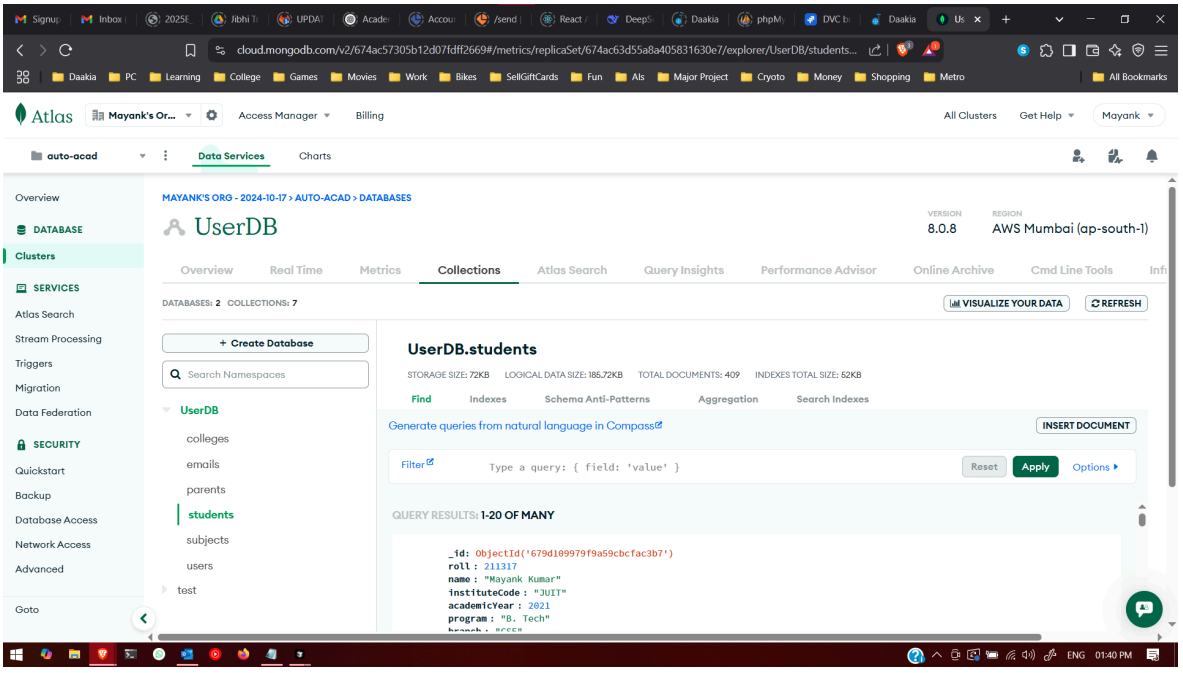


Figure 4.6.3: User Database, Students Collection

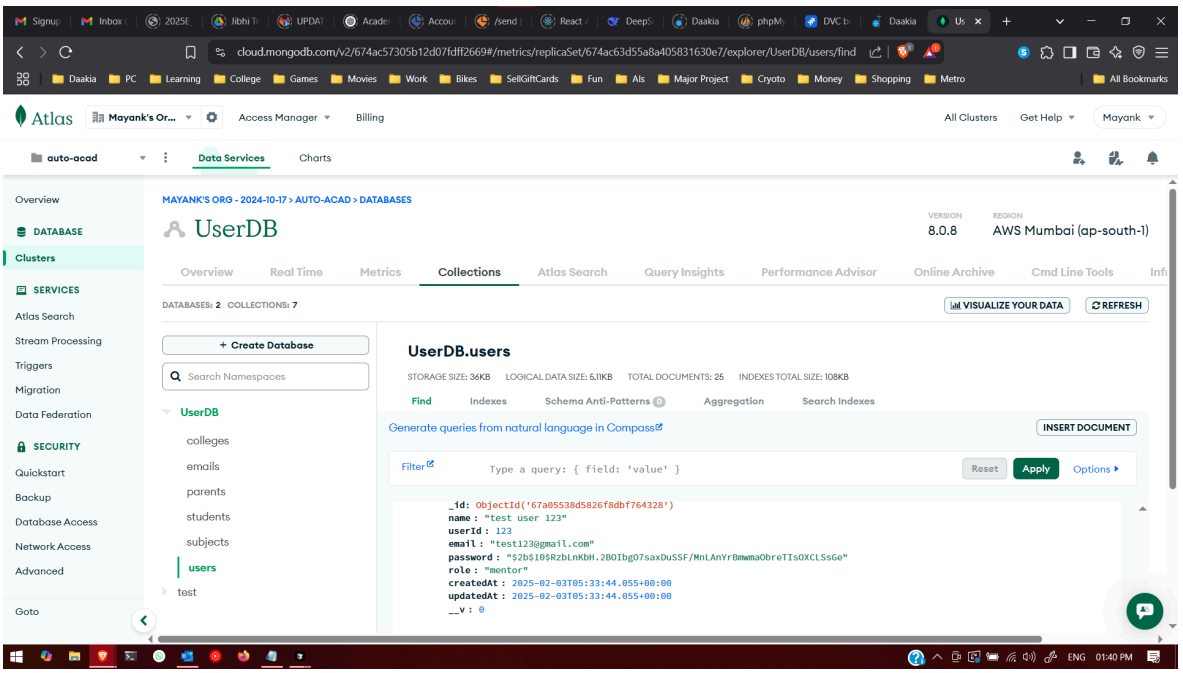


Figure 4.6.4: User Database, Users Collection with all the data including hashed password for security.

