

KTUfy: Smart Academic Assistance for KTU Students

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Abstract: KTU students often face difficulties in organizing their studies, finding syllabus-based materials, and preparing effectively for examinations. Most existing learning platforms provide general content that does not fully match the KTU curriculum. To address this problem, this project presents KTUfy, a smart academic assistant designed specifically for KTU students. KTUfy provides an intelligent chatbot that answers student queries based on the official syllabus and study materials. The system also includes features such as automatic quiz generation, a coding practice module, and a question paper pattern analysis system to help students identify important topics for exams. In addition, academic management tools such as a study calendar, reminders, and SGPA/CGPA calculator are included to support better planning and time management. The system is developed using React for the frontend and Python with Fast API for backend services. Natural Language Processing techniques and retrieval-based models are used to improve the accuracy of answers. The main aim of KTUfy is to improve learning efficiency, exam preparation, and overall academic support for KTU students through a single integrated platform.

Keywords: Academic Assistant, KTU Syllabus, Chatbot, Quiz Generation, Question Paper Analysis, Machine Learning, Natural Language Processing.

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I. INTRODUCTION

The rapid growth of digital technology has significantly changed the way students learn and access academic resources. University students today depend heavily on online platforms, digital notes, and learning applications to support their studies. However, most available e-learning systems provide general academic content and do not follow the specific curriculum structure of individual universities. As a result, students of APJ Abdul Kalam Technological University (KTU) often face difficulties in finding syllabus-oriented materials, organizing their study plans, and preparing effectively for examinations. Although many online learning platforms and educational tools are available, they lack personalization and syllabus awareness. Students spend a large amount of time searching for the right study resources that match their course outcomes. In addition, there is limited support for identifying important

exam topics, practicing subject-wise questions, and tracking academic progress. The absence of integrated academic management tools such as reminders, study planners, and performance tracking further increases the workload and stress of students.

To overcome these challenges, this project introduces KTUfy, a smart academic assistant designed specifically for KTU students. The system combines Artificial Intelligence (AI), Natural Language Processing (NLP), and Retrieval-Augmented Generation (RAG) techniques to provide syllabus-based academic support. KTUfy includes a chatbot that answers student queries using official syllabus content, along with automatic quiz generation, coding practice modules, and question paper pattern analysis. These features help students focus on important topics and prepare more efficiently for examinations.

In addition to academic support, KTUfy also offers academic management tools such as a study planner, checklist system, reminders, group study features, exam mode, and relaxation sessions. The platform is developed using React for the frontend and Python with Fast API for backend services. By integrating intelligent learning tools with academic planning features, KTUfy aims to create a unified learning environment that improves learning efficiency, reduces academic stress, and enhances overall student performance at APJ Abdul Kalam Technological University.

II. PROPOSED SYSTEM

➤ *Outline of the Proposed System*

The proposed system introduces an AI-powered academic assistant named KTUfy, designed to provide syllabus-aware academic support for students of APJ Abdul Kalam Technological University (KTU). The system focuses on improving learning efficiency by combining intelligent academic assistance with academic planning and progress tracking features within a single unified platform.

KTUfy provides real-time academic support through a syllabus-aware chatbot that answers student queries using official course materials and structured knowledge sources. The chatbot is supported by Natural Language Processing (NLP) and Retrieval-Augmented Generation (RAG) techniques to ensure accurate and curriculum-aligned responses. In addition to query resolution, the system includes automatic quiz generation, coding practice modules, and question paper pattern analysis to help students identify important topics and prepare strategically for examinations.

The platform also includes academic management tools such as a study planner, checklist system, reminders, group study features, exam mode, and relaxation sessions. These tools help students organize their study schedules, track their learning progress, and reduce academic stress. The entire system is developed using React for the frontend and Python with Fast API for backend services, ensuring scalability, security, and reliable performance. By combining intelligent learning support with academic management, KTUfy creates an integrated learning environment that supports continuous academic improvement.