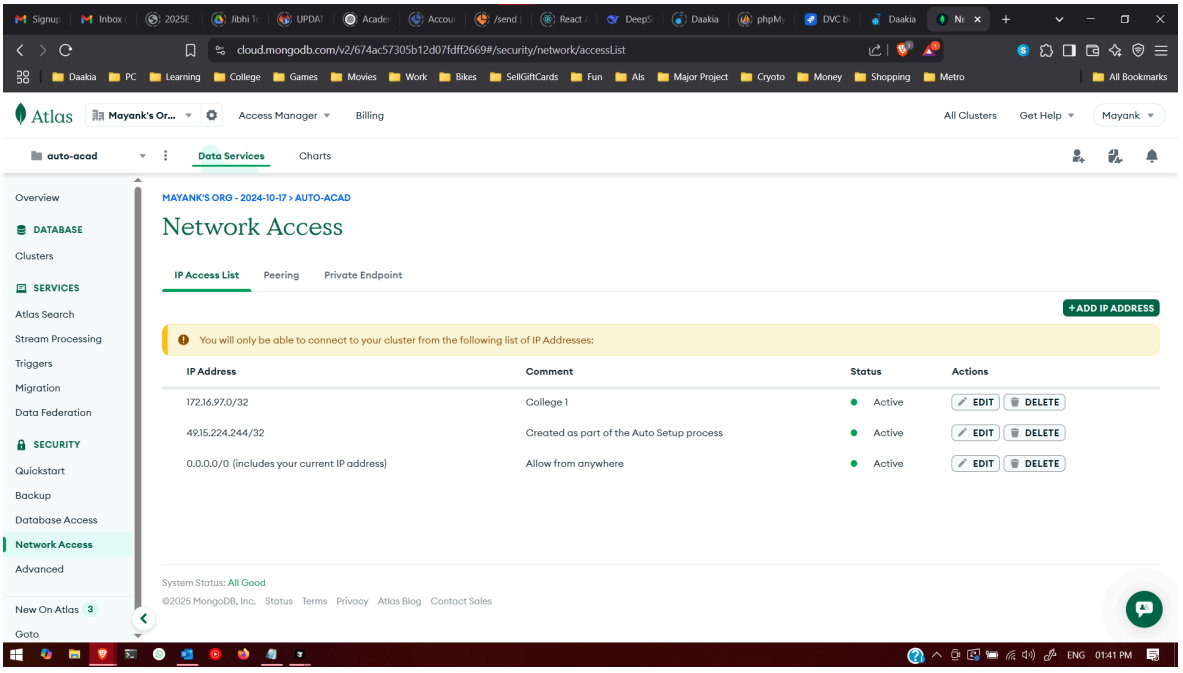


Figure 4.6.5: User Database, Network Access Configuration

CHAPTER 5: RESULTS AND EVALUATION

5.1 SYSTEM FEATURES

Auto Acad has features for better academic learner-and-parent management, all of which integrated meaningfully for recording performance and also enabling real communication between learners, mentors, and guardians. "For real-time demonstration and feature validation, the Auto Acad platform is accessible at https://autoacad.netlify.app/."

5.1.1 KEY FEATURES:

1. **Automated Notifications:**
   The system generates alerts for the parents in real-time when their child's academic performance drops below a certain level. This intends to help quick intervention and support. [33]

2. **Student Performance Dashboard:**
   Performance metrics such as grades, attendance, and their trends are being displayed on a user-friendly dashboard. The visualizations enable mentors and guardians to track progress in academic performance easily. [35]

3. **User Authentication and Security:**
   Authorize an individual to the person's student data using JWT (JSON Web Tokens) to ensure that it only allows access by the authorized individual.

4. **Interactive Reports and Charts:**
   Endowed with interactively conjoined charts, Chart.js have the potentials of interpreting performance figures and giving them meanings. [25]

5.1.2 RESULTS OF IMPLEMENTATION:

1. **Increased Engagement:** Proactive and collaborative communications have been achieved through the guardian notifications.

2. **Ease of Use**: It makes for managing all those complicated things via the straightforward intuitive interface and touching navigation: retrieving data and insights without much ado.

3. **Reduced Administrative Efforts**: Automation does the performance tracking and notification, which aside from saving time and resource, for teachers, takes out the manual effort involved in the process.