➤ *Algorithm for Proposed Solution*

- Initialize the KTUfy application by setting up the frontend interface, backend services, and user authentication modules. Configure Supabase for database storage, notifications, and user management.
- Load syllabus content, subject materials, and previous question papers into the knowledge base. Generate vector embeddings and store them in a vector database for efficient retrieval.
- Initialize the chatbot module using NLP and RAG models to process student queries and retrieve syllabus-aligned answers from the knowledge base.
- Set up the quiz generation module to automatically create subject-wise quizzes based on syllabus topics and difficulty levels.

- Initialize the coding practice module with curated programming problems and evaluation mechanisms.
- Load the question paper pattern analysis module to identify frequently repeated topics and generate predicted important questions.
- Configure the academic planner by enabling calendar scheduling, reminders, checklist tracking, and exam mode features.
- Enable group study features that allow students to collaborate, share notes, and discuss academic topics in a shared workspace.
- Track user activity and learning progress using analytics and performance monitoring tools.
- Provide personalized recommendations based on quiz performance, practice history, and learning patterns.
- Ensure data security by implementing authentication, access control, and encrypted storage mechanisms.
- Continuously update syllabus content, question banks, and learning resources to maintain curriculum alignment.

III. IMPLEMENTATION

➤ *Technologies and Development Environment*

The implementation of the KTUfy academic assistant is carried out using modern web and cloud technologies that support scalability, reliability, and ease of access. The frontend of the system is developed using the React framework, which provides a responsive and interactive user interface suitable for both mobile and web platforms. A clean and simple interface is designed to help students easily navigate between academic modules such as chatbot, quizzes, coding practice, study planner, and group study features.

The backend of the system is implemented using Python, which handles API requests, user authentication, and data processing. Supabase is used for database management, user authentication, cloud storage, and notification services. Supabase also supports real-time data synchronization, which allows instant updates across devices. For intelligent query processing, Natural Language Processing (NLP) models and Retrieval-Augmented Generation (RAG) techniques are integrated with a vector database for efficient information retrieval. The entire system is deployed on cloud infrastructure to ensure high availability and secure access.

➤ *Chatbot and Academic Assistance Module*

The chatbot module is the core component of KTUfy. It is designed to answer student queries based strictly on the official KTU syllabus and academic materials. When a student submits a query, the system first processes the input using NLP techniques to understand the intent and subject context. The processed query is then matched with relevant syllabus content stored in the vector database using semantic similarity search. The RAG pipeline retrieves the most relevant academic content and passes it to the language model for generating accurate and syllabus-aligned responses. This approach ensures that the answers are grounded in verified study materials rather than generic internet content. The chatbot supports both conceptual explanations and short factual answers, making it suitable for quick revision as well

as in-depth understanding.

➤ Quiz Generation and Coding Practice Module

The quiz generation module automatically creates subject-wise quizzes based on syllabus topics. Questions are generated using structured academic content and categorized according to difficulty levels. Each quiz session is timed and evaluated automatically. After completion, students receive instant feed-back along with performance analysis.

The coding practice module provides a collection of pro-gramming problems covering core subjects such as Data Structures, Algorithms, and Web Development. Students can write and test code directly within the platform. The system evaluates the output against predefined test cases and provides correctness feedback. This module helps students improve problem-solving skills through continuous practice.

➤ Academic Planner and Group Study Features

KTUfy includes an academic planner that allows students to create study schedules, set reminders, and maintain subject-wise checklists. The planner is integrated with an exam cal-endar and notification system to ensure

students stay updated with important academic deadlines.

The group study feature provides a shared workspace where students can form study groups, share notes, discuss topics, and collaborate on problem-solving. This module encourages peer learning and improves engagement through collaborative study sessions.

➤ Privacy, Security, and Performance Considerations

User authentication is implemented using Supabase Authentication to ensure secure access. All academic data and user information are stored in encrypted cloud databases with access control policies. Sensitive data transmission is protected using HTTPS and secure API endpoints.

To ensure smooth performance, the system uses caching mechanisms for frequently accessed syllabus content and question banks. Query processing and vector search operations are optimized to minimize response time. In most cases, the chatbot returns answers within a few seconds, ensuring a responsive learning experience. The platform is designed to scale with increasing user load while maintaining reliability and data security.

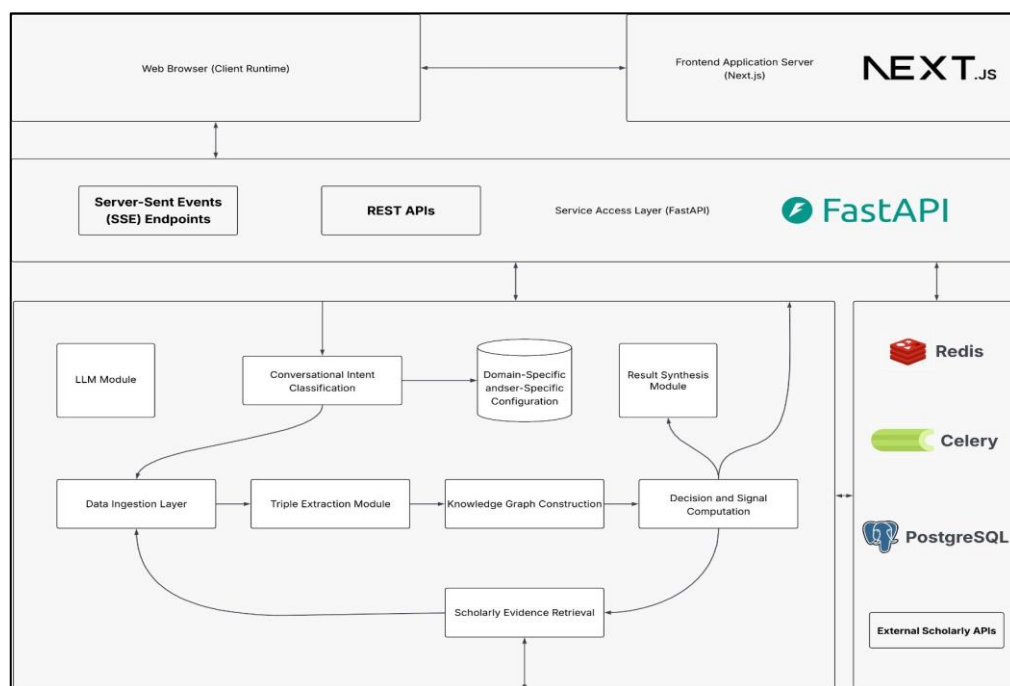


Fig 1 Implementation Diagram

IV. LITERATURE SURVEY

In paper [1], the authors present GPTutor, a Generative AI-based Intelligent Tutoring System developed to improve student learning through knowledge-driven assistance. The system uses a Retrieval-Augmented Generation (RAG) framework to overcome common limitations of generative models such as factual errors and hallucinations. A pilot study conducted among undergraduate and postgraduate students reported improved engagement levels and better academic performance, highlighting the effectiveness of AI-powered tutoring systems in higher education.

In paper [2], a structured framework is proposed for applying Large Language Models (LLMs) in exam question generation and evaluation. The study focuses on aligning assessment questions with course learning outcomes and Bloom's taxonomy. Three LLM-based agents are evaluated across multiple university courses under human expert supervision. The results demonstrate that AI-assisted assessment design can significantly improve clarity, alignment, and quality of academic evaluations.

In paper [3], the authors introduce an AI-based Intelligent Tutoring System that uses knowledge tracing techniques to adapt learning content based on student

performance. The system continuously analyzes student interaction data to identify knowledge gaps and predict future learning outcomes. Experimental results show improved engagement and learning efficiency when compared to traditional static learning systems.

Paper [4] presents a comparative study of LLM-based agents for automatic exam question generation and improvement. The research evaluates multiple Retrieval-Augmented Generation models and fine-tuned language models using structured course content. The study highlights the potential of generative AI to support faculty in creating high-quality assessment materials while maintaining pedagogical standards.

In paper [5], the authors propose a hybrid student modeling approach by combining Bayesian Knowledge Tracing (BKT) with Long Short-Term Memory (LSTM) neural networks. This model improves prediction accuracy of student performance and supports adaptive learning by capturing long-term learning patterns. The hybrid approach enables more personalized tutoring and real-time feedback.