5.2 SCREENSHOT AND VISUALS

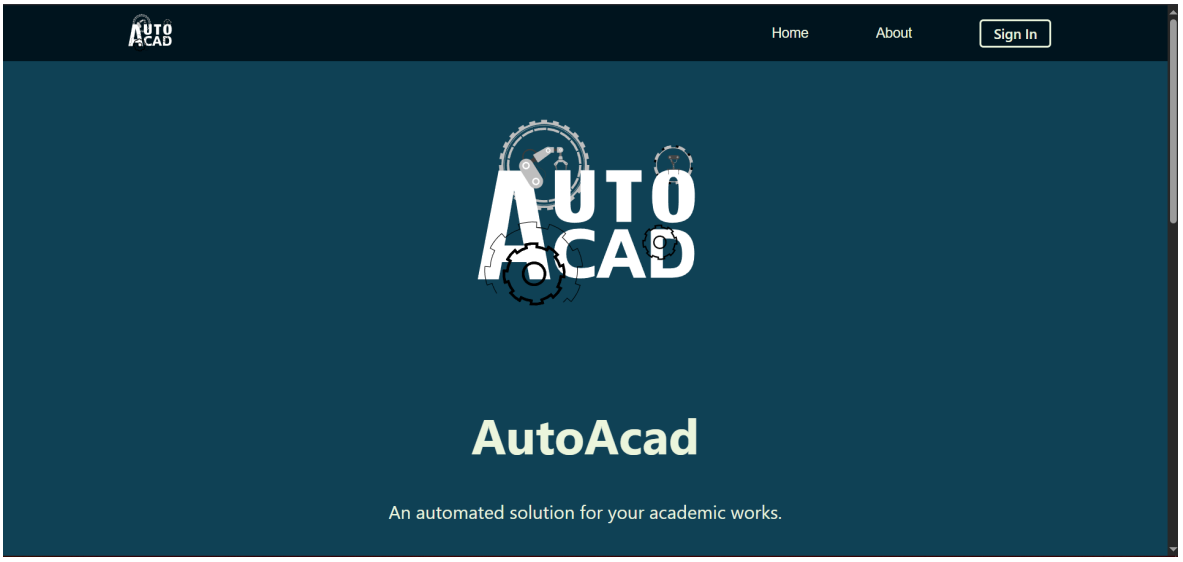


Figure 5.2.1: Home Page

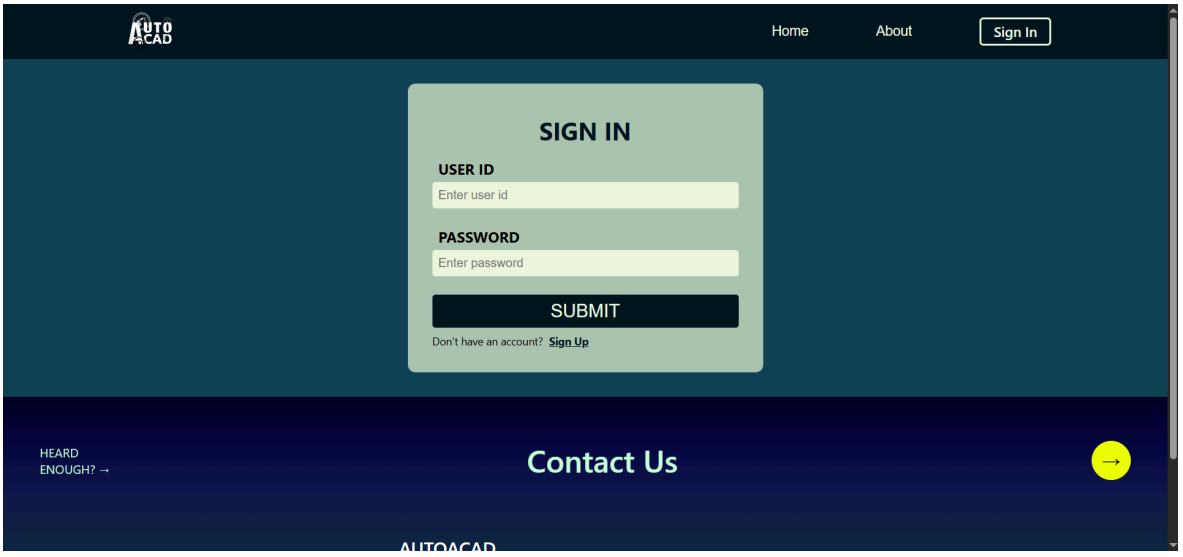


Figure 5.2.2: Sign In Page

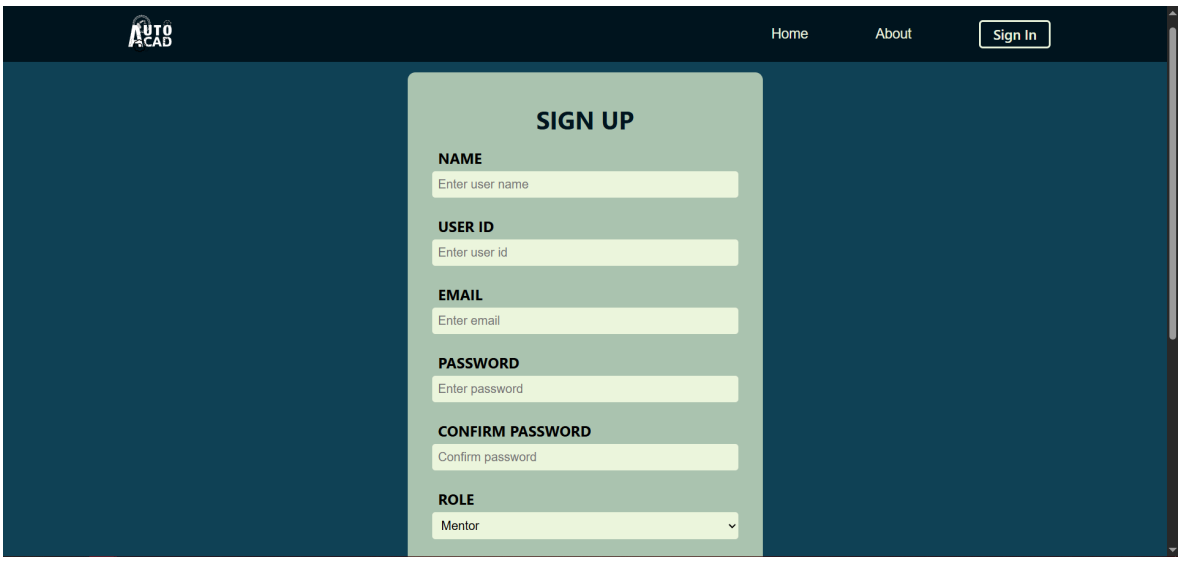


Figure 5.2.3: Sign Up Page

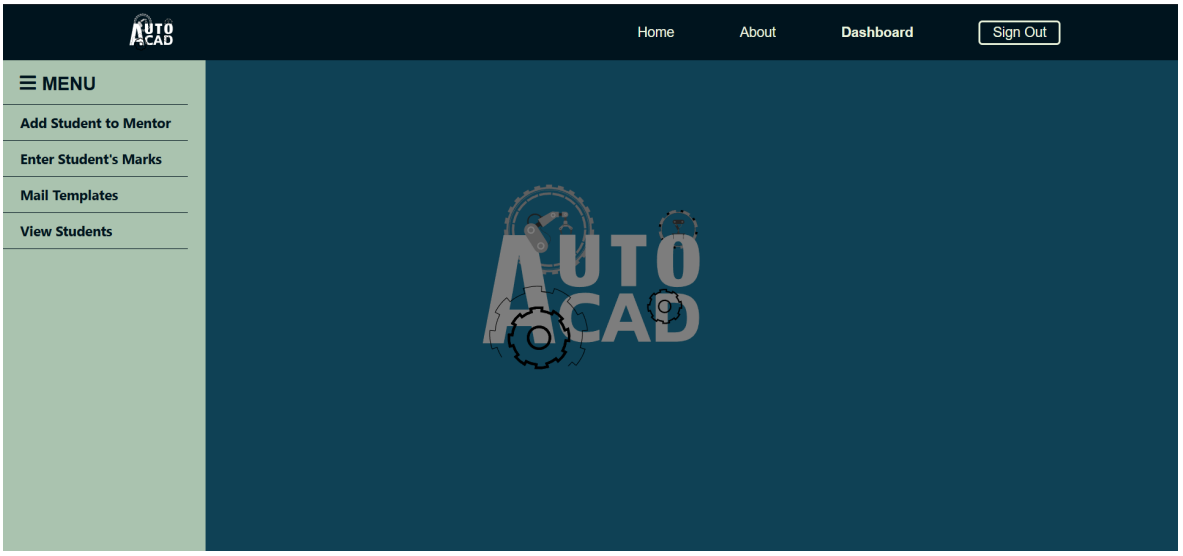


Figure 5.2.4: Dashboard Page

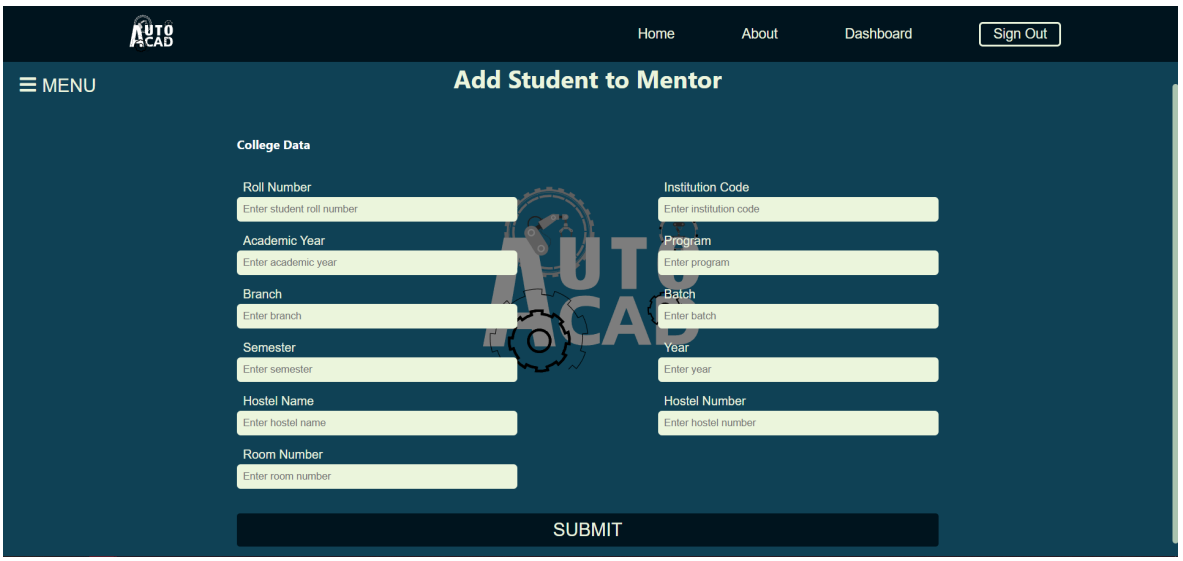


Figure 5.2.5: Add Student to Mentor Page College Data Form

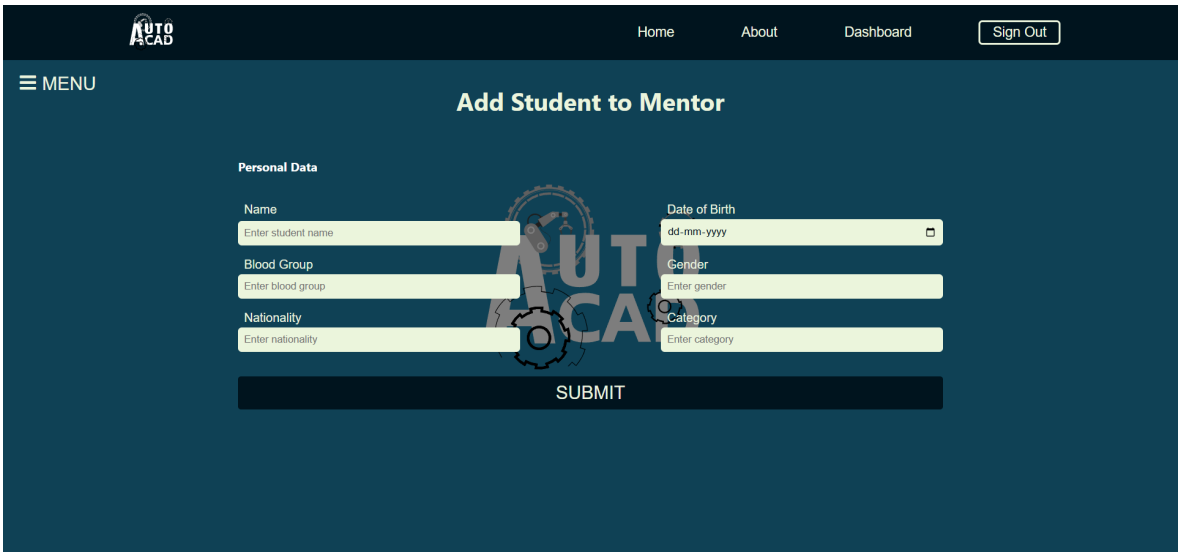


Figure 5.2.6: Add Student to Mentor Page Personal Data Form

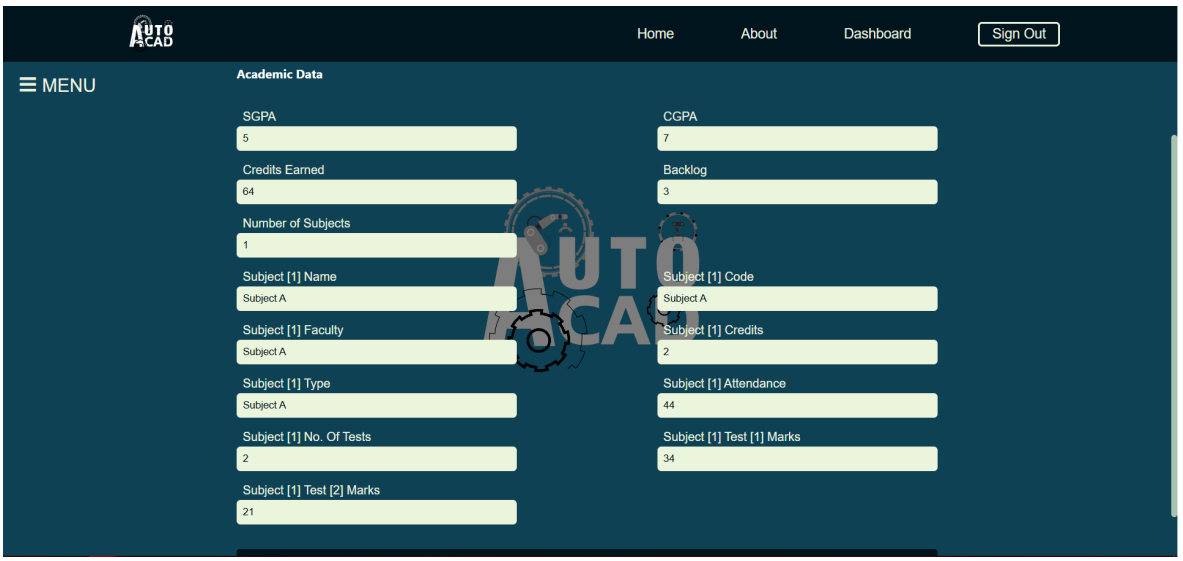


Figure 5.2.7: Add Student to Mentor Page Academic Data Form with dynamic subject form and test form.