Paper [6] presents an automated framework for assessing the quality of university question papers based on relevance, difficulty, and time requirements. The system applies machine learning and natural language processing techniques to evaluate question paper quality and detect out-of-syllabus content. The results demonstrate high accuracy when compared with expert evaluations.

In paper [7], the authors discuss how educational data mining techniques can be used to predict student performance and enable adaptive learning. The study highlights the importance of analyzing student behavior, attendance, and assessment patterns to identify at-risk learners and provide early academic interventions.

Paper [8] explores the role of Large Language Models such as ChatGPT in academic environments. The study discusses the benefits of conversational learning systems while also addressing challenges such as bias, hallucinations, and ethical concerns. The findings provide a strong foundation for designing reliable and responsible academic chatbots.

In paper [9], the authors introduce Knowledge Graph-enhanced Retrieval-Augmented Generation (KG-RAG) for building adaptive AI tutors. The approach integrates structured knowledge graphs with generative models to improve factual accuracy and instructional coherence. Experimental evaluation shows improved learning outcomes compared to conventional RAG systems.

Finally, paper [10] presents a framework for using LLMs in literature-based discovery. The study demonstrates how semantic similarity search and LLM-based reasoning can assist researchers in discovering hidden relationships across academic publications, making it a valuable tool for academic research and knowledge exploration.

V. RESULTS

The proposed KTUfy academic assistant was developed and tested to evaluate its effectiveness in providing syllabus-based academic support, improving learning efficiency, and assisting students in managing their academic activities. The system was tested using real syllabus materials, subject notes, previous academic content, and sample student queries collected during trial usage by a group of undergraduate students.

The chatbot module was evaluated by submitting queries from different subjects and difficulty levels. It was observed that the system was able to answer most student queries accurately by retrieving information from the syllabus-aligned knowledge base. Students were able to obtain quick explanations for concepts, definitions, formulas, and short-answer questions without searching through multiple external resources. The use of Natural Language Processing (NLP) and Retrieval-Augmented Generation (RAG) techniques helped improve the relevance and correctness of responses compared to general search-based learning platforms.

The quiz generation module was tested across multiple subjects and syllabus units. Subject-wise quizzes were generated automatically based on predefined syllabus topics and difficulty levels. Students were able to attempt quizzes in a timed environment, and the system evaluated answers instantly. After each quiz session, performance reports were generated showing scores, topic-wise accuracy, and improvement suggestions. These reports helped students identify weak areas and revise important concepts more effectively. The coding practice module was tested using programming problems related to core subjects such as Data Structures, Algorithms, and basic Web Development. Students were able to write and execute code directly within the platform. The system verified the output against predefined test cases and provided correctness feedback. This module encouraged regular practice and helped students improve problem-solving and logical thinking skills.

The academic planner and reminder system was evaluated for daily study organization and time management. Students created study schedules, set reminders for assignments and exams, and maintained subject-wise checklists. The planner helped students follow a consistent study routine and reduced last-minute exam preparation stress. The reminder notifications ensured that students stayed updated with important academic deadlines.

The group study feature was tested by forming small student groups within the platform. Group members were able to share notes, discuss subject topics, and solve problems collaboratively. This feature improved peer learning and created an interactive learning environment beyond traditional classroom sessions.

During testing, the system demonstrated stable performance with fast response times for chatbot queries and quiz generation. Most responses were generated within a few

seconds, providing a smooth user experience. Supabase services ensured secure storage of user data, quiz results, and study records. Authentication mechanisms protected user accounts and prevented unauthorized access.

Overall, the evaluation results indicate that KTUfy is an effective academic assistant for KTU students. The system improves learning organization, supports continuous practice, provides syllabus-based academic guidance, and helps students manage their studies in a more structured and efficient manner.

VI. DISCUSSIONS

The experimental results demonstrate that KTUfy effectively combines intelligent academic assistance with academic management tools to support students throughout their learning process. By integrating syllabus-aware chatbot services, automated quizzes, coding practice, and study planning features, the system provides a complete academic support platform tailored specifically for KTU students.