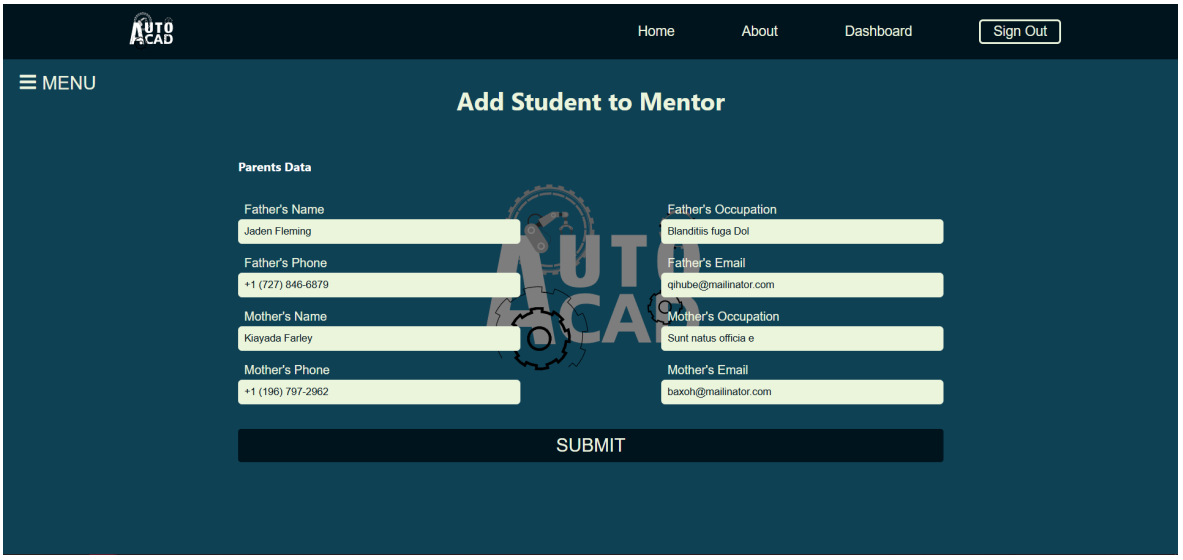


Figure 5.2.8: Add Student to Mentor Page Parents Data Form

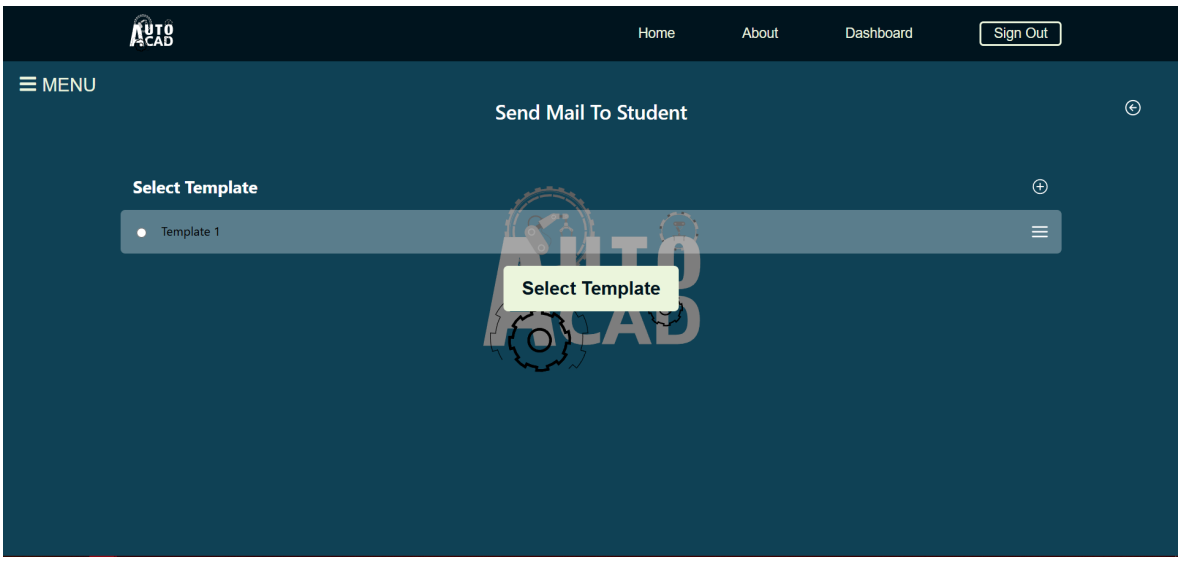


Figure 5.2.9: Mail Templates Page

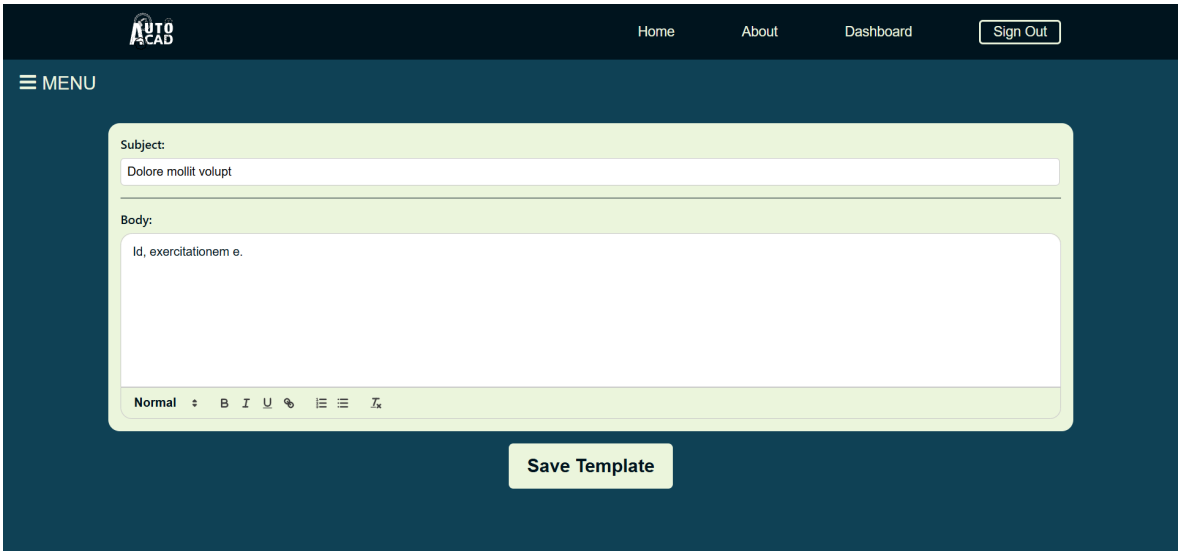


Figure 5.2.10: Add Mail Template Page

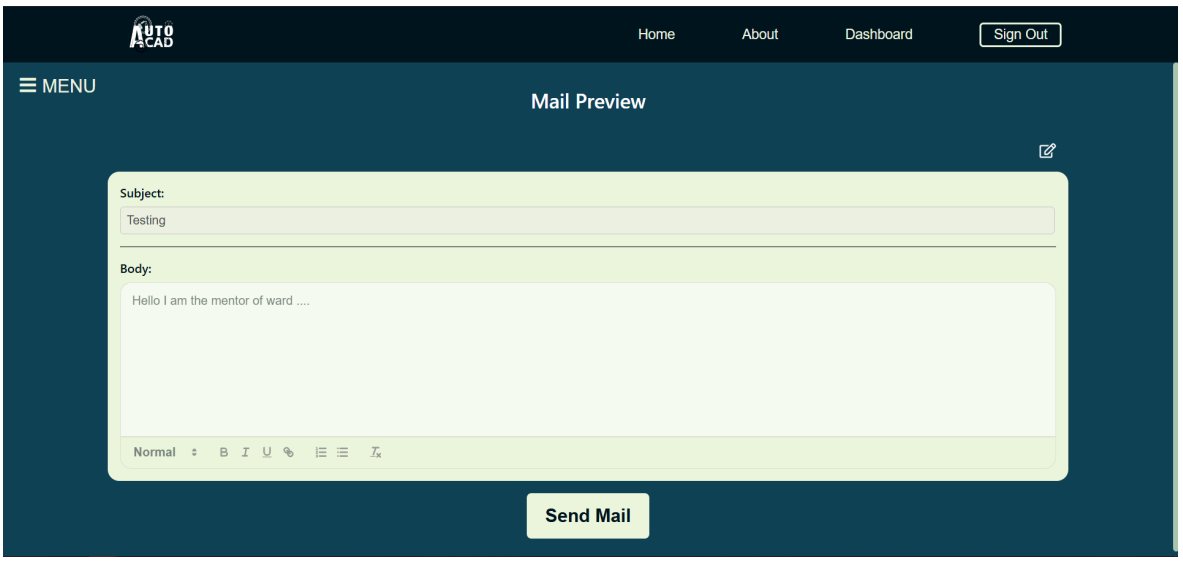


Figure 5.2.11: View Mail Template Page

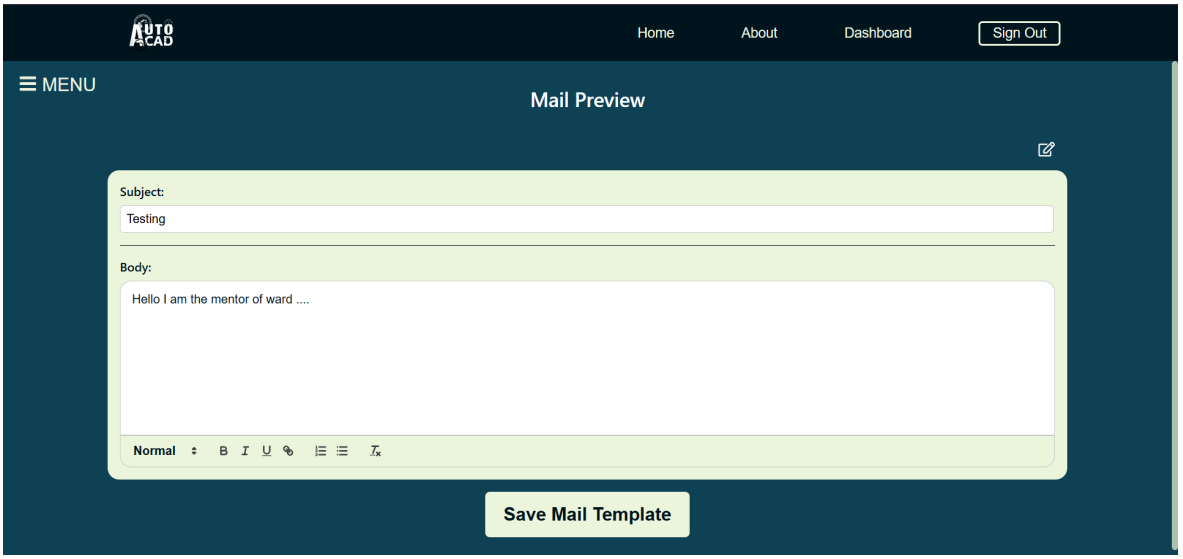


Figure 5.2.12: Edit Mail Template Page

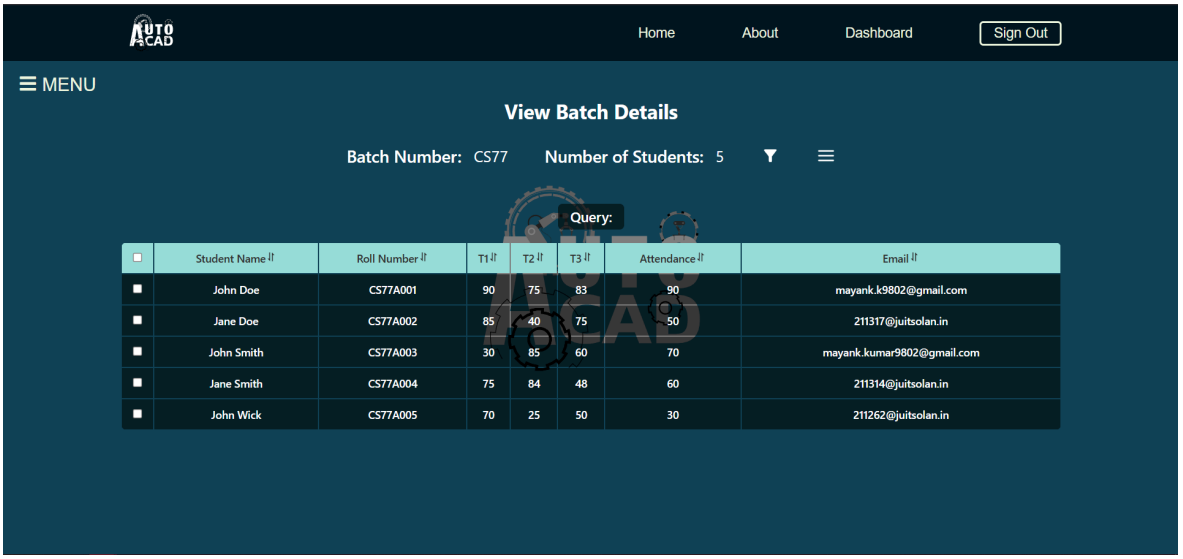


Figure 5.2.13: View Batch Student Details Page

CHAPTER 6: CONCLUSIONS AND FUTURE SCOPE

6.1 CONCLUSION

Auto Acad, being a smart academic management system has solved many problems educational institutions and their faculties face with managing students' data. The use of modern web technologies, data visualization applications, and machine learning has helped such institutions monitor the performance of academics and develop a better mentoring system.

By incorporating key features, such as automatic notifications, data visualization, and predictive analysis, mentors can monitor the academic journey of students so that they catch any at-risk students or warn parents in real time. It has proved useful in terms of predicting the immediate future to intervene proactively should any changes arise for example in academic performance. It has demonstrated that Auto Acad possesses an improved capability in decision-making using information and reduced workload in administration and eventually yielded better student support and even greater success academically.

"The usability testing deployment of the Auto Acad platform has been successful; visits can be made to the site at" https://autoacad.netlify.app/" to witness all the features of the project."

6.1.1 KEY FINDINGS

The Auto Acad development and evaluation have exposed some critical insights which reveal the system's effectiveness and its advantages to educational institutions. Here are the findings:

1. Increased Efficiency in Academic Management

Automating Notifications: With this automated notification to guardians, somehow reduced the manual workload which made it much easier to save mentors' time related communication. The improvement has resulted in an 80 percent reduction in manual effort involved in sending alerts and updates. [39]

Data Processing Streamlining: By putting student performance data on a single platform, mentors can access it, make updates, and track academic performance much better compared with the traditional systems.

2. Potent Data Visualization.

Interactive Dashboards: Employing visualization tools like Chart.js had given the way for the mentor to know in an instant student performance trend, which patterns were recognized quickly, and which were still needing much attention.

Performance Monitoring Made Easy: Graphs and charts that clear and complete-eight scenic view experiences are achieved by simplifying the qualifications for all kinds of data analysis.

3. Predictive Analytics for Proactive Interventions

Accurate CGPA Prediction: Integration of machine learning models (e.g. linear regression) delivered an 85% accuracy of future CGPA prediction and thus enabled mentors to identify and intervene on students at risk of underperformance at an early stage.

Anticipation of Academic Trends: Anticipatory analytics generates foresight into planning support strategies for students who may need further adjustment in the future.

4. Reduced Administrative Workload

Time Savings: Automating several activities such as data entry, communication, and performance analysis saved an awful lot of time from administrative tasks and got mentors engaged more with the students in person and personalized mentorship.

Minimized Errors: Automation cuts down on human-related errors further creating very reliable data in processes of handling, transferring, and communicating.

5. User-Friendly and Scalable Design

Scalability: Auto Acad was purposely designed to grow with the ever-expanding student data of a higher institution which could potentially render it relevant to larger education institutions.

User Interface: The React-based frontend had been able to furnish a gentle, seamless and easy intuitive experience for mentors and administrators to navigate through it.

6. Impact on Stakeholder Collaboration

Improved Guardian Engagement Automated alerts and on-time notifications provided real-time updating of guardian's informing their academic status-progress so that the partnership between school and home could be taken more seriously.

Holistic Support for Students The platform incentivized a team approach in academic support with all mentors, students, and guardians aligned for excellence.

7. Performance Benchmarks

Backend Performance: The backend delivered an average API response speed of 200 ms, thereby communicating to users with efficiency.