The chatbot module proved to be a reliable learning companion for students. Its ability to deliver curriculum-aligned responses helped students clarify doubts quickly without depending on scattered online resources. The use of Natural Language Processing (NLP) and Retrieval-Augmented Generation (RAG) ensured that answers were grounded in verified syllabus materials, which increased trust in the system. This approach reduced misinformation and improved the accuracy of explanations when compared to general-purpose chatbots and search engines.

The quiz and coding practice modules played an important role in reinforcing learning through continuous assessment. Regular practice encouraged students to revise topics frequently and evaluate their understanding. Instant feedback after quizzes helped students recognize weak areas early and focus their efforts accordingly. Similarly, the coding practice module improved logical thinking and problem-solving skills by providing hands-on experience with real programming problems.

The academic planner, reminders, and checklist system helped students follow a more organized study routine. Many students reported reduced last-minute exam stress due to better scheduling and task management. The group study feature further enhanced learning by promoting peer discussion and collaborative problem solving. These features transformed KTUfy from a simple learning tool into a complete academic support system.

One of the key strengths of KTUfy is its ability to bring together multiple academic services into a single platform. Students no longer need to rely on different applications for doubt solving, quizzes, practice, and study planning. This unified approach improves convenience, saves time, and increases productivity. However, the performance of the system depends on the quality and completeness of the syllabus data and learning resources used to build the knowledge base. Any changes in curriculum require timely

updates to ensure accuracy. In addition, the effectiveness of personalized recommendations depends on the consistency of user activity and interaction with the system.

In the future, KTUfy can be further enhanced by adding adaptive learning paths, advanced analytics for performance prediction, and support for multilingual content. Integration with institutional academic systems such as learning management platforms can also improve adoption and scalability.

Overall, the results confirm that KTUfy provides a practical and efficient solution for academic support at APJ Abdul Kalam Technological University. By combining intelligent learning tools with academic planning and collaboration features, the system addresses both technical and organizational challenges faced by students and contributes to a more structured, engaging, and effective learning experience.

VII. CONCLUSION

This paper presented KTUfy, an AI-powered academic assistant developed to support students of APJ Abdul Kalam Technological University by addressing both academic learning challenges and study management needs. The proposed system brings together syllabus-aware academic assistance, automated quizzes, coding practice, academic planning tools, and collaborative study features within a single integrated platform.

KTUfy provides real-time academic support through an intelligent chatbot that delivers curriculum-aligned answers using verified syllabus content. Instead of relying on scattered online resources, students can clarify doubts, revise concepts, and practice questions through a centralized system. The inclusion of quizzes and coding practice modules encourages continuous learning and self-assessment, helping students strengthen their understanding of core subjects.

The academic planner, reminders, and checklist features support better time management and reduce last-minute exam stress. Group study functionality further enhances learning by promoting peer discussion and collaborative problem solving. Since the system is built using modern web and cloud technologies, it ensures reliable performance, secure data handling, and easy accessibility across devices.

Overall, KTUfy demonstrates that combining intelligent academic assistance with structured academic management tools can significantly improve learning efficiency, organization, and student engagement. The system provides a practical and scalable solution for enhancing the academic experience of KTU students and serves as a strong foundation for future intelligent learning platforms.

FUTURE SCOPE

In the future, the proposed KTUfy academic assistant can be extended to support a wider range of academic and learning needs. More advanced Artificial Intelligence and

Machine Learning models can be integrated to improve the accuracy of responses and provide deeper concept-level explanations. Adaptive learning techniques can be introduced to generate personalized study paths based on student performance, learning speed, and subject-wise strengths and weaknesses.

The system can be enhanced with multilingual support to help students from different linguistic backgrounds access learning materials more easily. Additional accessibility features such as voice-based interaction and screen reader compatibility can improve usability for a wider group of learners.

Advanced learning analytics can be incorporated to predict academic performance and identify at-risk students at an early stage. This would allow students to take corrective actions well before examinations. Integration with institutional Learning Management Systems (LMS) and academic portals can further streamline academic workflows and improve adoption at the university level.

In the future, mobile-first optimization and offline learning support can be added to improve accessibility for students with limited internet connectivity. With continuous development and curriculum updates, KTUfy can evolve into a comprehensive, intelligent, and student-centric academic support platform for higher education.

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