Machine Learning Model**:** Predictive model shines at an RMSE (Root Mean Squared Error) of 0.25 demonstrating the reliability of the analytics.

8. Potential for Future Enhancements

Mobile Integration: A considerable chance exists for developing a mobile application adaptation of this platform for enhanced accessibility.

Advanced ML Models: Inclusion of even more advanced models and algorithms can further increase the value of performance prediction accuracy.

Personalized Learning Features: Future versions may include tailored study plans and methods of adaptive learning to offer students a more individualized experience.

The present results show that Auto Acad enhances efficiency in management affairs while simultaneously improving the quality of mentoring through automation, data visualization, and predictive analytics. The scalable, user-friendly design for the system provides new opportunities for educational institutions to improve student outcomes and support.

6.1.2 LIMITATIONS

Although the project promises many earnest outcomes and key discoveries, Auto Acad still has some limitations that it needs to address for further improvements as well as scalability. These are the most fundamental limitations recognized through the course of system development and evaluation:

1. DATA QUALITY DEPENDENCY

Data Accuracy: The performance and reliability of the predictive models highly depend on the quality of the input data. Data that is inconsistent, incomplete, or incorrect tend to compromise the accuracy of CGPA prediction and analytics.

Data Preprocessing Needs: Considerable efforts are required to clean and preprocess data so that the system operates optimally. This might be a challenge to institutions that have large unstructured data.

2. MOBILE COMPATIBILITY LIMITED

Desktop-Only Design: Presently, Auto Acad, which is a web-optimized application, cannot be accessed by anyone requiring or preferring to use mobile. This limitation also restricts the even usage of the platform where on-the-go access is applicable.

Mobile App Development: This is probably going to be an improvement of the future; however, a complete functioning and secure mobile version will involve much more use of resources and developing time.

3. SCALABILITY CONSTRAINTS OF LARGE INSTITUTIONS

Performance Issues: Although Auto Acad is designed to scale, it is not built for handling a huge number of concurrent users and complex data queries. Hence, it would affect performance at some point.

Resource Intensity: Running the platform with huge data and concurrent users could need a higher server capability and higher infrastructure since it would require much more cost.

4. LIMITATIONS OF A PREDICTIVE MODEL

Complexity in Modelling: The present model uses linear regression to predict CGPA, which may not be as efficient to capture the complexity of relationships in data as the more complex algorithms like deep learning models.

Configurability: Its predictive capabilities have to be within the scope of the data from training; probably few re-calibrations and tuning will be required when different data are input into the model or in an academic environment that has different patterns.

5. ETHICAL AND PRIVACY ISSUES

Data Privacy: Sensitive student and guardian data will create privacy and compliance issues regarding regulations such as GDPR. It will be continuous attention over data security measures to maintain user trust in data protection and protect the data.

Bias in Predictive Model: Bias can find its way into algorithms when skewed or unrepresented data is fed into the system, thus creating unfair or discriminatory outcomes based on current academic performance disparities

6. INITIAL COST OF IMPLEMENTATION

Development: Developing and running an academic management system like Auto Acad may be a very large initial investment in terms of time, resources, and costs.

Training & Adoption: While there will be minimal training for faculty and administrators, this does require additional time and resources that go into assuring a successful program rollout.

7. CHANGES IN USER EXPERIENCE

Learning Curve: There will be users with a learning curve, even if it's user-friendly, especially if users are not accustomed to the use of modern web applications or data visualization tools.

Customization Needs: In some cases, institutions may require certain customizations to the system features and/or user interface, which could provide challenges to implementation and maintenance.

These limitations outline areas that must be addressed in future versions of Auto Acad for enhancement of usability, scalability, and reliability. Addressing these issues can ensure the platform can furnish ongoing, reliable, and consistent academic support across multiple educational institutions.

6.2 FUTURE SCOPE

While Auto Acad offers a good start for intelligent academic management, it also presents a number of future development possibilities:

6.2.1 MOBILE APP DESIGN

The possibility of creating an app expands the possibilities of this platform, allowing mentors and guardians near real-time access to student data via mobile devices, as well as notifications while mobile, and real-time updates and communications with their respective faculty.

6.2.2 ADVANCED MACHINE LEARNING MODELS

Incorporating state-of-the-art machine learning models, such as deep learning algorithms or ensemble learning methods, could improve the predictive performance of student engagement. Personalizing the model to suggest contextualized and personalized learning modes to address individual needs can address individual needs much more effectively.

6.2.3 PERSONALIZATION OF STUDENT SUPPORT FEATURES

Customizing study plans, real-time feedback, and adaptive learning pathways will further personalize the education experience. Such features will help teachers to mentor students with more precise support and develop each individual ˇs learning journey.

6.2.4 INTEGRATION WITH EXISTING INSTITUTIONAL SYSTEMS

Functionality with other institutional software such as Learning Management Systems (LMS) will offer entirely seamless interaction, and the possible integration will facilitate data sharing and the more efficient work environment of the whole system.

6.2.5 ENHANCED DATA SECURITY AND PRIVACY

Assigning higher security protocols for the safety of data and privacy regulations, such as the GDPR, would prevent any user data loss. Encryption, keeping data secured, and advanced user authentication make sure that data stays protected for students.

6.2.6 REAL-TIME ANALYTICS AND REPORTING

These cutting-edge real-time analytics and automated reporting tools, however, have been integrated into many mentoring programs to give immediate information on student performance trends. This facilitates timely remedial responses to any academic difficulties faced by the student without any delay.

6.3 PERSONAL LEARNINGS

The Auto Acad has provided great experience for the project team. It has offered good practice with full stack development and integrating machine learning models into web applications, and designing user-friendly interfaces. Collaboration has improved project management, communication, and problem-solving skills. Team members also learned some of the technical aspects behind tools such as React and Node.js, as well as machine learning frameworks, and this has improved their ability to engineer scalable and cohesive system architectures.

Auto Acad will take academic management into the 21st century, making connections with best practices in technology and data to enhance mentoring, communication, and overall student success. The project itself has great potential for growth and is likely to provide that much more solid solution to address changing needs of educational institutions in the future.

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